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DESERT CAMPS

A case study of stone artefacts and Aboriginal behaviour in the Western Desert

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A thesis submitted for the Degree of Doctor of Philosophy in the Australian National University, March 1984

I, Scott Cane certify that all the research for this thesis is my own, except where otherwise acknowledged.



S.B. Cane

Errata Sheet

I would like to draw the attention of the reader to the following corrections to the text of this thesis:

Page 3	Line 14	archealogical should be archaeological
Page 4	Line 3	neibouring should be neighbouring
Page 9	Line 15	considerd should be considered
Page 24	Line 4	one "the" should be deleted
Page 24	Line 14	continally should be continually
Page 26	Line 1	this should be thus
Page 33	Line 4	bear should be bare
Page 57	Line 13	2500 km should be 2500 sq km
Page 66	Line 13	prehistorians make should be prehistorians to make
Page 99	Line 20	specie should be species
Page 117	Line 12	potatoe should be potato
Page 135	Line 14	escription should be description
Page 180	Line 8	largersamples should be larger samples
Page 181	Line 22	artefacts possible should be artefacts as possible
Page 207	Fig. 8.3-8.7	ocher should be ochre; unutilzed should be unutilized
Page 215	Line 19	p; should be deleted
Page 234	Line 1	proportion should be proportions
Page 280	Line 23	the dates 1971 and 1972 should be 1981 and 1982 respectively
Page 281	Line 26	archealogical should be archaeological

Kamminga has been misspelt several times in the thesis.

Lastly, I made a gross oversight in not acknowledging the assistance of my supervisors. I would therefore like to thank Dr Jim Jones and Dr Rhys Allen for their encouragement and assistance.

Scott Cane

Plate 1.

Contemporary desert camp. Jimi Djambidjin and Nyami roasting new seasons *Ipomoea* tubers (*ngamana*) on cold winter morning.



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First and foremost I would like to acknowledge the help of my wife, Elizabeth, who not only provided moral support throughout the thesis but who provided field assistance and typed and proof read the thesis as well. Thanks must also be extended to the Balgo community who offered generous hospitality, mechanical and health care. I would particularly like to thank the Aborigines I worked closely with, namely; Jimi, Sunfly, Bill, Jambu, Arthur, Mick, Linda, Bye Bye, Nyami and Budja Budja.

I would also like to thank Betsy Jane Osborne and Winifred Mumford, who drew all the figures; Dragi Markovic, who produced the plates; Jeaninne Mummery, who typed the tables; and Jill Burton who typed the bibliography. Peter Latz kindly identified most of the plant specimens and Mrs. P. Maggiorie conducted the nutritional analysis of food specimens. Ian Johnston, Yvuonne Pittelkow and Bill Fitzgerald provided assistance with statistical and computer problems. Lastly I would like to thank the Australian Institute of Aboriginal Studies for the use of their 2way radio and caravan.

ABSTRACT

This thesis attempts to ascertain what aspects of the behaviour of a hunter gatherer society can be interpreted from a study of stone tools. It is set in the northern part of the Western Desert among a traditional group of Gugadja/Pintubi speaking Aborigines. In pursuit of this goal the thesis presents a case study of the traditional environmental, social and economic characteristics of these Aborigines. It also employs the technique of seeking the Aborigines' view of their own technology and thus defines the functions of stone tools used in the region during the past. The proportional variation in these traditionally defined categories of artefacts at different camp sites are examined and compared to a series of predictive statements, derived from Aboriginal testimony of site use, regarding the proportion of stone tools which should be found at sites if stone tools do provide an accurate and reliable indication of Aboriginal behaviour. Anomalies in the distribution of these artefacts are discussed and the various aspects of Aboriginal behaviour which can be inferred from a study of stone tools are defined.

TABLE OF CONTENTS

1. INTRODUCTION 1

Background 5

Archaeological correlates of hunter gatherer societies 6

Development of my research strategy 12

2. ENVIRONMENT AND LOCAL HISTORY 28

Environment 28

Terrain 30

Plants and animals 31

Climate 32

Seasons 32

Water resources 34

Contact history 36

3. THE PEOPLE AND THEIR SOCIAL ORGANIZATION 44

The linguistic unit 45

Bands 49

Family units and estates 51

Population 55

Actual population densities 60

Summary 63

4. PLANT AND ANIMAL RESOURCES 66

Plant resources 68

Seeds 69

Distribution 69

Grass seeds 69

Acacia seeds 70

Eucalyptus seeds 71

Herbs and succulents 71

Other species 72

Seasonal availability 72

Seed processing 76

Grass seeds 77

Collection..... 77
Winnowing..... 77
Grinding..... 78
Acacia seeds..... 79
Collection and storage..... 79
Grinding..... 80
Herbs..... 83
Eucalypts..... 83
Succulents..... 84
Shrubs..... 84
Dietary importance..... 84
Roots and tubers..... 87
Distribution..... 87
Seasonal availability..... 88
Processing techniques..... 90
Dietary importance..... 93
Edible fruits..... 94
Distribution..... 94
Seasonal availability..... 94
Processing techniques..... 95
Dietary importance..... 96
Nectars and edible gums..... 96
Insects..... 97
Wooden implements..... 98
Miscellaneous items..... 100
Animals..... 100
Mammals..... 101
Distribution..... 101
Hunting techniques..... 102
Dietary importance..... 103
Reptiles..... 103
Distribution..... 103
Seasonal availability..... 104
Collection and consumption..... 104
Dietary importance..... 105
Birds..... 106
Insects..... 107
Summary..... 108

5. SEASONAL PATTERN, SUBSISTENCE AND CAMP SITE OCCUPATION.. 110
Wet time..... 112
Western plains..... 113
Stansmore Range..... 115
Green grass and cold times..... 117
Balgo Balgo..... 119
Diringberi and Yunggubalibanda..... 119
Ngandalarra..... 121
Nganawalbinyu..... 122
Nabulabanda..... 122
Goanna get up time..... 123
Hot time..... 124
Summary..... 127

6. FUNCTIONAL ASSESSMENT OF STONE TOOLS..... 130
Women's wooden implements..... 133
Men's wooden implements..... 135
Stone artefacts..... 137
Seed grinding implements..... 137
Flaked stone artefacts..... 144
Raw materials..... 144
Cores..... 146
Single platform cores..... 147
Horsehoof cores..... 147
Multiplatform cores..... 148
Core scrapers..... 148
Aboriginal comments on the function of cores..... 148
Aboriginal comments on stone tool manufacture..... 150
Hammers..... 151
Unretouched flakes..... 152
Utilized flakes..... 154
Adze flakes..... 157
Blades..... 160
Points..... 162
Burins..... 164
Edge ground axes..... 166
Ochre and pigments..... 168
Manuports..... 170
Summary..... 171

7. ARCHAEOLOGICAL RECONNAISSANCE..... 175
Sites investigated..... 175
Site numbers..... 177
Map reference..... 177
Topography..... 177
Artefact scatters..... 178
Sample locations..... 179
Sample size..... 180
Exposure..... 181
Artefact numbers..... 181
Artefact density..... 182
Other archaeological material..... 182
Organic remains..... 182
Scarred trees..... 183
Stone arrangements..... 183
Rock shelters..... 184
Quarries..... 184
Artefactual recording techniques..... 185

8. ETHNOGRAPHIC AND ARCHAEOLOGICAL COMPARISONS..... 190
Variation in the proportion of artefact types..... 191
Statistical significance of the variations..... 192
Ethnographic expectations..... 195
Seed grinding..... 195
Woodworking artefacts..... 197
Stone tool manufacture..... 198
A predictive ethnographic model.....200
Subsistence group 1..... 201
Subsistence group 2..... 201
Subsistence group 3..... 201
Subsistence group 4..... 202
Subsistence group 5..... 202
Ethnographic and archaeological comparisons..... 203
Taxonomy of archaeological sites..... 204
Clustering technique..... 205
Results..... 207
Archaeological review of these results..... 210

Taxonomic correlations..... 212
Sites, stone tools and Aboriginal behaviour... 214
Archaeological Group 1..... 214
Archaeological Group 2..... 215
Archaeological Group 3..... 216
Archaeological Group 4..... 218
Archaeological Group 5..... 219
Ungrouped and misplaced sites..... 220

9. ANOMALIES AND OTHER INTERPRETATIONS..... 223
Woodworking tools..... 224
Scrapers..... 224
Collection of tubers..... 225
Manufacture of wooden implements..... 226
Curation..... 227
Summary: Scrapers and Aboriginal behaviour..... 233
Blades..... 234
Engravers..... 236
Seed grinding artefacts..... 237
Grindstones and population..... 238
Grindstones and seed collection..... 239
Summary: Grindstones and Aboriginal behaviour..... 240
Stone tool manufacture..... 242
Cores..... 242
Distribution of cores..... 243
Summary: Cores and Aboriginal behaviour..... 247
Unretouched flakes..... 248
Anomalies in the distribution..... 249
White chalcedony..... 249
Other raw materials..... 250
Aboriginal movement and the distribution of stone..... 252
Exotic materials..... 255
Summary: Unretouched flakes and Aboriginal behaviour..... 256
Hammers..... 257
Ochre..... 259
Manuports..... 260

10. CONCLUSION AND WIDER IMPLICATIONS 262

Seed processing 263

Woodworking location and activities 264

Specialized woodworking activities 265

Stone tool manufacture 266

Movement of people 267

Population 268

Foraging behaviour 269

Seasonal occupation of sites 270

Sacred activities 270

Wider implications 274

Stone tool form and function 275

Curation 281

Subsistence and the Australian Desert Culture 281

BIBLIOGRAPHY 291

APPENDIX I.

Brief histories of the people I worked with

APPENDIX 2. Chi-squared analysis of inter-site comparisons of artefact categories.

Chapter 1

INTRODUCTION

In Australia stone tools are the most common form of archaeological debris. It is generally assumed that stone tools provide at least a partial summary of the social and economic activities of man and as a consequence contemporary prehistorians employ a variety of techniques to define the characteristics of stone tool assemblages and thus gain insights into the behaviour of prehistoric man.

Archaeological investigations of this kind have shifted from intuitive assessments of stone tool functions towards more sophisticated quantitative analyses of assemblages. Archaeologists employ a variety of techniques such as metrical examination of edge angles, edge shapes and stone tool morphologies (Jones 1971; White 1972; Lampert 1982) and there has been growing interest in techniques of stone tool replication and microscopic examination of use wear and use polish (Kaminga 1978). Another area of great potential is the ethno-archaeological investigation of stone tool functions (Tindale 1965; Gould et al. 1971; Hayden 1979) and the relationship between patterns in stone tool residues and the environmental, economic and social characteristics of traditional Aboriginal societies (O'Connell

1977). Unfortunately, however, there are few places in Australia where stone tools can still be observed in use or where the traditional pattern of economic and social activities to which they relate can be recorded.

The Western Desert is such a place and is probably one of the best places remaining in the world where these studies can be conducted. (Clark 1968:278; Isaac 1977:5; Hayden 1979:3; Binford 1983:24). The Western Desert is vast (Fig.1.1); it is over 1,300,000 sq km in total area, is three times larger than the American Great Basin and if located in Europe would include London, Berlin and Rome. The archaeological debris of the Western Desert consists almost entirely of stone tools and it is one of the few places in the world where the native inhabitants were still using stone tools within living memory and have retained most of their traditional economic, social and religious perspective. Furthermore, the archaeological debris has remained largely undisturbed by millennia of erosion, uncontrolled scavenging by amateur collectors and agricultural or urban development. Therefore the importance of the Western Desert as an empirical testing ground for discerning which aspects of Aboriginal behaviour can be interpreted from a study of stone tools is unsurpassed.

Interest in stone tool technology in the Western Desert and neighbouring regions goes back to the turn of the century (Stirling 1896; Carnegie 1898; Spencer and Gillen 1899; Basedow 1904) although most of these observations dealt primarily with unusual components of Aboriginal material culture such as pressure flaked points and

Figure 1.1

Location of study area and the Western Desert.


Study area
NORTHERN TERRITORY
Gt. Sandy Desert
Tanami Desert
QUEENSLAND
Gibson Desert
WESTERN AUSTRALIA
Gt. Victoria Desert
SOUTH AUSTRALIA
NEW SOUTH WALES
VICTORIA
TASMANIA

ceremonial blades. This information was supplemented quite extensively between the 1920's and 1950's (Horne and Aiston 1924; Davidson 1935; Love 1936; Tindale 1941; Mountford 1941; Elkin 1948) and these investigations formed the basis for much of the contemporary stone tool typology used in Australia (McCarthy 1946; Mulvaney 1961,1975). Ethno-archaeological research gathered further momentum during the 1960's and 1970's, contributing extensively to our understanding of stone tool form and function (Thomson 1964; Tindale 1965; Gould et al. 1971; O'Connell 1977; Hayden 1979). Most of this research, however, was directed towards observing Aboriginal use of individual stone tool types and was not oriented towards an understanding of total stone tool assemblages. With the exception of O'Connell's (1977) work in Central Australia none of these attempted to test the relationship between patterns in stone tool residues on archealogical sites and known patterns of Aboriginal behaviour. Furthermore, some of the original attempts to document Aboriginal concepts of their own traditional stone tool typologies appear to have certain limitations and no one has attempted to compare Aboriginal classifications of stone tools with those of contemporary archaeologists. Exemplifying some of the limitations of this initial research is the apparent misunderstanding of basic technical terms used by Aborigines. Thomson (1964), Tindale (1965) and Gould et al. (1971), for example, record the use of the term Djimeri and Gandi for different tool types by neighbouring groups of Pintubi and Ngatatjara people whereas according to my own research among Pintubi/Gugadja speakers these terms were used to refer to the raw material being used (white chalcedony). Gould (et al. 1971:149) also records the use of the term "yiri" by Ngatatjara Aborigines for the "working edge" of a stone tool whereas

it most probably reflects Aboriginal comments that a given edge was simply sharp. It may be that these terms are used differently among neibouring dialectic groups but I suspect the generic use of these terms by Aborigines has been misunderstood. Gould (1970:42) comments, correctly I think, "that a body of evidence on how native people do, in fact, classify their artefacts ... is generally lacking, especially for hunter gatherer societies".

Parallelling and overriding European interests in Aboriginal technology has been an interest in the social and religious aspects of desert Aboriginal life. This has developed quite markedly over the last 40 years (Strehlow 1947; Meggitt 1957; Stanner 1965; Berndt 1959,1972,1977; Myers 1976; Tonkinson 1978) but, despite the fact that anthropologists recognize the "two great driving forces in traditional Aboriginal life were all-pervasive, religion and economics" (Berndt 1980:9) there has been comparatively little attention focused on the Aboriginal methods of "getting a livelihood from hunting and food-collecting" (ibid.). With the exception of a recent publication by O'Connell et al. (1983) and earlier papers by Peterson (1977), Gould (1969) and Sweeney (1947) the bulk of the literature concerned with desert subsistence consists of lists of plants and animals. These reveal nothing of the relative importance, seasonality or distribution of different foodstuffs (Meggitt 1957; Cleland and Johnston 1939). Consequently there seems to be some necessity to salvage as much economic data as possible and I take Gould's warning (1969:273) that unless quantitative studies of desert Aboriginal subsistence are completed in the near future "it will be the sad task of historians of anthropology to ask how it was that anthropologists failed to get this

kind of information before it was too late".

Thus it would appear that there is a need, perhaps even a sense of urgency, for a project designed to make a complete investigation of these under recorded aspects of Aboriginal life in the Western Desert. I certainly perceive a need and accordingly have attempted to write this thesis as an integrated study of the correlation between stone tools and the social, technological and economic characteristics of the society which produced them.

Background

Archaeologists in general are aware of the limitations of archaeological debris as a means of reconstructing the totality of human behaviour (Thomson 1939; Heider 1967; Deetz 1968; Bonnichsen 1973; Gould 1974, 1980) and in particular the inadequacies of stone tools in this regard. Generally the view is expressed that an understanding of human behaviour cannot come from stone tools alone and that stone tools must be examined in the "context of distribution within and among sites and in relation to food refuse and other economic and ecological markers" (Isaac 1977:5; see also Bowdler 1981:65).

In the Western Desert, for example, Hayden (1977,1978) and Gould et al. (1971, 1980) both believe that stone artefacts were used almost exclusively as maintenance tools (see also Binford and Binford 1969:71). It is also widely accepted that stone tools were often used for a variety of functions without showing evidence of having been used at all. Similar observations have been made amongst the Ova

Tjimba in south west Africa (Mason 1967) and are particularly common from New Guinea (White 1967; Strathern 1969). Prehistorians in Australia have also drawn attention to the fact that Aborigines in Central Australia and the Western Desert often used stone tools in an ad hoc fashion, that unretouched tools were commonly used, that the same tools were used for a variety of functions and that the Aborigines did not always shape specific and easily recognizable stone tools (see Stockton 1981; Hiscock 1983; Wright 1977; White and O'Connell 1982; Bowdler 1981; Gould et al. 1971, 1980; Hayden 1977, 1979).

The implications for these observations for the Western Desert are disturbing. If they are true it is clear that the bulk of the archaeological debris in this region will not provide an adequate reflection of man's prehistoric activities, since stone tools form the bulk of that debris. Yet, is it true? This thesis sets out to examine whether Aboriginal behaviour can be recognized from stone tools.

Archaeological correlates of hunter gatherer societies

Pioneering research into the archaeological correlates of hunter gatherer societies in Australia has been done by Thomson (1939) and Meehan (1983). Both demonstrate the value of this kind of research. Thomson established the importance of "the seasonal factor" in the archaeological expression of the subsistence behaviour of a nomadic group of hunter gatherers in the Cape York Peninsula. Meehan made a vital contribution to our understanding of human adaptive strategies by defining techniques of shell fish gathering, discard, and the relative dietary importance of shell fish in the economy of a group of

coastal Aborigines in eastern Arnhem Land.

Apart from these investigations the bulk of the ethnographically oriented archaeological research conducted in Australia has been directed towards deriving the relationship between the temporal and/or spatial variation apparent between assemblages of stone artefacts and the implication these have for determining patterns of human behaviour. Most of this work has been inspired by the debate over the variation apparent in Mousterian stone tool industries in south west France (Bordes 1973; Bordes and de Sonneville-Bordes 1970; Binford and Binford 1966; Mellars 1969; Binford 1973) and the variation in site location and artefact distribution in the Great Basin in central western U.S.A. (see for example, O'Connell and Hayward 1972; Thomas 1973, 1979, 1981; Bettinger 1977, 1979, 1981a, 1981b; Munday and Lincon 1979; Masden 1981; Hall 1981).

The most notable Australian example of this kind is probably the work by McBryde (1977) in New England in eastern Australia. Here the spatial variation apparent in the regional assemblage of stone tools was seen to correspond to a major environmental division in the region. Variations in the proportional distribution of stone tools appeared to reflect seasonality in the subsistence economy and the extensive use of seed foods in particular areas. Similarly Lourandos (1977) considered the variation apparent in the proportion of unretouched to retouched flakes in coastal and inland archaeological sites in eastern Tasmania reflected a basic difference in the subsistence strategies practised in each area.

In Arnhem Land, investigation by Peterson (1968,1971) revealed a direct relationship between pestles and mortars in wet season camps and the number of women occupying them, thus providing indirect evidence of the size of the band occupying different camps. In another study conducted by Schire (1972; White and Peterson 1969) regional variation in the artefactual content of different sites was seen to correlate with the seasonal variation in the ethnographic pattern of occupation and exploitation of the Arnhem Land escarpment and plains.

Surprisingly, very little work of this kind has been conducted in the Western Desert. Both Gould (1968, 1980) and Hayden (1976, 1977) have used ethnographic data derived from the direct observations of the use of stone tools by Aboriginal people to model the spatial distribution of assemblages of artefacts in sites across the landscape. However, neither have made any systematic attempt to actually test these models against the archaeological record (O'Connell and Hayden n.d.:16).

Gould alludes to the futility of attempting to define the "archaeological signature" - or the "distinctive pattern of residue formation that characterizes certain kinds of adaptive behaviour among human beings" (1980:112) in the Western Desert because the flaked stone tools used there were largely maintenance tools (Binford and Binford 1969:71) and therefore "can tell us little or nothing directly about subsistence or other activities related to the procurement of basic resources" (Gould 1980:137).

As a consequence Gould's contribution to our understanding of the spatial distribution of artefacts at open camp sites has been confined to a theoretical consideration of the likely "rules of Aboriginal site behaviour" (1968:118) and the effects that the relative availability of different types of flakable stone may have on the contents of sites (1980:121).

Hayden's (1976,1978) initial work in the Western Desert was inspired by the debate over whether the temporal variation in the Mousterian stone tool industries in south west France was due to differing cultural traditions or economic activities (Bordes and De Sonneville-Bordes 1970; Binford and Binford 1966; Bindford 1973). He attempted to throw fresh light on this discussion by considering the factors influencing the synchronic variation in the proportional distribution of artefacts in assemblages in the Western Desert. He considerd that "culture" was the major influence but that the difference between assemblages was minimal. He concluded

> Western Desert assemblages seem to be surprisingly homogenous within broad ethnic boundaries; and only exceptional circumstances appear to lead to the formation of specialized moderately "visible" assemblages (1976:459).

A similar opinion was offered by Isaac (1977:10) regarding the archaeological data collected from Central Australia by O'Connell (1977).

Hayden's later work in the Western Desert (1979:3) focused on the "manufacture, use and patterns of disposal" of stone tools and he also turned his attention to an examination of the distribution of tools and material types within individual sites. He again concluded

(after a detailed examination of two sites) that

> if pronounced differences between tool proportions in assemblages do occur in the Western Desert due to task specificity at sites, it seems that they occur under very exceptional circumstances and are very rare (1979:169).

O'Connell's (1977) preliminary research into Central Australian assemblages of stone tools produced a different result. He believed there were "significant intersite differences in the composition of stone tool assemblages" (1977:267) and, in an attempt to determine what such differences signified, returned to these sites with Aborigines who had inhabited them and recorded what activities they said took place there. The preliminary results of his research suggested that the differences between sites were functional, relating to the relative availability of stone and biological resources. Specifically he found there were differences in the proportions and types of seed grinding implements at sites in different environments and that the composition of stone tool assemblages was influenced by the relative access of sites to stone resources.

Isaac (1977) comments that "such a research strategy involves risks", suggesting it is possible that these surface scatters of artefacts

> do not derive simply from the time span of ethnographic memory, the assemblages may have accumulated over centuries, even millenia and they may incorporate items from earlier, different material cultural systems (1977:10).

In the light of excavation reports from the Central and Western

Deserts however this risk would appear to be less than in other parts of Australia. These reports suggest that man has only occupied this region for a relatively short time span of 5,000 - 10,000 years (Stockton 1971; Gould et al. 1971, Gould 1977,1980; Smith 1983) during which there appears to have been no major climatic changes (Bowler 1976; Beard 1982). Gould (1971a:171, 174) suggests that the hunting and foraging way of life in the Western Desert was stable during the post-Pleistocene period and claims that his sequence at Puntatjarpa "reveals one of the most dramatic and best documented cases of cultural conservatism in the world". Certainly the people I worked with recognized the majority of artefact types we examined and none of the distinctive artefacts recorded (tula adze slugs, unifacial points) have been dated in stratified sites older than 5,000 BP (see Flood 1970; Dortch 1977; Lorblanchet and Jones 1979; White and O'Connell 1982).

I consider the supposed "risk" inherent in any research strategy involving surface scatters in this area to be outweighed by the opportunity to compare the archaeological debris with contemporary Aboriginal behaviour. Furthermore, I would suggest that the only way to establish the reliability of such surface scatters of artefacts (which, after all, constitute the bulk of Australian archaeological sites (Hiscock and Hughes 1983)) as documents of prehistoric Aboriginal behaviour is to authenticate and decipher their "archaeological signature" through empirical ethnographic examination. As a result I have employed a technique similar to that used by O'Connell (1977) to investigate the archaeological sites in this thesis.

Development of my research strategy

Prior to beginning this reserch I had conducted an archaeological consultancy in the Great Sandy Desert in Western Australia. At that time no other archaeologist had visited the area and all that was known of its archaeology was contained in a brief description of artefacts collected from Gregory Salt Lake (McCarthy 1957).

In the course of this archaeological consultancy recorded the location, extent and archaeological content of sites in the region in order to determine which were the most interesting and significant for preservation or future salvage work. At that stage no-one knew how to determine the significance of one surface scatter of artefacts compared to another, or if there were any inter-site differences between scatters of artefacts or even if surface scatters of artefacts in this region were reliable archaeological evidence of prehistoric life at all.

Another aspect of this archaeological consultancy was that one had to work with local Aborigines so as to ensure that sites which were of special significance to them were not damaged. In the course of this I met two men, Tom Gordon and his brother (who has since died and must be referred to anonymously as Djambidjin's brother). Both men once lived in the region under investigation and during the archaeological field work I saw them make four crude tula adze flakes, cook a kangaroo and collect some witchetty grubs and a few lizards.

Consequently, two avenues of research began to present themselves. Originally I perceived the opportunity to make an extended, detailed investigation of open sites in an attempt to ascertain what aspects of prehistoric Aboriginal life could actually be interpreted from them. Secondly, I saw the possible opportunity to undertake some salvage ethnographic investigations and thus make some contribution to the limited body of subsistence data recorded for the Western Desert (Sweeney 1947; Meggitt 1957; Gould 1969). The thought also occurred that I may even be able to work with local Aborigines and use their traditional knowledge to elucidate the hidden meaning or "archaeological signature" of open sites.

In accordance with these broad objectives the thesis in March 1981 was seen to contain two interrelated objectives. The first of these I described as follows:

> In this study I propose to use ethnographic information a little differently than it has previously been used in the Western Desert region. Whereas formerly archaeologists have encouraged traditional Aboriginal behaviour in a dubious effort to provide ethnographic models for archaeological interpretation (see Hayden 1977, 1979) I intend to use traditional knowledge in conjunction with archaeological analysis to make direct interpretations of prehistoric debris. A major focus of the investigation will be open sites. To my knowledge no profitable investigation of open sites in desert areas has been conducted and consequently the actual value of open sites to the discipline of archaeology remains in question.

The second objective I argued was that:

> Associated with the definition of the range and distribution of material in sites should be an investigation of local land use, including such things as food staples, distribution and seasonality of resources, reliability and

permanency of water and the capture and processing of foodstuffs. Leading from this detailed economic picture it is hoped to assess the correlation between biological resources, economic behaviour and the archaeological deposits found at sites.

The first field season began in May 1981, with permission from, and the assistance of the Aboriginal community at Balgo. This lasted four and a half months and was designed as a reconnaissance trip to assess the feasibility of the project, familiarize myself with the language and meet local landowners. I also wanted to travel extensively with them in the intended research area to determine the extent of their traditional knowledge and to make sure they were fully aware and happy with the kind of work I wished to carry out. In the course of this field season I defined the limits of the study area, completed a preliminary archaeological and ecological survey and met the local Aborigines; Jimi Djambidjin, Sunfly, Mick Djagamarra, Mark and Thomas Moora, Arthur Djabanunga, Bill Djabanunga, Jambu Djabanunga, Bye Bye, Linda and Nyami.

By the completion of this field trip I was confident that the Aborigines had a sufficient memory of past social, religious, economic and technological activities for me to be able to pursue the specific task of determining what aspects of this hunter gatherer existence could be ascertained from a study of their stone tool debris.

The second field trip (April-September) was then undertaken to gather specific data to answer this question. This time I travelled to Balgo with my wife and two young children and in this family,

content, we fitted in very well with the local Aboriginal community. The second season began in April 1982. It lasted over six months, during which we made 11 trips into the desert. Below I have provided a brief summary of these trips in terms of the work I did, the places I visited and the people I worked with. Methodological details pertaining to the collection of economic, technological and archaeological data have been included in subsequent chapters. The numbers associated with each place name are mapped on Fig.2.3 in the following chapter (the sequence of site numbers used in this project conforms to the sequence with which each site was numbered during the course of the field work).

Trip 1

After being held up for severad weeks by the unusually large summer rains I finally managed to get the project underway. This was a short reconnaissance trip, with Jimi Djambidjin and his son Bruce, designed to check access to the field area. After eight hours travel, bypassing several huge swamps and patches of "quick sand" we eventually reached Nganawalbinyu (3) where we set up the first camp. Nganawalbinyu (3) is a large deep claypan east of Thomas Peak (Fig.2.1). It holds a substantial quantity of drinkable water and was a major camping area in the past. Returning to Balgo we managed to find a shorter route, crossing scores of continental sand-dunes.

Trip 2

On this trip we travelled back to Nganawalbinyu (3) with Jimi's entire family. The country around this waterhole belongs to Jimi's wife Nyami (as well as her sisters Bye Bye and Linda, and brothers Mark and Thomas). People used to camp all around this claypan and I

took a large archaeological sample from an exposure on its south western shore. To the east of Nganawalbinyu (3) are Yunggubalibanda (9) and Djungurr (4) - a site I had worked on in 1981. Yunggubalibanda (9) is a spring at the base of a sand-dune on top of a long escarpment. Along the escarpment are numerous small caves or rockshelters (called pundungari) in which the people used to live during large wet season rains. Here I recorded 33 caves with habitation debris in them. These are very rich in artefactual material and we found charcoal, burnt wood, piles of unused firewood, stone tools, grinding stones, ochre, bone, broken boomerangs, fragments of spears, wood shavings, spinifex bedding, paintings, engraved stones and stone arrangements.

Trip 3

On this trip I travelled with Mick Djagamarra, Budja Budja, Sunfly, Bye Bye and Nyami. I hoped to record the northern extent of important "bush potato country" encountered at Nganawalbinyu (3), so we set our camp at Naligudjarra (5) - two beautifully deep crystal clear waterholes to the north. Naligudjarra (5) is very well vegetated and unfortunately has very few archaeological exposures, consequently, we moved south to Ngandalarra (6), locating a large soak, Yayarba (7) on the way. Ngandalarra (6) is a magnificent large swamp but only holds water for a short time. It is a very sacred place and women are not allowed to camp near it when it is dry. There was more archaeological debris at Ngandalarra (6) and I mapped and recorded artefacts in two large samples. We also visited a large claypan called Guralba (8) and recorded more archaeological debris there. On the south eastern corner of this pan we noticed a devastated swathe of vegetation running in a south easterly direction

for over a kilometre. This was an extraordinary sight and the men thought it must have been flattened by the Rainbow Serpent travelling from Emily Springs (Nyili) to Lake Hazlett (Rabi) during the wet season although it may well have been carved by a giant whirlwind. We drove back from here to Balgo via Nganawalbinyu (3) and Nabulabanda (10) - an archaeological site around a deep soak in a creek running east from a small escarpment.

Trip 4

On this trip I travelled with Jimi, Nyami, Mick, Budja Budja, Bye Bye and her old mother. We made another camp at Nganawalbinyu (3) as the women wanted to collect "bush potatoes" and the men wanted to relocate several stone arrangements related to the "bush potato dreaming". This eventually took two trips - but on this one we located and mapped a cave (Galibarda) filled with paintings and ochre and surrounded by several impressive arrangements of standing stones. I had hoped to finish the work around Thomas Peak this trip so we could move south into the Stansmore Ranges. This, however, was not to be the case, and I only managed to record one more archaeological site at a place called Balgo Balgo (17). During this time, however, an important seed bearing herb (galbari) ripened and we managed to collect and process a sample of this so it could be sent to Perth with other foods which had been collected for nutritional analysis.

Trip 5

On this occasion I travelled with Arthur Djabanangga, Jimi, Sunfly, Nyami and Bye Bye. This was the final trip into the area we had been working in during the last few months. Our first stop was Nabulabanda (10). This site proved to be very rewarding, as it was

located next to a field of tubers and was adjacent to an escarpment in which I recorded several caves that people had lived in, as well as several very unusual stone arrangements. It was also adjacent to a major source of red ochre and it contained the remains of Bye Bye's and Nyami's last camp (which we mapped) in the region before they travelled to and settled at Balgo. This camp (or five individual camps) was well preserved and we were able to identify individual sleeping areas, dinner camps, single men's camps and so on.

Having finished this, we spent some time tidying up things that were left unrecorded in the area. In doing so, we recorded Gunagulu soak (14) next to Nganawalbinyu (3); we located another spring called Diringberi (11) as well as another stone arrangement and rockshelter south of Yunggubalibanda (9). We also located another large area of "bush potato" and, returning to Galibarda, we recorded three more arrangements of standing stones, as well as a magnificent stone arrangement representing Ludbari - the ancestral being said to be responsible for the mythological planting of all "bush potatoes".

Having completed work in this region, we moved south to make a start on the Stansmore Ranges. We camped at Djulyurrulyurru (19) a moderately sized waterhole in a creek in the northern part of the Stansmores. This is the first of four waterholes that were shared by Walmadjeri, Wanggadjungga, Gugadja and Ngardi people during the cold season. Archaeological debris was abundant at Djulyurrulyurru (19) and I recorded three archaeological samples there. We then travelled a little further south, locating Migiliri (22) - a large waterhole and then north to Dalabanda (18), a very spectacular and sacred

claypan, where we collected a bag of grass seeds for processing and nutritional analysis.

Trip 6

On this trip I was accompanied by Arthur, Bill Lari, and Jambu Djabanangga. We made another camp at Djulyurrulyurru (19), from which we travelled to Dalabanda (18) and recorded several stone arrangements and another archaeological sample. Having completed this we moved camp to Migiliri (22) where we found abundant archaeological debris and once again numerous "old people's" camps. In these, we could still recognize sleeping areas, hearths, chopped firewood - and even a roughed out digging stick, which the men thought was probably used to dig Vigna tubers. We left Migiliri (22) and made a quick trip to Mindirr (23) before returning to Balgo.

Trip 7

On this trip I returned to Mindirr (23) with Jambu, Bill Lari, Nyami and Budja Budja. Here I recorded another archaeological site and mapped more "old people's" camps (on which we found an old spear thrower and a European axe), a cave with numerous seed grinding grooves cut in its floor, and a carved stone ceremonial board hidden in the cliff near the waterhole. Very close to Mindirr (23) was another large waterhole called Diedi (25) - the last of the major waterholes in the northern half of the Stansmore Ranges. Once again I recorded a nice archaeological site here as well as a small camp used by Bill Lari and Sunfly when they were single men. In addition we located three wooden ceremonial boards that had been hidden in a hill nearby and we found another three rockshelters - one of which had a stone wall windbreak across its mouth. We also recorded three

circular pit-shaped stone arrangements which had been excavated in search of echidnas.

Trip 8

The commencement of this trip marked a slight change of field tactics. The sites I was now visiting were over a full day's drive from Balgo, and I was running out of time and money. The Aboriginal men were getting tired of the constant field work and the women were worried about their families. I began to fear the project was too ambitious and wondered if I should drop some aspects of it, or reduce the area I was trying to cover.

Fortunately, this was not necessary as the people made a tremendous effort to help me complete the project. The women began a roster so somebody could look after the children in Balgo while others came with me. The men did the same so each got a break from the work and strenuous travel, and others could work for a mining company operating in the area. In this way, the Aborigines ensured I always had a completely knowledgeable team to work with. Towards the end of the project, when my funds dwindled to next to nothing, Jimi Djambidjin offered to help pay for petrol and food in order to finish the work I had set out to do.

On this trip I went with Jimi, Arthur and his wife, Nyami, Bye Bye and her mother. We drove south of our previous camps to a low ridge containing four rockshelters called Burrudju. At Burrudju I was shown a couple of small, but very important, artificially placed round stones, two engravings and a cave with the most spectacular panels of art I had seen in the region. On the floor of this cave was

an old hearth, a fragment of a spear and the dehydrated remains of a meal left by the last men that camped in this sacred place.

After leaving Burrudju we camped below a large hill called Wilbarinyu (27). Next to our camp was a massive quarry of green silcrete. From this camp we made several reconnaissance trips and recorded Wandidjarra; a low escarpment, where I recorded another 12 rockshelters rich in material cultures, two soaks at Nguwagudjarra (42) and Brinbin Brinbin (41) and a rockhole at Managudjibanda (39). Unfortunately, the sand and vegetation cover was so great at these places that I could not find any substantial archaeological deposits.

Having completed this, the Aborigines had to return to Balgo for voting in a local election. On our return we visited another old camping place called Galundjunu (24), but again sand and vegetation had covered most signs of past habitation.

Trip 9

The Stansmore Range falls into three distinct sets of hills. I had completed work at the first of these and wanted to complete work at the second this trip, before heading south west to record the major sites on the western side of the range. I had decided at the beginning of the project not to work in Manggayi (49) - the third and southernmost group of hills - because it was too far away.

On this trip I took my family along, as well as Nyami, Bye Bye, Sunfly and their granddaughter Melissa. We made our first camp at Wilbarinyu (27), from where I recorded a small site next to a billabong called Rundju Rundju (26). Having completed this we drove

south to Birbayga (28) where I recorded another large archaeological site. South of Birbayga (28) is a small creek called Mirrilmirril (44) and below this is Gandawarra (46) a relatively large waterhole and source for yellow ochre.

Travelling west from here we made camp at Djarrga Djarrga (2); a site recorded in 1981. This site, and another to the north, called Gawayurru (29), are both rich in archaeological deposits and both were sampled in the project.

Trip 10

On this trip I travelled with Sunfly, Jimi and Nyami and their eldest son Peter. I was hoping to locate the major sites west of the Stans[illegible]nge and, depending on the number of sites, be close to windi[illegible] up the project. This country belongs to Walmadjeri people (see Chapter 3) and Jimi Djambidjin is the only man at Balgo who still has a detailed knowledge of the area. With Jimi's and Sunfly's combined knowledge it was also a good opportunity to check the place names and sites so far recorded. Therefore we spent most of this trip going over the country we had already seen. In doing so, I visited another rockshelter, and was shown another small waterhole and archaeological site called Lindabarru (50) previously missed west of Ngawagudjarra (42).

From here we returned to Balgo via Pt. Moody - recording at Djowa Djowa (40), Barowala (34), Gundjimaru (30), Nybigarri (35) and Yurinubadu (31) and two huge white chalcedony quarries at Marl (37) and Lamban Lamban (32).

Trip 11

Having visited and worked at all but a few sites in the region, I felt that this should be the last trip. Consequently, I returned to the area and recorded archaeological samples at Gundjimaru (30) and Yurinubadu (31). Jambu, Arthur, Bill Lari and Jimi came on this trip, and having completed my archaeological investigations we made a long trip west to Forebank Hills to get spears for the men at Balgo.

When we returned to Balgo, we had completed 7,000 km of bush travel and had visited many places never before seen by white man. My wife and children were in fact the first white woman and children to travel in the Great Sandy Desert in Australia's history.

As can be seen this project involved extensive bush travel and provided the opportunity to record a lot of "bush tucker" and archaeological debris. By the end of the field season I had made an exhaustive examination of about 2,500 sq km and appeared to have recorded every habitation and sacred site and the location of every known stand of mulga, area of edible tubers, fruits, grasses, witchetty grubs and stone quarries etc. in the region. I had collected specimens and recorded the uses of approximately 100 plants as well as the major animal foods and had sent over 20 food samples to Perth for nutritional analysis. I had recorded over 200 archaeological sites and traditional information for about 6,000 artefacts. A mass of other related personal, social, religious and economic incidentals were recorded in over 1,600 slides, 400 foolscap pages of my diary and 2,500 minutes of recorded conversation.

By the end of the field work (September 1982) I had more than enough data for a thesis and the problem arose as to what aspects of data could be best developed within the context of a PhD thesis. In order to address the the original problem, namely an examination of the relationship between stone artefacts and Aboriginal behaviour in this region, I have had to set aside many data for later publication.

Throughout the course of the field work for this project it was quite obvious that the people I worked with retained a detailed memory of their traditional desert way of life. For example they seemed to have a good memory of stone tool form and function. They also knew the location of all the major archaeological sites in the region and also knew who occupied them, when they were occupied, how long they were occupied, the resources available and the technology that was required to utilize them In addition I was continally aware that I was enjoying what may be one of the last opportunities to make a detailed study of the traditional Aboriginal behaviour in this region. Because of this, the topics covered in this thesis are designed to incorporate as much Aboriginal knowledge and provide as much detail of Aboriginal life in the Western Desert as possible.

Given the apparent wealth of this ethnographic information I felt the best way to pursue the original objective of this thesis was to reconstruct the prehistoric activities of the local Aborigines and see how favourably the archaeological debris, namely stone tools, compared with it. I felt that if I could sample a sufficient number of archaeological sites and counterbalance them with a rich supply of first-hand ethnographic data then I would be in a strong position to

determine what aspects of the behaviour of this hunter gatherer society could be interpreted from a independent study of their stone tools.

Thus I have made a detailed case study of the traditional pattern of Aboriginal social organization and land use and relocated important camp sites, biological and physical resources. Furthermore, I have attempted to determine what activities are reflected by stone tools by asking the local Aborigines what they remembered using stone tools for during the past. I have made extensive use of this information to determine the function of stone tools and thus determine which activities are reflected by stone tool assemblages at the major camp sites investigated. In fact, I have treated the sites examined in this project in much the same way as coastal shell middens. In the same way I would determine the economic focus of a midden by counting different species of shell fish I have attempted to determine the behaviour reflected in open sites by making an assessment of the dominant functions of stone tools and counting them. The rationale here is that if the occupants of different sites had access to different resources and these resources were used in the same way throughout the life span of each site then sites at which different activities took place should contain distinctive assemblages of artefacts. For example, sites near particular raw materials should display a dominance of these raw materials; sites which were important woodworking locations should contain more woodworking tools; sites at which particular foods were prepared should contain the highest proportion of artefacts used for that task.

This, from the ethnographic data it is possible to make a series of predictive statements regarding the proportions of stone tools which should be found at sites if stone tools do indeed provide an accurate and reliable indication of Aboriginal behaviour. These predictions are essentially what the Americans call "assemblage modelling", the purpose of which is to:

> derive a set of hypothetical artefact distributions from ethnographic accounts which can be compared to actual artefact distributions as these are established by field work (Bettinger 1977:7).

The prediction is that if stone tools provide an adequate reflection of hunter gatherer behaviour then the correlation between the hypothetical and actual artefact distributions will be close. If they are not, then several other possibilities are raised. One is that stone tools do not provide an adequate measure of the past. Another is that the pattern of subsistence has changed during the past and that contemporary ethnographic data is not a satisfactory analogue for the region's prehistory.

The objectives of this thesis and this general approach determine the topics covered in this thesis. In Chapter 2 I discuss the broad ecological characteristics of the landscape in which the research was centred and present a brief history of the local Aborigines. Chapters 3 and 4 detail the demographic, social, religious and economic traditions of the hunter gatherer population who used to live in this region. In Chapter 5 this detail is synthesized into a regional model of social and economic behaviour. Chapter 6 presents a functional assessment of the stone artefacts

recorded in the project and Chapter 7 provides a brief description of the archaeological sites examined and the archaeological methods of investigation. Chapter 8 presents a multivariate statistical analysis of the proportional distribution of artefact categories at major camp sites in the region and assesses the correlation between these and the ethnographic model of subsistence. Chapter 9 discussed the anomalies and other interpretations which may be made from the distribution of artefacts in the region. This chapter draws attention to the different aspects of Aboriginal behaviour that can be inferred from a study of stone tools in this area. Chapter 10 concludes the thesis and discusses the wider implications of the study.

CHAPTER 2

ENVIRONMENT AND LOCAL HISTORY

ENVIRONMENT

In order to give the reader an impression of the landscape in which the study area was located it would almost be sufficient to quote the titles and page headings of the explorers' journals who travelled through the region. Carnegie's (1898) chronicle was called "Spinifex and Sand" and Warburton's journal (1875) provides illustrative page headings such as "The Desert", "Sand Hills and Spinifex", "More Sand Hills", "Scanty Wells" and "Carnivorous Flys". Terry (1928,1931,1937) in turn called three of his books "Sand and Sun", "Untold Miles" and perhaps nearer the reality "Hidden Wealth and Hiding People".

The Great Sandy Desert is in fact a forbidding and monotonous expanse of undulating sand on which the dominant landforms are the endless longitudinal dunes which run east west over 1,000km across the Canning Basin (Fletcher 1965; Brown 1960). The desert rises only 400m above sea level and the highest point in the entire region is the Stansmore Range; only 510m above sea level (Blake and Yeates 1976).

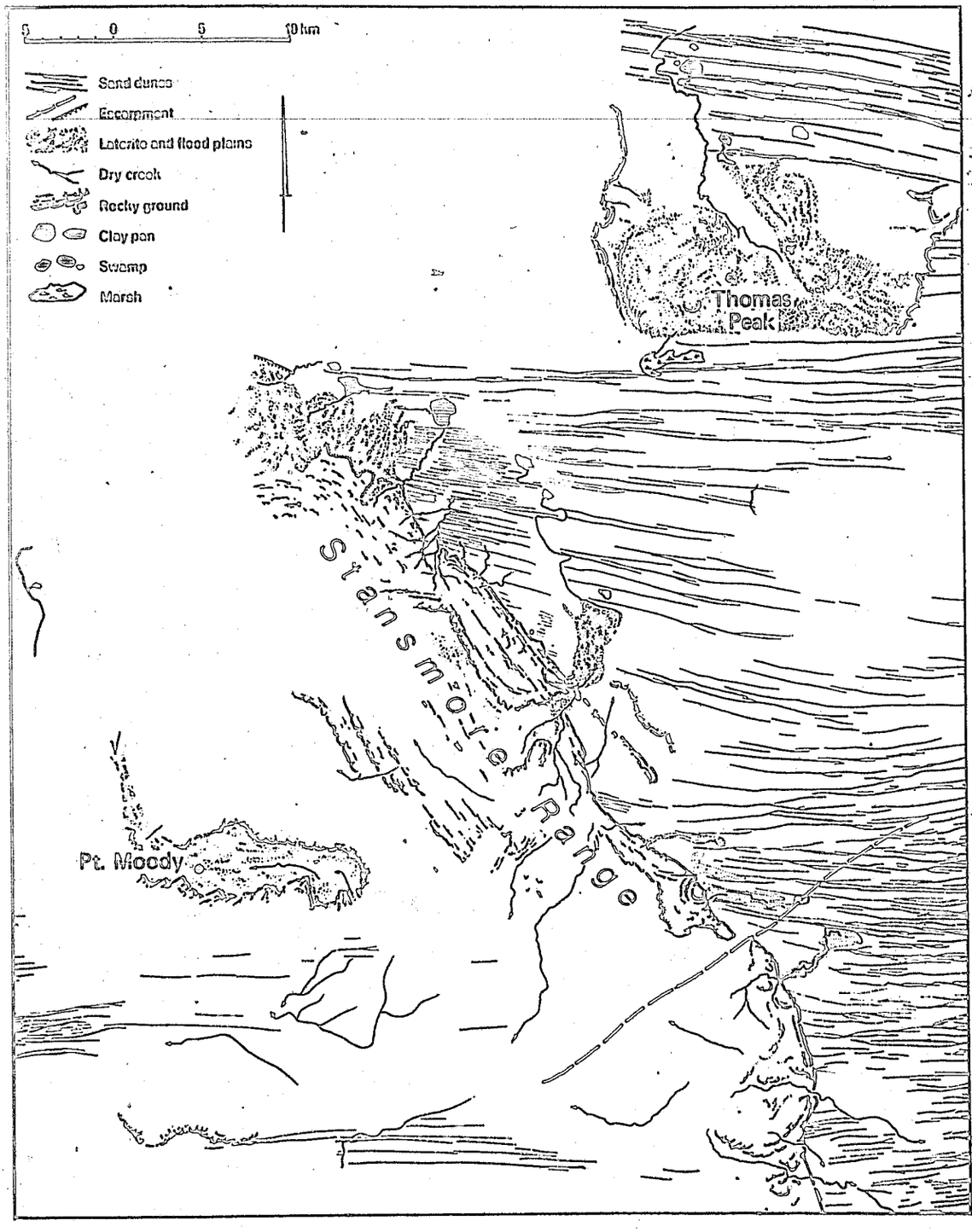
The Stansmore Range forms the back bone of the southern two thirds of the study area. It is located on the margins of the Great Sandy Desert and the Tanami Desert and is approximately 100km west of the Northern Territory border. It lies immediately south of latitude 21 degrees and longitude 128 degrees.

The study area itself (Fig.2.1) was loosely located within an area of about 2,500 sq km around the Stansmore Range. There were no particular boundaries which defined this area of investigation - rather the region defined itself according to the location of traditional camp sites and the traditional pattern of movement practiced by the local landowners I worked with. In a sense the study area was loosely located around the traditional foraging range (Stanner 1965) of the local Aborigines. The approximate boundaries of the area under investigation followed the eastern contour of the Stansmore Range and extended north around Thomas Peak, south west adjacent the northern tip of the Stansmore Range and onto the sand sheets north and west of Pt. Moody. The southern edge of the study area was marked by a natural break to the southern portion of the Stansmore Range.

This area was most suitable for investigation for several reasons. It was not unrealistically remote (although it did take two days of solid bush travel to reach the southern limit of the area) and contained a wide range of environmental variation. It was once an important area of prehistoric settlement and it contained ample archaeological sites. By and large the landscape has remained much as it was left by the local Aborigines. The only real changes that have

Figure 2.1

The study area (dashed line indicates approximate southern margin of area).


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
Thomas Peak
Stansmore Range
Pt. Moody

taken place have been a decrease in the fire frequency and the introduction of feral cats. A few camels occasionally visit the area but there were no rabbits, foxes, pigs, donkeys or cattle.

Terrain

The Stansmore Range itself is an uplifted block of Permian sandstone, siltstone and shale. It slopes gently to the west before giving way to small intermittent laterite plains, flood plains and an extensive dune-free sandplain. This side of the range is largely waterless and was considered to be "bush" or "rubbish country" by the local Aborigines. In the south west corner of the study area this plain is interrupted by a large escarpment (or breakaway) which surrounds a flood plain dotted with mesas and small clayplans.

The relief on the eastern side of the Stansmore Range is more dramatic. Here the range drops sharply over steep rocky talus slopes before giving way to a sand plain covered with small (8-10m) evenly spaced sand-dunes. Numerous creeks dissect the eastern side of the range and create spectacular scenery before running dry on the surrounding plain.

The dominant relief near Thomas Peak, in the northern third of the study area consists of two parallel escarpments running north south. These rise between 20m and 50m above the surrounding plains. Between these escarpments are broad piedmonts, lateritic plains, sandplains, flood plains and several swamps and claypans. This area and the eastern side of the Stansmore Range are both well watered,

Plate 2.1a

Looking north over a natural break in the Stansmore Range. This forms the southern limit of the study area.

Plate 2.1b

Looking north from the Stansmore Range. The study area is typified by flat, spinifex covered sandplains.





Plate 2.2a

Small evenly spaced sand-dunes in the study area.

Plate 2.2b

Laterite and floodplains north of Thomas Peak. *Acacia pachycarpa* is the dominant hardwood.





fertile regions and were consequently the main area for habitation in the past.

Plants and Animals

From a botanical point of view the local landscape has been described as "desert in its more limited sense" (Gardiner 1944:56) and generally characterized as mixed shrub steppe (Beard and Webb 1974). Acacias and spinifex (Triodia sp.) dominate the landscape. Acacia pachycarpa is the dominant plant found on the flood plain although there are also pockets of mulga (A. aneura) in the region as well. Spinifex, acacias, grevilleas and hakeas are the most frequently encountered plants on the sandplain and the desert bloodwood (Eucalyptus terminalis) is found on the flanks of dunes. Coolibahs (Eucalyptus microtheca) and red river gums (E. cameldulensis) characterize the swamps, claypans and creeks. The stoney rises are probably the most desolate part of the entire landscape and are vegetated with scattered spinifex bushes and stray eucalypts (E. brevifolia).

Animal life is relatively scarce in the region although numerous birds, including budgerigars, crested pigeons, finches and cockatoos congregate around waterholes. Bustards are quite common but the population of larger animals such as dingoes, emus, kangaroos and euros are small. The population of small marsupials appears to have declined in the recent past. During the course of the field work we saw few tracks or nests of bandicoots, wallabies or marsupial mice.

Climate

The stark and desolate landscape of the study area is matched by the harshness of its climate. According to the Climatic Atlas of Australia (1975) the study area falls within the region which experiences the highest average summer (39 degrees Celsius) and winter (24 degrees Celsius) temperature range in Australia. This corresponds to an equally high evaporation rate of between 4,000 and 4,500mm a year whereas the average rainfall at Balgo, 100km north of the study area, is only 268mm (Beard and Webb 1974:26). This annual average is unpredictable and over the last 40 years has varied from as little as 91mm to over 900mm (Bureau of Meteorology) (Figure 2.2c). Beard and Webb (ibid.) claim Balgo experiences a "true desert climate" and that further south, toward the study area, it is drier but still gets summer rain.

Seasons

The local Aborigines divide the year into five seasons which merge into one another and correspond approximately to the temperate pattern of summer, autumn, winter and spring.

The first season of the year was the wet season (Warrgal). This brought fresh rains to the countryside in the form of spectacular thunderstorms. These occasionally came as early as November but usually came in late December or early January. The wet season usually finished by about February but sometimes continued until April. Long summer rains were very welcome as the desert landscape became very fertile and the abundance of water across the landscape

Figure 2.2a

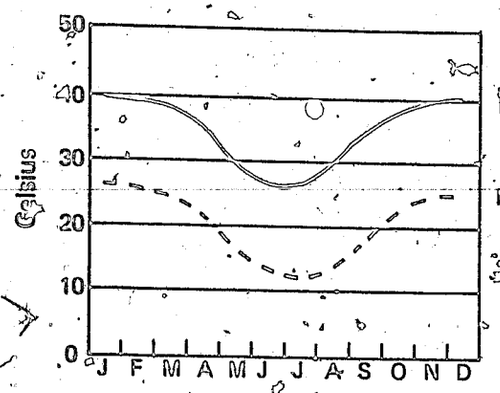
Average annual temperatures recorded at Balgo.

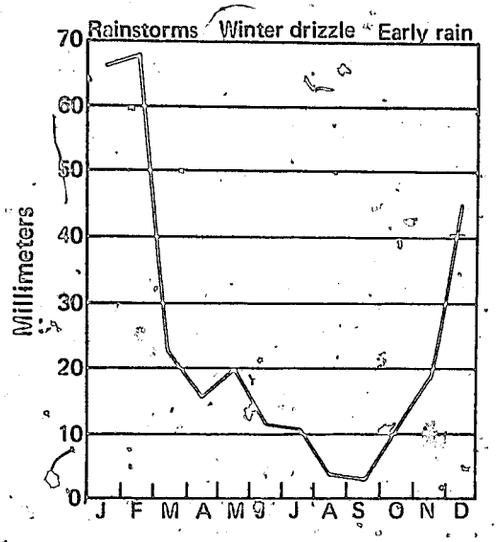
Figure 2.2b

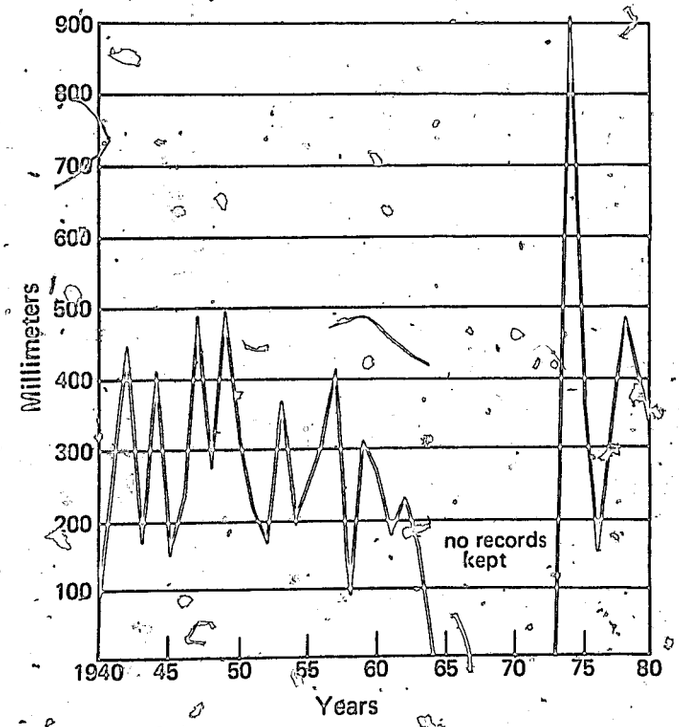
Average monthly rainfall recorded at Balgo.

Figure 2.2c

Annual rainfall totals recorded between 1940 and 1980 at Balgo.


50
40
30
20
10
0
Celsius
Day
Night
J F M A M J J A S O N D


Rainstorms
Winter drizzle
Early rain
70
60
50
40
30
20
10
0
Millimeters
J F M A M J J A S O N D


900
800
700
600
500
400
300
200
100
Millimeters
no records kept
1940 45 50 55 60 65 70 75 80
Years

allowed people to come together from great distances to attend ceremonies. The average temperature at this time of year was about 39 degrees Celsius but the abundance of water made heat stress easier to bare than in the months before rain fell (Figure 2.2a,b)

Summer rains stimulated plant growth in the desert and the desert began to bloom and appear very fertile. This growing season was called the "green grass time" (yugari) by the Aborigines and extended from about March until May. At this time of year all the large waterholes were full, resembling lush oases and temperatures began to moderate. Migratory birds came into the region but local game dispersed widely with the availability of water. During the "green grass time" Aborigines usually travelled and foraged widely in the direction of ceremonial gatherings they were to attend.

The "green grass time" merged into winter or "cold time" (yaltaburru). Cold easterly winds made the first few months of this season quite chilly although frosts were rare. Temperatures dropped to six to eight degrees Celsius at night and rose to an average of 25 degrees Celsius during the day. The cold often prevented sleep so individuals sat naked around fires in the early hours of the morning and then rested and rose about mid morning. Occasionally the "cold time" was plagued by weeks of miserable winter drizzle, however it was a period of economic prosperity and social interaction. The women were the principal food gatherers and the men were heavily involved in ceremonial activities.

The end of the cold season was heralded by the sudden appearance of warm westerly winds and the movement of reptiles from hibernation. The Aborigines called this season the "goanna get up time" or Djintubalya (sun good). This season lasted from August until October and temperatures rose steadily to an average nightly temperature of about 22 degrees Celsius and an average of 36 degrees Celsius during the day. People were usually forced back to their large rockholes during this season.

The "goanna get up time" merged into the hot season (wandaburru) which in turn lasted until the next rains fell. Temperatures rose to an average nightly temperature of 24 degrees Celsius and an average daily temperature of 39 degrees Celsius. It was a period of food and water shortage and as a result was frequently referred to as the "hard" or "hungry time" by the Aborigines.

Water Resources

In the northern part of the Western Desert rainfall comes in both summer storms and winter drizzle but tends to concentrate in the summer months (December-March), decreasing through autumn and winter (March-August) and stopping almost completely through spring (August-December) (Figure 2.2b). The availability of surface water decreases accordingly and with it the supplies of water available to the local Aborigines.

There are no permanent water resources in the study area. The only two permanent springs in the immediate vicinity are Helena Springs 160km to the west and Emily Springs 60km to the north (Figure

3.1;Chapter 3). These are the only permanent water supplies I know of in an area of desert covering approximately 18,000 sq km.

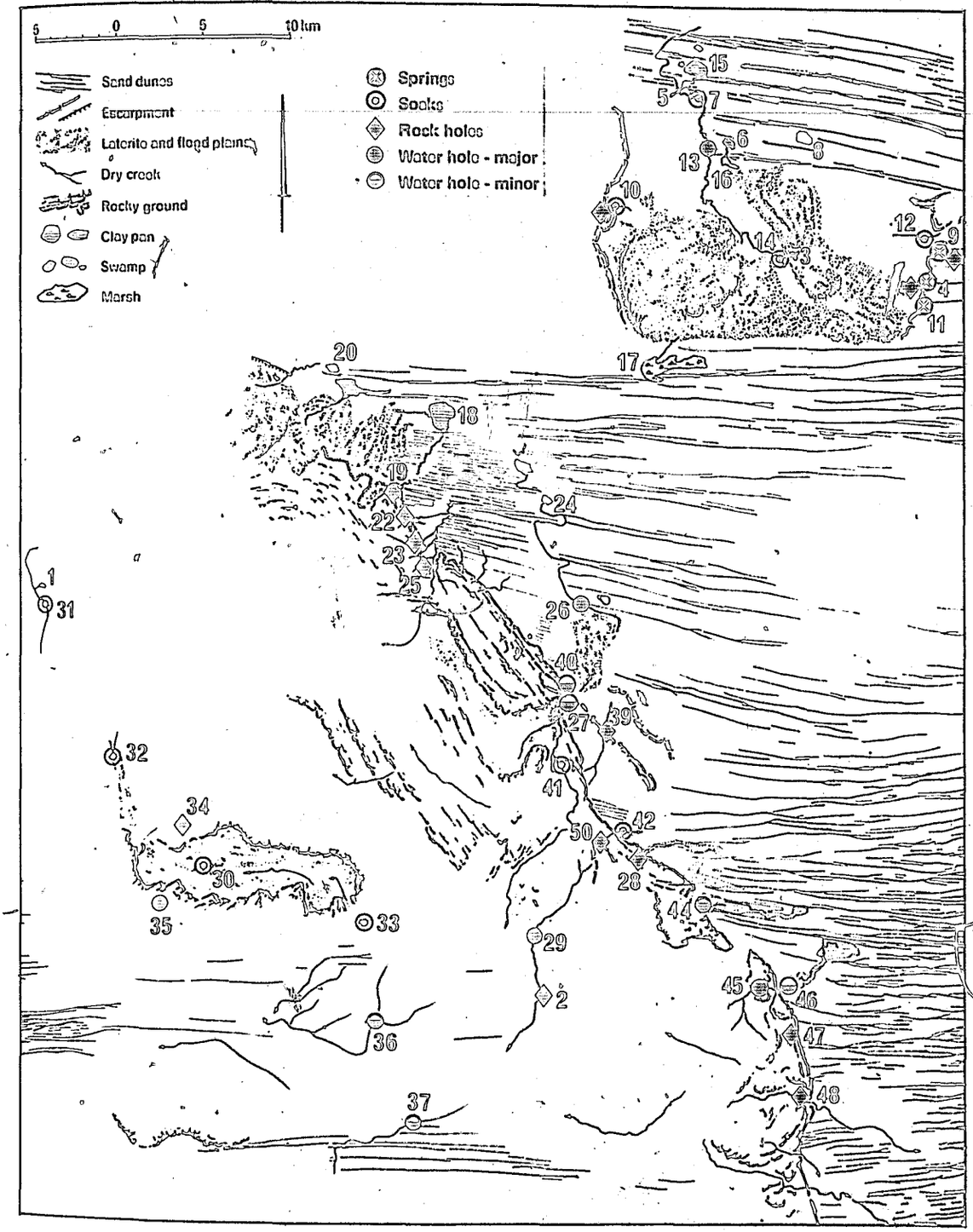
Within the study area water could be obtained from subsurface water and waterholes in creek beds and from claypans, swamps, springs in sand-dunes, soaks and rockholes. In fact there were over 40 different waterholes within the study area which were used at different times of the year. These are located and named in Figure 2.3. The major water resources consisted of nine soaks, three large claypans, three springs at the base of dunes, six swamps, 12 minor and four major rockholes and several waterholes in creeks.

After "normal" summer rain (250mm) water could be found almost everywhere in the landscape. All the major catchments filled and there was water on the flood plains, in small erosion gutters and little rock pools all over the hills. These small catchments evaporated quickly and were followed by shallow pools, claypans, subsurface water in creeks, swamps, small rockholes, and springs at the base of sand-dunes. Claypans only supplied serviceable water for a short time after fresh rains fell. They soon became polluted with iron oxide and a suspension of clay and were only drunk by thirsty passers-by (eg. hunting parties). Prolonged intake was said to have resulted in "guts ache" and "guna like brildji" - or faeces like red ochre. Soak waters usually lasted longer and helped groups exploit the sandplains and dunes until about August or September. After this family groups had to fall back onto the major rockholes in the hills.

Figure 2.3

Location of major waterholes and campsites (note: the numbers follow the sequence they were recorded during the course of field work).

1. Djulugan
2. Djarrga Djarrga
3. Nganawalbinyu
4. Djungurr
5. Naligudjarra
6. Ngandalarra
7. Yayarba
8. Guralba
9. Yunggubalibanda
10. Nabulabanda
11. Diringberi
12. Wirribil
13. Jiminba
14. Gungagulu
15. Birrilyibarru
16. Yiliyili
17. Balgo Balgo
18. Dalabanda
19. Djulyurrulyurru
20. Diriberigudjarra
22. Migiliri
23. Mindirr
24. Galundjinu
25. Diedi
26. Rundju Rundju
27. Wilbarinyu
28. Birbayga
29. Gawayurru
30. Gundjimarra
31. Yurinubadu
32. Lambanlamban
33. Djowa Djowa
34. Barawala
35. Nydibigari
36. Lamanbanda
37. Marl
38. Wandidjarra
39. Managudjibanda
40. Mabanbidi
42. Ngawagudjarra
44. Mirrilmirril
45. Gandawarra
46. Yurnin
47. Gangganyu
48. Lirriwili


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
Springs
Soaks
Rock holes
Water hole - major
Water hole - minor
1
2
3
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Gould (1969:267) noted that the largest waterholes were left until last but this strategy should be thought of in fairly loose terms in this region. There were four large rockholes or "living water" in the study area. The largest of these (Mindirr) (23) was kept for the extreme end of the dry season although it was visited intermittently earlier in the year as well. A larger waterhole Lirrawili (48), located just south of the study area (Figure 2.3) had more severe "law" restrictions placed on it. Everybody was apparently forbidden from travelling or camping near this waterhole and when used it had to be visited fleetingly and each individual's drink had to be taken in one breath.

Neither Mindirr (23) or Lirrawili (48) were 100% permanent although they appear to have been able to withstand the normal range of climatic extremes. Nobody I spoke to recalled either running dry although Mindirr (23) did reduce to a muddy soak underneath the cliff at the base of the rockhole. Apparently Lirrawili (48) could always be relied upon to get them through the hard time.

No biological resevoirs such as water bearing roots, frogs or vegetable foods were used as substitutes for resevoirs of surface water in the study area.

CONTACT HISTORY

The forbidding Great Sandy Desert isolated its Aboriginal population from the influence of Europeans until remarkably late in Australia's history. When contact was made it was woven with racial

hostilities and protective Christian paternalism which further protected the Aboriginal population from the impact of western civilization. This history is intended to provide the reader with a brief account of the extent and nature of contact between white and black people in the Great Sandy Desert and assess the effects it had on the traditional behaviour and knowledge of the local Aborigines today.

The first European feet were tentatively placed on the margin of the Great Sandy Desert by A. Gregory in 1855. He travelled 450km down Sturt Creek and discovered a large lake which, to his disappointment, was filled with salt water (Gregory Salt Lake). From Mt. Wilson (near Balgo) he looked south over the desert and observed:

> nothing was visible but an unbounded waste of sandy ridges and low rocky hillocks ... all was one impenetrable desert. (Gregory 1884:137).

On the strength of this he headed home, having seen but not contacted 11 Aboriginal people in the vicinity of the lake.

Following this brief encounter the local population was not to see another white man until 1872 when Warburton (1875) made his epic crossing from Alice Springs to the Indian Ocean. This was an extraordinary trip, not least because Warburton was such a poor navigator (Carnegie 1898:385; Terry 1957:161) but also because one of his party went mad, Warburton became partially blind, they lost 16 of their 17 camels and the whole party almost died. He named the region the "Great Sandy Desert" and travelled within 40-60km of the study area where he met a small group of Aborigines (1875:197). In general the Aborigines seem to have kept well clear of Warburton's party. He

states (1875:206) they "avoided us as though we had been plague stricken".

Warburton's expedition occurred when the explorer Carnegie was only two years old and no other white people went into the Great Sandy Desert until about the time of Carnegie's expedition in 1896-7. About this time there were two minor unsuccessful expeditions by Smith and Buchannan to locate two waterholes discovered by Warburton south of Gregory Salt Lake. Another expedition led by Wells travelled from Wiluna to the Fitzroy River (far west from my study area) in 1896 and Rudall led a reconnaissance in search of lost members of Well's expedition in 1897 (Carnegie 1898:316-320,374). Halls Creek, a small gold rush town, was also set up in 1896 and in that year Carnegie met a group of Aborigines near Godfrey Tank on the Canning Stock Route who had apparently seen white men before (Carnegie 1898:296-7).

Apart from Warburton, Carnegie was the only major explorer to venture into the Great Sandy Desert. He travelled a total distance of 5000km within what is now called the Western Desert. He named the Stansmore Range and captured two local Aborigines from the study area to help him find water on the way.

Following these two epic journeys there were eight smaller geological expeditions and probably a number of unknown expeditions both along the Canning Stock Route and into the desert in general between 1904 and 1940 (Canning 1906; Terry 1957:161; Crowe and Muhling 1977). During that time, for example, there were 11

expeditions down the Canning Stock Route (Piele pers. comm.) but this was about 250km east of the study area. In 1910 Weston (1910) travelled from Tanami to Lake White, 40km west of the study area. In 1932 Terry found the initials J.R. O'D/1910, on a rock near Hidden Basin. He says there were a few prospectors travelling through this region in 1909 (Terry 1937:249). Terry himself made the last major excursions into the desert in 1925, 1928 and 1932. On the last journey he travelled from Alice Springs and discovered "Hidden Basin", 40km west of the Stansmore Range. He, like his peers, only had limited contact with Aborigines (see Terry 1937:239,245). He found they "were not antagonistic" and felt it was better to discover his own supplies of water "as the savage cannot convey the quantity of water he will show" (Terry 1957:505). In 1930, 1949 and 1954 there were aerial reconnaissance flights over the region (Mackay 1930; Blake and Yeates 1976; Crowe and Muhling 1977; Kimber 1983) and from the 1960's until the present there have been a series of geological excursions into the general area.

The bulk of the Aboriginal people had left the Great Sandy Desert by the mid 1950's to live in towns, missions and cattle stations. The literature suggests until that time the contact and likely influence of European civilization on Aboriginal culture was insignificant although the Aborigines suggest it may have been greater than the literature describes. They remember traded European goods (such as thumb sized packages of tea and sugar), hunting parties, unrecorded expeditions and early cattle stations coming into their country and said they were afraid of white people and tried to keep away from them. This racial hostility was probably as important

in isolating Aboriginal people and preserving their traditions during this time as the environmental hostility of the region had been during the 1800's.

In the early 1940's Balgo Mission began and this marked a turning point in the relations between local Aborigines and Europeans. In contrast to other Europeans the first missionary, "Father Alphons", was thought to be a good white man by the Aborigines. This characteristic, added to the attraction of ample food slowly began to draw people from their traditional lands.

Durack (1969:258,59) records the first mission was established near Balgo in 1939. It was a German Pallotine mission and was plagued by difficulties in its early years. Superintendent Alphonsus Bleischwitz failed to find water at the first two sites (Dooma Dora and Djaluwan) and had to move to a new site west of Balgo in 1943. This was better watered but war time restrictions made progress very slow. Guns and ammunition were forbidden so the missionaries could not hunt and this difficulty was compounded by suspicious neighbours who not only refused to sell them beef but frequently vandalised the settlement. Their situation was "hopeless indeed but for the attitude of the Aborigines ... who would occasionally wander in with the gift of a lizard, snake or kangaroo" (ibid.). The new site, or "old mission" was also unsatisfactory because it was not within the Balwina Aboriginal Reserve and was moved to its present position in 1964 (Palmer 1980:21).

Annual reports began to come from Balgo from 1947/8. They record that the "Gogoda" (Gugadja) started coming into the desert in 1950/51 but that the adults were "for the most part nomadic" until 1954-55. By 1957-58 people were still entering the mission from near the Canning Stock Route and the mission reached its present number (about 250) in 1962-5. Tindale (1965) records there were still people in the desert as late as 1964 (see also Evans and Long 1965; Lockwood 1964).

The Aboriginal people with whom I did most of my field work came into the mission in the early 1950's although Arthur Djabanungga was still living a full traditional existence as late as 1957 (Thomson 1975:83-4). The age of these people when they first came to the mission varied from about 14 to 40 although most of them arrived when they were in in their mid twenties. Until that time their contact with Europeans had been fairly limited. I have included a brief personal history of these people in Appendix 1.

As Aboriginal people settled into mission life there was a superficial process of cultural change. Everyone was encouraged to wear clothes; the women even wore bloomers. They became gardeners, bakers, builders, stockmen and goat herders and by 1955 English began to be spoken by some children. Otherwise the people appear to have retained much of their traditional perspective. They seem to have tolerated these peripheral changes and inconveniences in favour of the pleasure of plenty of good company and easily obtained food and water.

Even today the mission seems to have had little influence on the traditions the elderly people consider important. Until 1982 there had been no voluntary baptisms or attendance at Mass since the mission started. An elderly nun who had worked in the region for 40 years said "we drove them in and drove them straight out again".

Even though the Aborigines stopped returning to their country soon after settling at the mission they retained detailed memories of it and continued to practise many of their traditional economic, social and religious customs. Naturally the memories of many people are now indistinct and are coloured by nostalgia and some of their traditional skills, such as the manufacture of hair string and stone tools, are out of practise. Generally, however I found the quality and detail of their memories exceptionally good and people I worked with obviously knew what they were talking about. This is not surprising when one considers that most of the people I worked with were older than their mid twenties when still living a fully traditional life in the bush.

In 1963 the annual report from the mission stated one of its aims was to be a "buffer station" between the Aborigines and the harsher realities of civilization which, for example, were encountered by their peers at Halls Creek and Alice Springs. In this the mission seems to have been partially successful. Even today access by Europeans is as limited as possible and loss of Aboriginal traditions has been less than elsewhere in Australia. As a result this thesis is set in a uniquely rich traditional situation which is possibly unparalleled in Australia and matched by very few places in

the rest of the world.

Unfortunately the traditional wealth of this situation will probably be short lived. The old men candidly state they are "too chicken" to go back to the traditional life and the young men enjoy sport, video and "want to live in style like the white man". They are not interested in returning to the bush for long periods. Eventually the traditional core of the Balgo community will be lost; the old men continue to get older and the destruction of their country by mining concessions is increasing at an alarming rate.

Chapter 3

THE PEOPLE AND THEIR SOCIAL ORGANIZATION

This chapter introduces the reader to the traditional owners of the study area and provides a detailed account of the social and demographic factors influencing the movement of people within and outside the study area.

Much of the discussion in this chapter is centred around data I collected from Aborigines whilst travelling with them through their own country. As such it is one of the few accounts from the Western Desert which have attempted to accurately document and map the population movements, location of bands, descent groups, linguistic units and so on from within the country belonging to the Aborigines (but see also Myers 1976; Palmer 1983).

I am not an anthropologist but felt it necessary to gather detailed data of this kind first hand. There were two reasons for this. In the first place the treatment of these topics in the anthropological literature was complicated, contradictory and often unclear. In the second instance I wanted to make an independent assessment of the influence differing cultural traditions were likely to have on the distribution of artefacts within the study area.

The Linguistic Unit

The Western Desert contains probably the largest cultural block in Australia (Berndt 1977:92). My own study area is located in the north east corner of this desert and straddles the interface of territories belonging to the Walmadjeri (west), Gugadja (south and east) and Ngardi (north) (Fig.3.1). It is also central to the Pintubi (Long 1971; Hayden 1976; Myers 1976), Walbiri (Meggitt 1962) and Mardudjara (Tonkinson 1978).

Berndt (1959,1972,1976,1977) called these entities "linguistic" or "dialectal units" rather than tribes because they were culturally and socially homogeneous and spoke different dialects of the same language. This seems to be a most appropriate term as the Aborigines themselves acknowledge language as the principal difference between areas and otherwise consider everyone to be "countrymen". This feeling of fellowship extends to include Walmadjeri, Wanggadjungga, Ngardi, Gugadja, Pintubi, Mardudjara and Walbiri people but I am not sure how far it extends south. Bill Lari, for example, said the Pitjantatjarra did not "sing the same songs" as these groups and seemed to imply they were not fellow countrymen.

As fellow countrymen the people within these northern linguistic units seem to have enjoyed considerable freedom of movement within each other's territories. This extensive mobility and flexibility is very characteristic of Western Desert Aborigines (Gould 1969; Tonkinson 1978; Myers 1976 Berndt 1959, 1972 and 1977) and has made it difficult to locate their territorial boundaries accurately (eg.

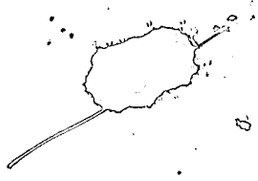
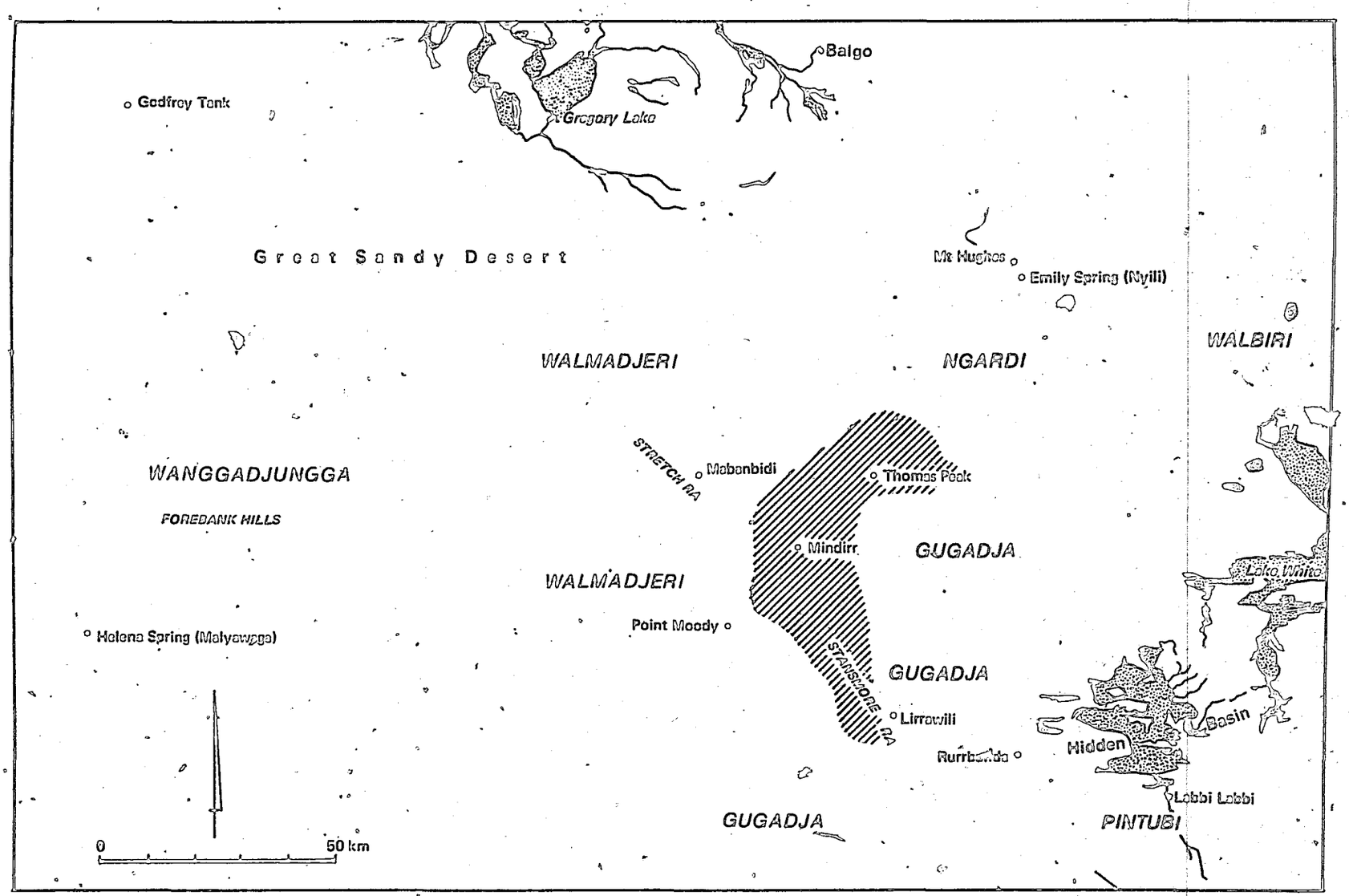


Figure 3.1

Linguistic units and some major waterholes in the vicinity of the study area (hatched area is referred to as "Gugadja mix up" by the local Aborigines).


Balgo
Godfrey Tank
Gregory Lake
Great Sandy Desert
Mt Hughes
Emily Spring (Nyili)
WALBIRI
WALMADJERI
NGARDI
STRETCH RA
Mabanbidi
Thomas Peak
WANGGADJUNGGA
FOREDANK HILLS
Mindirr
GUGADJA
Lake White
WALMADJERI
Point Moody
Helena Spring (Malyawagga)
STANSMORE RA
GUGADJA
Lirrawili
Basin
Hidden
Rurrbandda
Lobbi Lobbi
GUGADJA
PINTUBI
0
50 km

Tindale 1974) and explain the nature of these linguistic units (cf. Birdsell 1970,1976 and Berndt 1970, 1976). Birdsell (1970:125, 1976) claims that the boundaries of "dialectical tribes" were real and acted as partial barriers to cultural exchange and that they were population entities existing in "cellular geometery" in space which usually reflected topographic and ecological boundaries (Birdsell 1976). Berndt, on the other hand (1977:33) suggests that boundaries were "relatively flexible ... one gradually merging into another with boundaries more or less fluid". He says that a diagramatic representation of the Western Desert would look like a series of overlapping circles (1977:183).

My own field data tends to support aspects of both views. As stated above, the study area straddles the interface of Walmadjeri, Ngardi and Gugadja linguistic units. This region is very fertile (see Chapters 3 and 4) and was said to have been shared by these groups as well as Walbiri, Pintubi and Wanggadjungga people. They identified the Gugadja as the ultimate owners of the land and termed the whole area Gugadja "mix up"(Fig.3.1).

This idea of shared or "mix up" country was in fact alluded to by Berndt (1976:137) who recorded that the country around Yunggubalibanda (9) and Diedi (25) within the study area was shared by Wanggadjungga and Ngardi as well as Ngardi and Gugadja people. Thomson (1964:410) documents a similar situation on the eastern margin of "Bindibu" (Pintubi) country where this group and Walbiri people shared common territory. Myers and Clark (1983:3-4) also record that people living on the border of Ngardi, Walbiri and

Gugadja territories were also living in permanent association. Berndt (1976) also noted that the eastern margin of the Gugadja linguistic unit was said to be both Walbiri and Gugadja. He interpreted this as a series of Walbiri sites which had lain "fallow" and were now claimed by Gugadja people (1976:139). This interpretation was based on genealogical information from which Berndt inferred there were insufficient people to be allocated to all the possible sites; hence some remained unoccupied (1976:142). This is possible, although it strikes me as an odd luxury in such marginal country and I suspect the absence of people in Berndt's genealogies may simply be the result of a severe epidemic which is said to have killed hundreds of people in the early years of the first European Mission. The only information I have on this is contained in an unsigned Annual Report of the Pallotine Mission in 1948/49:

> Epidemic During November an epidemic broke out and continued for about two months. Notification of deaths was forwarded to the Department. All natives then staying at the mission were infected particularly those who had recently come from the desert due to their undernourishment. The sick were cared for by the mission staff and were treated from our medical store. The flying Doctor trip occurred during this time and Dr. Elphingstone advised.

With this in mind I think that the most likely explanation for country claimed by both Walbiri and Gugadja people recorded by Berndt is that it was stated by both; as territorial "mix up".

This concept of territorial "mix up" also goes some way to explain Meggitts' unique division of the Walbiri into four "communities". He defines these as the "largest group of Aboriginal

people who normally reside together in a face to face situation" (1962:51,58) and identifies these communities as the Yalpari (east), Ngalia (south), Waneiga (north) and Walmalla (west) (ibid.:5). Walmalla is also a name used by people I worked with to describe the traditional characteristics of the study area. The term means "too many people" and can simply mean a load of people in the back of a truck or, as it does in this case, identifies the study area by one of its major characteristics, relative overcrowding.

It is possible that Meggitt and I are referring to the same community of people although Meggitt locates the Walmalla 200km to the east in what he calls "the poorest and most desolate country" (1962:48). It is also remotely possible there are two separate communities called Walmalla; one relating to many people inhabiting the fertile landscape in the study area and the other to a few people living in a desolate landscape. Whatever the case, it appears that traditional Aboriginal "communities" were not unique to the Walbiri and probably occurred commonly in areas of territorial "mix up" throughout the entire region.

Territorial "mix up" contrasts with that described as "Gugadja proper" or the heartland of that linguistic unit's territory. I have not worked in "proper" country but understand from informants that movement into it was more restricted. I am under the impression that this restriction was environmentally rather than politically imposed and I imagine that the core of each linguistic unit was only visited fleetingly by families travelling to and from more resource rich areas of territorial "mix up".

If this interpretation is correct then one has a traditional situation in which there was a precisely located core or heartland belonging to each individual linguistic unit which is surrounded by a wide but well defined zone of access. This concept reconciles the apparent ambiguity and flexibility which is said to exist between territorial boundaries (Berndt 1959,1970,1976,1977) with the notion that boundaries were real and reflected topographic and ecological barriers (Tindale 1974; Birdsell 1970,1976).

Bands

The concept that Australian Aboriginal "tribes" were composed of bands (hordes) of about 30 people travelling around a well defined tract of land was first proposed by Radcliffe-Brown (1930-1). This however, does not seem to be a particularly accurate characterization of the situation in this part of the Western Desert. Berndt (1977:43) for example notes that bands varied a great deal in size and Long (1971:268) thinks of bands in this part of the desert as "loose associations of families". Peterson (1975:59,63) states Aboriginal society was "mobile and individualistic" and that their territorial organisation was by "no means as rigid" as commonly believed. Tonkinson (1978) says bands were flexible in size, movement and membership. Meggitt (1962:71) claims the term is misleading and does not apply to the Walbiri. Myers (1976:310) concludes that there was "no such thing as a group of individuals travelling together constantly from point A to B to C and so on" in Pintubi society.

My own field data confirms the latter view and suggests that the only economic unit that can be clearly and predictably defined is the family unit. It was explained to me on many occasions that one family travelled together, and that during the "cold time everyone walk about and hot time everyone go home". Within this seasonal round people could go "anyway" and travel with whom they liked and enjoy the company of whomever they met.

Generally Aborigines in this part of the Desert were naturally open hearted and sociable and welcomed any company they met when travelling. I imagine it would be impossible for anthropologists to determine the exact nature of these meetings or predict the composition of these co-travelling units throughout the course of one family's lifetime. One example that highlights this relates to a man called Djingganyui (Djangula) who attached himself to Bye Bye's family for several months after he had given his "screaming kids a hiding". He had been thrown out by his wife and was travelling with Bye Bye's family to get away from his children for a while.

However if one particularly wanted to reconstruct a generalized pattern of social interaction it would be better done on a seasonal rather than sociological basis. For example at the extreme end of the dry season, before fresh rains fell, several families were usually camped together around the few "living waters" in their estates. In the study area a minimum of six family groups had access to two waterholes, Mindirr (23) or Lirrawili (48). However, as soon as rain fell this group broke up (possibly not seeing each other again until the next extreme end of the dry season) and travelled via the

abundance of new water resources, to ceremonial gatherings. Here many different families camped together, often in very large numbers (see below). As these broke up some families lingered on while others travelled back to their own country. Several families often travelled together, separating as each reached their own homes. Individual families then spent the rest of the year foraging as widely as water supplies allowed, until water became so scarce they again fell back on the major waterholes.

Because of the obvious variability in group composition in this situation it seems unlikely that definite bands of people with set compositions existed at all. In the desert the family group; i.e. a man, his wife or wives and children, was the only unit that predictably travelled together. Obviously even this unit did not exist in social isolation. On occasions larger groups of people would have united and travelled together and on other occasions, such as when young men were sent into ritual isolation prior to initiation or when unmarried adult men travelled widely on their own in search of experience and knowledge, the composition of the family unit would have changed.

Family Units and Estates

As far as I can ascertain the family unit is the most important and possibly the only definable economic group that existed within each linguistic unit in this part of the Western Desert. There were five (or possibly six) families located in the study area and although they identified each other as "country men" or "one mob" and

shared the local resources generously, the current generation clearly identify themselves with different clusters of individual sites which they inherited from their fathers. These five men were Gulala (Djangula) (see Meggitt 1962 or Berndt 1977, for an explanation of subsection or kinship terms), Wanmal (Djabanungga), Warrabimarradji (Djagamarra), Djilmadjanu (Djabangardi) and Djinadjanggu (Djabaldjeri). With the exception of Wanmal, who is Djilmadjanu's classificatory father (or youngest brother of his real father; called Nyndunberi) these men are not related patrilineally and consequently appear not to make up a local descent group (Berndt 1977:96) or be part of a larger estate (Stanner 1965;Tonkinson 1978:49).

Stanner describes an estate as:

> the traditionally recognized locus ("country", "home", "ground", "dreaming place") of some kind of patrilineal descent-group forming the core or nucleus of the territorial group (1965:2).

The definition of this term is therefore inadequate for this region and there has been some attempt to improve it. Barker (1970:227,229) for example, says that an estate need not be a descent group and that it may be large or small, simple or complex and have a high percentage of adult males or conversely women and children. Furthermore, Tonkinson (1978:51) suggests the "estate group can be elusive" and that membership is not rigorously defined.

These opinions seem to throw the debate open and as far as I am concerned the most sensible approach for this study area is to use the term "estate" in direct reference to the specific clusters of sites which individual famlies claim as their own. I shall use the

term this way throughout the thesis.

Estate One (Fig.3.2)

This estate extends beyond the northern limit of my study area and includes two major sites, Ngandalarra (6) and Naligudjarra (5). This estate was owned by a Ngardi man called Gulala (Djangula) whose only living descendant, Jack Djambidjin, lives at Billaluna Station.

Estate Two (Fig.3.2)

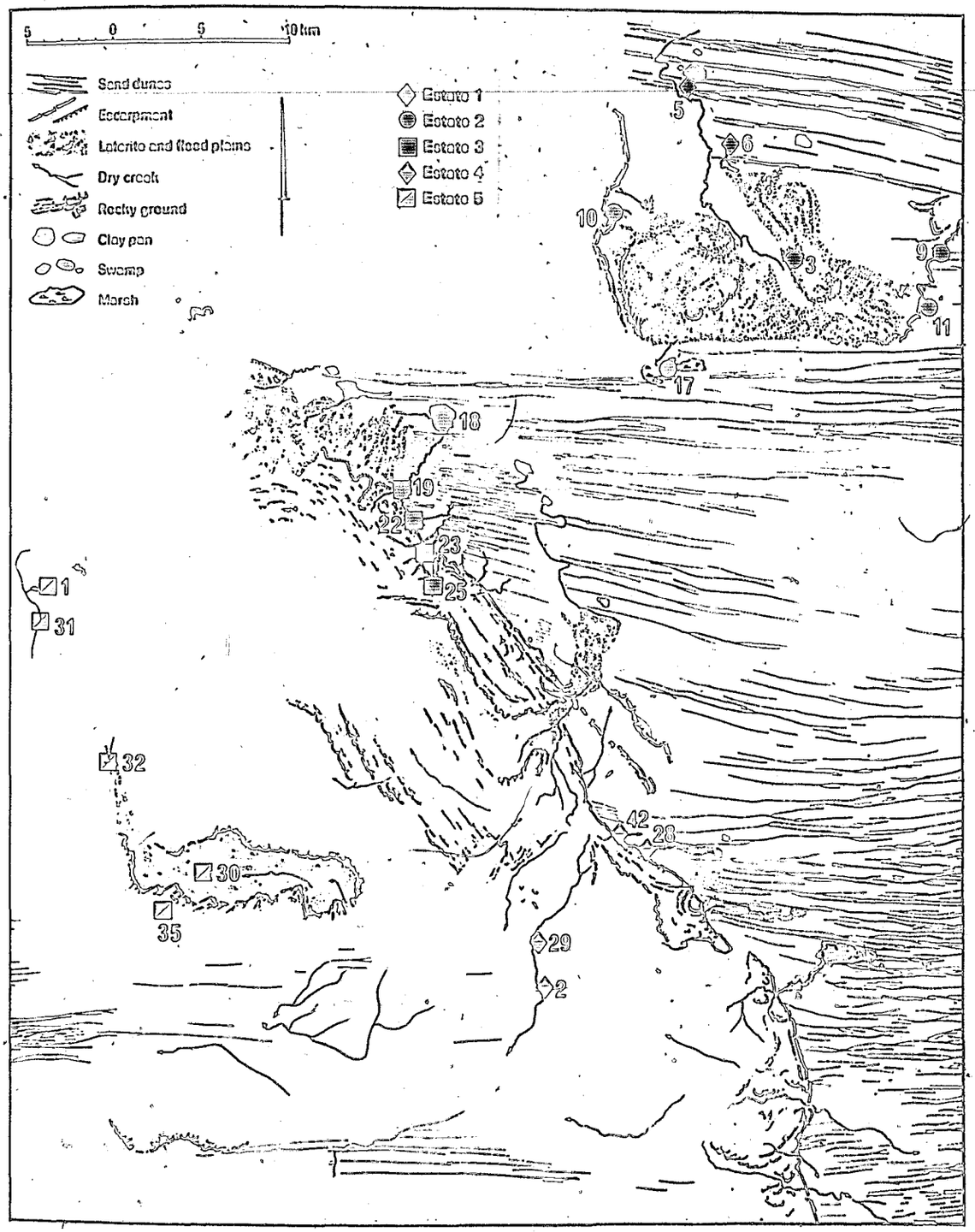
This estate is located immediately south of Estate One and incorporates Dirringberi (11), Nganawalbinyu (3), Nabulabanda (10) and Balgo Balgo (17). I worked closely with members of this estate and can accurately identify the original family members. The head of the family was a Gugadja man called Wanmal who had three wives. The youngest of these died childless but the remaining wives are still alive. The oldest, now blind, lives at Balgo and had three daughters and a son. Linda, Bye Bye and Thomas are the surviving children and now live at Balgo. His second wife lives at Gordon Downs near Halls Creek and had two boys and one girl. One boy died leaving Mark Moora and Nyami. The surviving members of this family live at Balgo.

Estate Three (Fig.3.2)

Estate Three is central to the study area and includes Dalabanda (18), Djulyurrulyurru (19), Migiliri (22), Mindirr (23) and Diedi (25). This country was owned by a Gugadja man called Warrabimarradji (Djagamarra), whose only surviving descendant is a blind old man called Bagala, now living at Billaluna.

Figure 3.2

Location of estates' owned by family groups within the study area.


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
Estate 1
Estate 2
Estate 3
Estate 4
Estate 5
5
6
10
3
9
11
17
18
19
22
23
25
1
31
32
42
28
30
35
29
2

Estate Four (Fig.3.2)

This is the most southerly estate in the study area and includes Birbayga (28), Ngawagudjarra (42), Djarrga Djarrga (2) and Gawayurru (29). This estate was owned by a Gugadja man called Djilmadjanu (Djabangardi). He apparently possessed abnormal physical strength and was said to be able to carry kangaroos like others carried goannas. He had three wives although one was taken by his brother Gagadu (who was chased and killed by Djilmadjanu, who was in turn killed and dumped in the creek at Djarrga Djarrga (2) by a group of Walbiri men). The only descendant I know of from this man is called call. Bumble Bee. He is totally blind (Bumba - blind) and lives at Balgo. Djilmadjanu had a third brother, Mini, but I am not sure of the exact location of his estate. He seems to have shared Estate Four, and the adjacent countryside but I suspect h[illegible]ate was located to the west and perhaps outside the study area. He died at Nydbigarri (35) and has one surviving son, Guguman (also blind), and a daughter Yuria.

Estate Five (Fig.3.2)

This estate is located on the western side of the study area and includes Gundjimarra (30), Lambanlamban (32), Yurinubadu (31) and Djulagan (1). It was owned by a Walmadjiri man called Djinggadjanu (Djabldjeri) and his wife Dimi. They are both dead and have no surviving children.

The people I worked with often commented that they were not like Gadiiyas (white men) and that movement into each other's country by neighbours and their relatives was unrestricted. In proof of this I was shown camps made by Djilmadjanu (Estate Four) at Djulagan (1) (in

Estate Five) and Ngandalarra (6) (in Estate One) and saw camps, scarred trees, and distinctive artefacts such as an old spear thrower and a steel axe that belonged to Wanmal (Estate Two) in Estates Three and Four. Gulala's brother from outside the study area apparently lived in Estate Two for a period and died at Nabulabanda (10) in this Estate.

Many of the people I worked with also travelled freely in the study area and almost every one I spoke to had visited the area at some time. Bill Lari and Sunfly travelled extensively through the region as young unmarried men and later with their respective families. Their estates are between 90 and 150km from the centre of the study area. Sunfly married Bye Bye (Estate Two) for his second wife. Mick Djagamarra visited the region at least twice, once for a period of about six months isolation prior to his initiation and later with his family on his way to a ceremony near Gregory Salt Lake. His estate is about 200km from the centre of the study area. Jimi Djambidjin and his brother lived about 70km from the centre of the study area and also travelled extensively through it. Jimi ended up taking Nyami for his second wife and his brother married Linda. Both women are from Estate Two.

Population

So far I have alluded to and circled around the problem of the prehistoric population in both the study area and desert in general. Estimates for the latter vary considerably and as Berndt suggests "reveal nothing of the concentration or "actual" density of

population within the area" (Berndt 1959:86,1977:26). In fact Radcliff-Brown (1930:689) said there was "no data whatsoever on which to estimate the poulation of the arid region of Western Australia".

In spite of this Hayden (1976:154) used Radcliffe-Brown's population density of one person per 207 sq km in the South Australian desert for the Western Desert. Long (1971:264) using his own data suggests there may have been a density of one person per 200 sq km for the Pintubi but Meggitt (1962:32) suggests a figure of one person per 90 sq km among the neighbouring Walbiri. Yengoyan (1968:189) gives a general figure of one person per 78 to 104 sq km for Central Australia. Berndt presents two figures for the Western Desert: one person per 37 sq km and one person per 371 sq km (1959:86, 1972:180, 1977:26). I am not sure which figure is correct but assume it is the former, as this fits with Berndt's estimate of 18,000 people for the entire prehistoric population of the region he defines as the Western Desert cultural bloc.

Therefore there is a need to rationalize the "actual" population density in the Western Desert. In attempting to do this I have taken into account the likely pre-contact location of families in the study area as well as the seasonal movement of people throughout the year. It is particularly difficult to reconstruct the actual number of people in pre-contact family units in the study area; even when their original location can be accurately mapped. This is primarily because Aboriginal people in this area are loathe to mention individuals who have died (<u>warri warri</u> - poor bugger, leave him). The difficulties this creates when trying to reconstruct the original size of family

units should be obvious and I was never inclined to push people past their individual emotional limits.

Nevertheless, a rough idea can be obtained by examining the composition of the five estates in the region. In summary there were eight individuals from Estate Two, three people from Estate Three and four people from Estate Four. The low figures may not be reliable for Estates Three and Four as it is possible that some individuals from these estates have died and I was not told of them. I have excluded the people from Estates One and Five from this calculation because only portions of these estates are found within the study area and I am unsure how far they extend outside the area I investigated. Consequently this leaves a core - or absolute minimum population of 15 people occupying an area of about 2,500km^2. This is a population density of only one person per 167km^2 and; allowing for the absence of people who may have died and members of Estates One and Five, should be considered an absolute minimum, if not an unrealistically low figure. However it is a figure that compares with those presented by Long (1971) and Radcliffe-Brown (1930).

The reliability of this figure would be enhanced if I knew how many people were likely to have been in an average pre-contact family. The figures above suggest there were only about five people per family but Evans and Long (1965:320,328) recorded 17 people in two families as well as a group of 20 people constituting another two families. However Long (1971:265) suggests that families ranged from three to 12 people. In agreement with this Carnegie (1898) recorded nine families with between three and 12 people in them. Meggitt

(1962:78) records about 300 families in a group of 1,400 Walbiri (4.6 people per family) and 37 residential families from a group of 143 people (3.9 per family).

Unfortunately no detailed records were kept of families coming in from the desert at Balgo. In 1963 a detailed census was taken although its reliability is open to question since it was taken after a severe epidemic in 1948 (see above) and seems to have left some people out. For example, there were 217 Aborigines at Balgo in 1962 and between 256 and 266 in 1964 but the census only records 180 people for 1963. Nevertheless 41 families were recorded in this population. This is an average of 4.4 people per family and is consistent with Meggitt's average and the figure I recorded for the study area. If this original figure is accurate then a population density of one person per 167 sq km for this part of the desert may be reasonably accurate. If for the sake of this discussion the figure is extended over the area of the Western Desert to which Berndt refers (1977:26) then the total population was probably about 4,000 people - considerably less than the 18,000 estimated by Berndt (1959,1977).

If the figures for Estates Three and Four are doubled (14 people) so they approximate figures I know to be accurate for Estate Two then the population density for the study area rises to 22 - or a density of one person per 110 sq km. This figure is consistent with the population densities given by Meggitt for the Walbiri and Yengoyan for Central Australia and increases the overall population in the Western Desert to about 6,000 people.

Both figures are substantially less than the figure given by Berndt (1959:26, 1977:86) and leads one to question why Berndt assumed "the region may have carried 18,000 persons". The reasons for this are not clear. Berndt (1977:26) does in fact say that the recorded population in the late 1950's was 3,200 and considering there were still people in the desert, my initial figure of 4,000 people may be quite accurate. However, taking into account the impact of disease at contact both at Balgo and in Western Australia in general (Radcliffe-Brown 1930:659) the second figure of 7,000 people may also be accurate. Whichever is correct an estimate of between 4,000 and 6,000 may be more realistic than the 18,000 suggested by Berndt.

The impact disease had on the prehistoric population in arid Australia is difficult to assess. Butlin (1983) suggests that smallpox may have reduced the initial Aboriginal population by as much as 50% in advance of white settlements in south east Australia. If this is true then the same thing may have occurred throughout the desert. Giles (1889:20) recorded one individual with smallpox scars in the Rawlinston Ranges and Green (1981:119) recorded that Aborigines between York and the northern Kimberleys were ravaged by small pox introduced by Malay fisherman in the mid nineteenth century. The possibility obviously exists that smallpox halved the pre-contact population, and in this instance Berndt's estimate of 18,000 may be correct for the prehistoric population. However, given that the (limited) evidence for smallpox was recorded over 100 years ago, it is likely that the desert population at contact had fully recovered and the lower figures suggested here are the most

realistic.

Actual Population Densities

Fortunately the study area provides an interesting case study of the changes in actual population density because it drew large numbers of people from surrounding areas. This immigration was most extreme after exceptional rains (gulawa) when people came into the study area to participate in an increase ceremony for "bush potato" (Ipomoea costata). The Aborigines say there were a "thousand thousand" people at these meetings but the nearest rationalization of this I can get is that there were about the same number of people as are currently living at Balgo. This figure fluctuates from a few families to about 1,000 but Berndt (1976:141) records 270 official residents with an extra 400 with dialect affiliations. This combined population may turn up at Balgo for big meetings held around Christmas.

A figure of about 300 people may seem exceptionally high for any ceremonial gathering although I believe the environment in the study area (see Chapter 4) could support such a population for at least a couple of months after good rains. Also, there are several observations of similar sized meetings throughout the general area. For example, in the Tanami Desert Gee (1911:20) recorded "150 male Aborigines holding a corroboree" and Carnegie (1898:369) recorded an encounter with 100 Aboriginal men near Gregory Salt Lake. Both these gatherings must have been accompanied by an equivalent number of women and children, thereby raising the population of each to about 300. Meggitt (1962:55) says groups of 400 to 500 Walbiri attended

ceremonies and records 300 Pintubi [illegible]een together as recently as 1925. In other areas Gill (1968:110) r[illegible]ed gatherings of 130 people, Gould (1971:168, 1969:102-3) reco[illegible]ed 107 and 150 people, Tindale (1935:199) and Hackett (1937:289) recorded between 250 and 270 people and Strehlow (1947:65) recorded several hundred Aranda and Matuntara congregating for four to six months at a time.

Meggitt (ibid.) suggests that such large gatherings were more common than usually believed although I would imagine that such gatherings would have been relatively rare events. This is because of the scarcity of areas fertile enough to support them and because of the necessity for big rains to make travel to and from the ceremonies feasible over otherwise waterless country. The only other local area I am aware of that drew equally large crowds was at Billiluna pool - near Gregory Salt Lake. It was probably a large group of people here that Carnegie saw. Mick Djagamarra's family travelled from near the Kintore Range in the Northern Territory to attend these ceremonies. This is a return journey of about 700km in a straight line.

During the course of a normal year however smaller gatherings probably occurred quite regularly. Many of these occurred within the study area - for example at Ngandalarra (6), Dalabanda (18) and Migiliri (22) and in the southern part of the Stansmore Range slightly outside the study area. Somewhere between 40 to 60 people usually seem to have attended these smaller ceremonies and I was told that people often stayed on and foraged in the areas after the ceremonies had finished. Aborigines I worked with frequently complained that there were "too many people" living in the vicinity

of the Stansmore Range and that there was often a lot of fighting.

Ceremonial gatherings and seasonal changes in the availability of water were both very important factors influencing changes in the "actual" concentration of people in the desert. This interrelationship can be summarized as follows.

During wet season rains people moved into the hills for shelter. These rains may have only lasted for a short time but during that time the entire population of this part of the Western Desert was probably densely packed into rock shelters in the hills. Immediately after these rains people moved widely and freely over the country. The abundance of water meant virtually every nook and cranny could be explored and under these conditions the population density in any given part of the desert would be at its lowest.

With the assistance of a healthy wet season people travelled into fertile regions for large ceremonies. At these gatherings the population density in a few isolated areas would have been great. In the study area for example, the influx of about 300 people would have increased the density to about one person per 8 sq km. This is somewhere between that recorded for other more fertile regions such as Tasmania (with an average of one person per 12 sq km) or Arnhem Land (with an average of one person per 8 sq km) (Jones 1977:321; Maddock 1974:22-3). However under normal conditions smaller meetings probably resulted in an annual maximum population of about 50 people - or a density of one person per 52 sq km. During these times vast expanses of the desert would have been empty.

Following these meetings people gradually returned to their estates where they foraged and socialized quite freely while surface water remained plentiful. Again this was probably a time when the population was quite evenly distributed over the countryside and the density of between one person per 110 or 167 sq km recorded for the study area may be reasonable.

With the contraction of water supplies family groups fell back on their main waterholes. In the Stansmore Range two rockholes were shared by at least six families. During this extreme end of the dry season the entire population was probably scattered in tiny pin point population groups throughout the hills and ranges. During this time most of the desert was empty again and the congregated family units were making out on scarce resources (see Chapters 4 and 5) over a foraging area of about 10-15 sq km. Assuming there were between 10 and 15 people per rockhole the density of these discrete population entities was probably about one person per sq km.

Summary

One of the most obvious aspects of traditional social organization which evolves from the preceding text is that only two sociological units can be recognized in the region in which I worked. The first of these is the family unit which in combination with other family units speaking the same dialect constitute the second sociological unit; the linguistic unit. The linguistic unit has a specific geographic location and is composed of a central core surrounded by a zone into which access was virtually unrestricted. My

study area sits astride such a zone of access.

My field data suggests that within the respective environmental constraints of individual estates families exercised considerable freedom of choice. This manifested itself as pronounced mobility and social flexibility and this undermines the rigid framework of local organization traditionally proposed by anthropologists. I cannot identify local descent groups or bands within the study area and with regard to the latter support Myer's view that bands probably did not exist at all.

However this anthropological framework appears to have been accepted at face value by archaeologists. Gould (1969:269-72) for example originally saw the Pitjantadjarra people as belonging to "patrilineal cult lodges" but later (1982:86) changed this, to claim that

> unpredictability of water supplies and the nomadism and fluidity of residence ... precluded any kind of local organization based upon groups of fixed size or compositions operating within bounded territories.

O'Connell (Toohey 1979:6; O'Connell and Hawkes 1981:101) identifies "discrete named units ... or continuous blocks among the Alyawarra". Hayden (1976) goes beyond both to claim that bands not only exist in Pintubi society, but that "there are major differences between groups (bands) in traditional material culture"(1976:27). If my interpretation of the evidence is correct then this seems most unlikely. I think the body of evidence presented here suggests that there was in fact very little cultural or stylistic variation within the study area. The Aborigines refer to the region as one of

sociological "mix up" and identify themselves collectively as "one mob". Consequently I would expect the influence of differing cultural or stylistic traditions on the distribution of stone artefacts throughout the region to be minimal.

Chapter 4

PLANT and ANIMAL RESOURCES

In the preceding chapter I have described the people who occupied the landscape within the study area. In this chapter I would like to examine the distribution, seasonal availability, processing techniques and dietary importance of the plant and animal resources used by those people in that region. This chapter is designed to provide the reader with a detailed knowledge of the resources used in the study area and in conjunction with the following chapter forms the basis from which an assessment can be made of the extent to which archaeological debris reflects the pattern of Aboriginal subsistence practiced in the region.

Throughout the field work for this thesis I was constantly aware that I was enjoying one of the last opportunities available to prehistorians make a detailed record of the traditional pattern of subsistence in the Western Desert. Because of this I made a conscious effort to make a detailed record of the subsistence activities I saw taking place. Without doubt I found it fascinating to observe real hunter gatherers at work in the bush and because of this found it quite easy to spend as much time participating and recording these activities as my commitments to archaeological research would allow.

The Aborigines themselves were extraordinarily helpful to this end. I can remember many occasions on which I had to "work" when they would return with collections of lizards and vegetables, separate them into traditional taxonomic groups and wait for me to return to count and weigh them. The only conscious encouragement I gave to promote these activities was to get the women to prepare several meals from grass seeds.

In addition to observing and participating in traditional subsistence activities I also spent long hours talking about traditional economic practices and seeking answers to many questions about subsistence in such a marginal habitat. Such questions included which foods were the best, which were hardest to gather, how long were different foods available, what happened if certain plants failed and what foods were used in time of drought? Bye Bye was particularly lucid in this regard. She not only had a very accurate and detailed memory but was unwaveringly patient and thoughtful in describing the subsistence activities practiced by her and her parents. The most relevant of these accounts are included in this chapter.

In the course of conducting research for this chapter I recorded a considerable quantity of new data. This reveals a broader, more reliable economic base and a less opportunistic subsistence strategy than previously supposed for the Western Desert. Because of the quantity of new data this chapter is relatively detailed. It hopes to build on the initial work done by Sweeney (1947) and Gould (1969) and provide complementary data to that available for Central Australia

(O'Connell et al. 1983). Nevertheless, wherever possible I have attempted to condense much of the data into tables (Table 4.2-4.22) and distribution maps (Fig.4.2-4.6). Figure 4.1 presents a summary of the seasonal availability of the major classes of food utilized in the region. Table 4.1 presents the result of a nutritional analysis conducted on many of the important foods eaten in this part of the desert.

Plant Resources

Within the study area I recorded 128 plants of which all but two were recognized and named by the Aborigines. 102 of these plants provided materials suitable for 138 different economic, social and medicinal functions (Tables 4.2-4.20). Various parts of 70 plants produced edible seeds, tubers, fruits, nectars, excretions and an additional seven plants contained edible insects or larvae. This list compares with a total of 38 edible plants recorded for the southern portion of the Western Desert by Gould (1969), Cleland and Tindale (1959) and Cleland and Johnston (1933) and compares with between 15 and 81 economically useful plants recorded in the north east of the Western Desert by Meggitt (1957,1962) and Cleland and Johnston (1939). O'Connell et al. (1983) recorded 122 economically useful plants and between 92 and 77 edible plants in different parts of Alyawarra territory in Central Australia.

Cleland and Tindale (1959:120) claim there are probably more than 1200 vascular plants in Central Australia and O'Connell et al. (1983:83) says there are probably 500 species in Alyawarra territory.

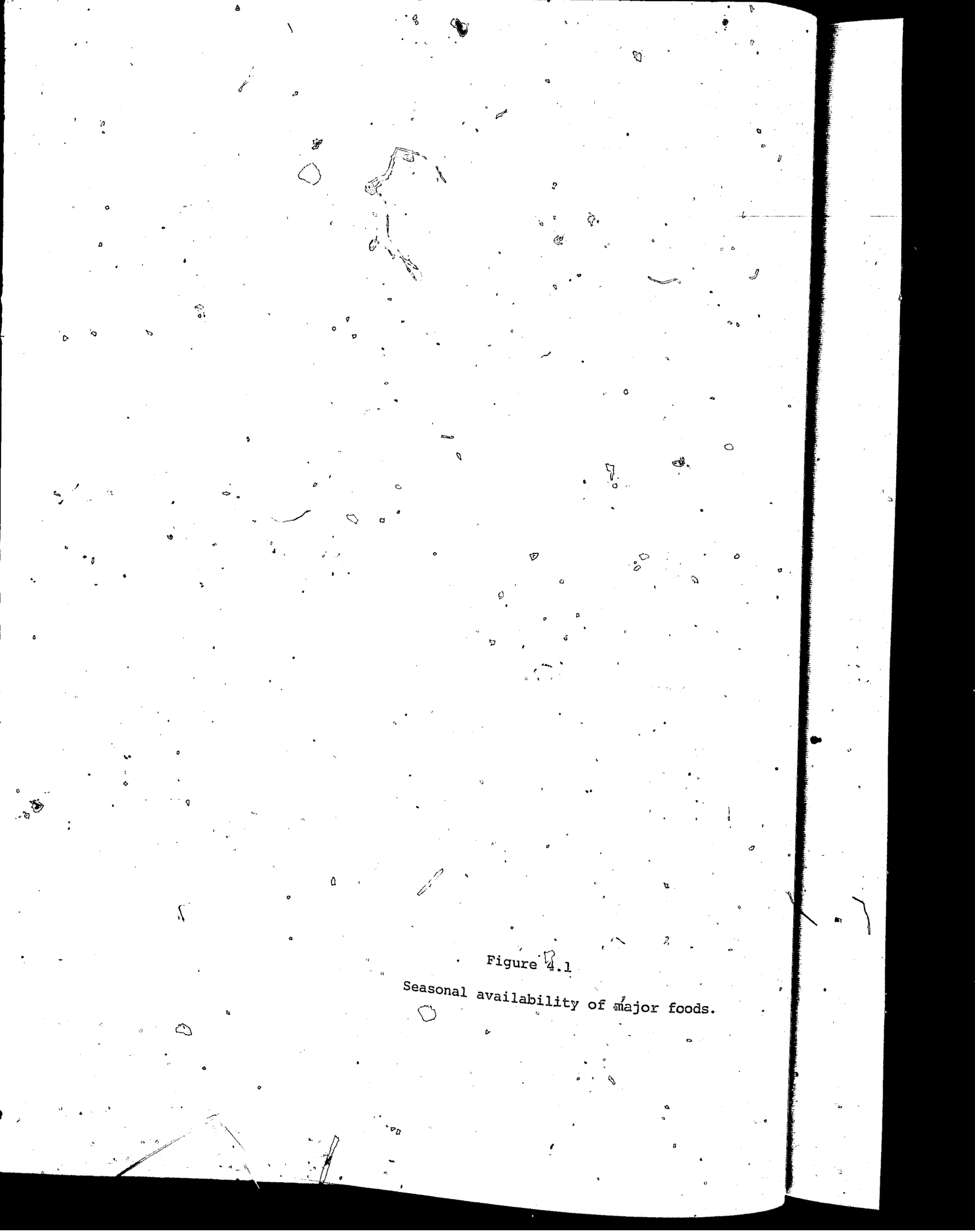


Figure 4.1

Seasonal availability of major foods.

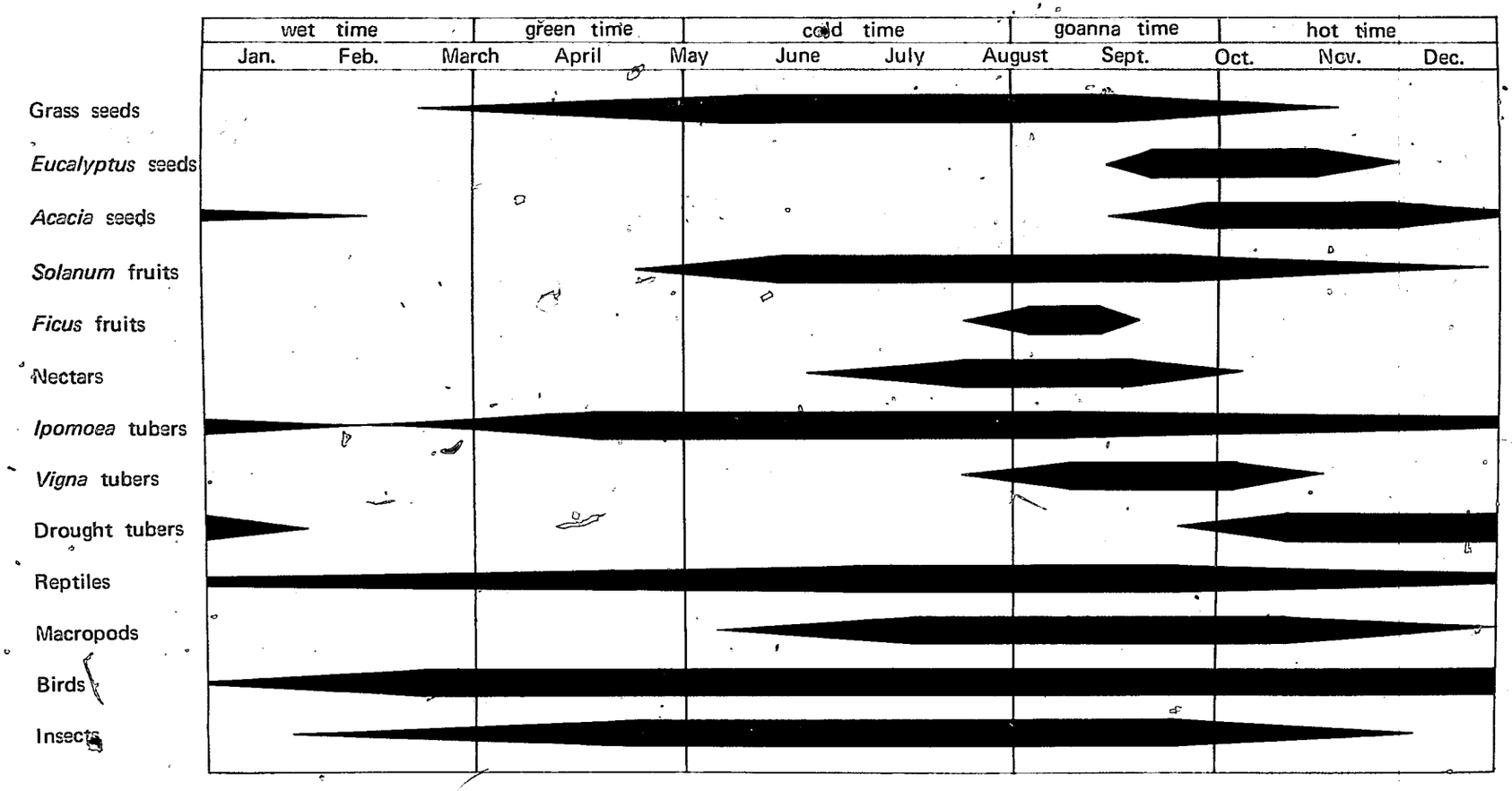

wet time
green time
cold time
goanna time
hot time
Jan.
Feb.
March
April
May
June
July
August
Sept.
Oct.
Nov.
Dec.
Grass seeds
Eucalyptus seeds
Acacia seeds
Solanum fruits
Ficus fruits
Nectars
Ipomoea tubers
Vigna tubers
Drought tubers
Reptiles
Macropods
Birds
Insects

TABLE 4.1 Nutritional analysis of bush foods

Scientific name	Aboriginal name	Moisture g/100g	Protein g/100g	Fat g/100g	Ash g/100g	Carbo-hydrate g/100g	Minerals mg/100g Ca	K	Na	Ascorbic acid mg/100g	Kilo calorie per/100g
SEEDS											
Panicum australiense and Fimbristylis oxystachya (cooked damper)	Yidagadji Lugarra	53.30	5.28	1.83	11.16	28.43	12.01	91.52	34.89	-	158.57
(raw seed)		3.67	12.32	6.29	11.30	66.42	21.23	172.02	50.37	-	373.86
Chenopodium rhadinostachyum (cooked damper)	Galbarri	51.09	14.30	1.31	11.86	21.44	127.39	282.38	39.84	-	161.69
(raw seed)		-	15.37	-	-	-	-	-	-	-	365.01
Panicum australiense (cooked damper)	Yidayadji	25.71	13.32	1.83	21.84	37.30	25.15	175.41	45.58	-	241.76
(raw seed)		-	13.82	4.78	9.80	-	-	50.73	22.55	-	380.99
Fimbristylis oxystachya (cooked damper)	Lugarra	32.60	7.10	11.96	22.57	25.77	16.90	182.70	43.96	-	244.70
(raw seed)		6.54	10.72	19.03	22.93	40.78	10.97	78.96	12.06	-	404.57
Panicum cymbiforme (cooked damper)	Gumbulyu	47.54	8.47	4.33	7.51	32.15	25.25	216.98	54.81	-	196.01
Styloblasium spathulatum (raw nut)	Nirdu	10.88	.31	.11	1.51	87.19	321.00	290,43	55.79	-	300.04

TABLE 4.1 (continued)

Scientific name	Aboriginal name	Moisture g/100g	Protein g/100g	Fat g/100g	Ash g/100g	Carbo-hydrate g/100g	Minerals mg/100g Ca	K	Na	Ascorbic acid mg/100g	Kilo calorie per/100g
TUBERS											
Ipomoea costata (cooked)	Garndi	64.30	1.23	.54	.94	32.99	89.26	299.21	32.66	-	134.96
(raw)		78.76	.81	.13	1.19	19.11	72.28	286.17	56.82	3.62	83.01
Cyperus rofondus	Djunda	31.24	1.73	.43	3.06	63.54	57.22	470.12	195.18	-	277.03
Elderia sp.	Mulbu	52.22	2.53	3.80	20.43*	21.02	24.46	227.81	53.88	-	150.25
FRUITS											
Solanum chippendalei	Wilgarrba	55.95	4.40	.55	2.33	36.77	121.73	830.65	51.56	45.25	201.64
Solanum centrale	Gawarrba	77.99	3.84	1.52	2.12	14.53	59.66	782.23	35.13	26.55	-
Ficus platypoda	Widjirgi	55.47	1.79	1.21	2.08	39.45	163.22	200.32	54.04	-	193.88
Mukia sp.	Ngalbuwandji	84.13	5.20	.19	1.60	8.88	33.52	456.55	82.20	-	70.09
MEAT											
Varanus acanthurus (cooked)	Djaran	44.47	32.52	14.96	6.85	1.20	173.77	174.25	480.64	-	327.14
Varanus gouldii (cooked)	Banggabari	51.54	25.90	13.87	8.02	.67	185.08	242.11	407.93	-	245.28
Eupodatis australis (cooked)	Barrulga	60.41	29.12	6.58	2.35	1.54	33.51	247.58	355.26	-	164.03
MISCELLANEOUS											
Sap: Acacia acradenia	Mawida	10.88	.31	.11	1.51	87.19	321.00	290.43	55.79	-	300.04
Wasp galls (Eucalyptus aff. terminalis)	Malagudu	45.01	9.66	16.12	3.61	25.60	132.07	155.40	60.96	-	-

*Sample contaminated in sand

Nutritional analysis done by J. Gedeon, W.A.I.T. Dept Home and Consumer Studies, Perth.

Clearly ethno-botanical investigations in arid Australia account for only a limited range of the available flora but nevertheless appear to have identified the majority of economically useful species found in the region. According to the people I worked with I had recorded "everything now" and I consider the following text representative of the economically important plant foods used within the study area.

Seeds

It has always been assumed that seeds are a fundamentally important part of the traditional diet in arid Australia (Gould 1969, 1980; Meggitt 1957; Tindale 1974; O'Connell *et al.* 1983; Lawrence 1969; Allen 1974). They are also important from an archaeological point of view because they are virtually the only part of the Aboriginal food gathering activities which is reflected directly, via women's seed grinding tools, in the archaeological debris. Because of the importance of seeds I would like to discuss this particular resource in some detail.

Edible seeds were collected from 42 plants by Aborigines in the study area in the past. These included 11 species of acacia, 18 species of grass, four species of eucalypts, three succulents, two herbs and four other miscellaneous shrubs (Table 4.2).

Distribution (Fig.4,2)

Grass Seeds

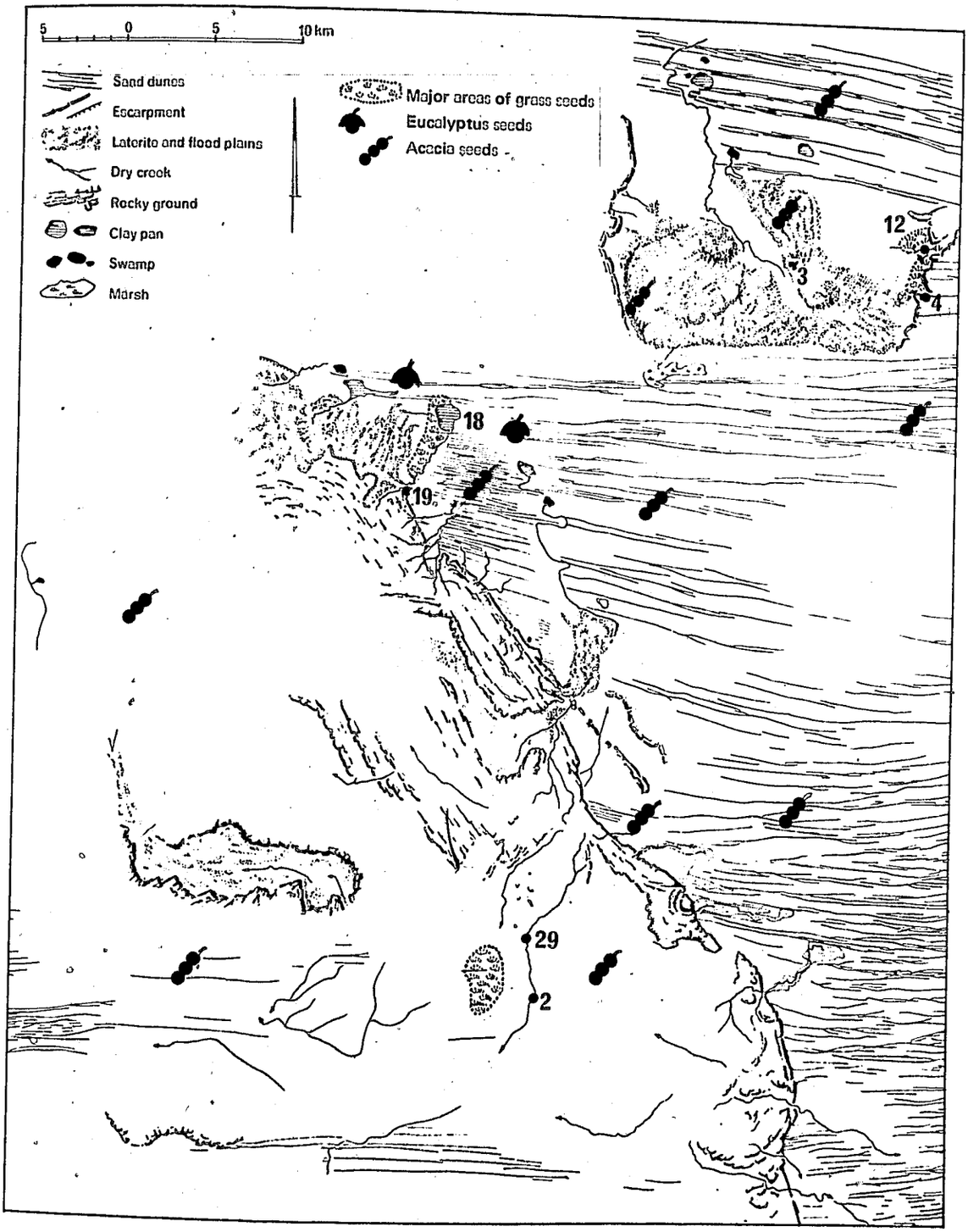
Among the grasses found in the region the most important were *Fimbristylis oxystachya* and *Panicum australiense*. These species are

TABLE 4.2 Edible seeds

Scientific name	Aboriginal name	Habitat	Relative importance
Acacia acradenia	Wilbud	Sandplains	minor
Acacia adsurgens	Nganamarra	Sandplains	moderate
Acacia ancistrocarpa	Wadayurru	Sandplains	moderate
Acacia aneura	Mandja	Flood, laterite plains	moderate
Acacia coriacea	Gunandru	Deep sandplains	major
Acacia holosericea	Gilgidi	Adjacent water	major
Acacia ligulata	Wadarrga	Sandplains	moderate
Acacia monticola	Birrbin	Sandplains	moderate
Acacia stipuligera	Djibrin	Deep sand, dune flanks	major
Acacia tenuissima	Minyinggurra	Sandplains	moderate
Acacia tumida	Girriling	Sandplains	minor
Acacia tumida	Nadurrdi	Sandplains	major
Brachiaria miliiformis	Balgurrba	Adjacent water	minor
Bulbostylis barbata	Lyillyil	Adjacent water	minor
Capparis loranthifolia	Yidaringgi	Flood plains	minor
Chenopodium inflatum	Garndubungba	Clayey sand	minor
Chenopodium rhadinostachyum	Galbarri	Clayey sand	major
Cyperus iria	Yanmid	Adjacent water	moderate
Dactyloctenium radulans	Burrandjarri	Adjacent water	moderate
Daspalidium rarium	Yulumburru	Rocky ground	minor
Diplachine fusca	Miarr Miarr	Floodplains	minor
Echinochloa colunum	Dudjurnba	Adjacent water	moderate
Eragrostis eriopoda	Wangganyu	Sandplains; near water	moderate
Eragrostis laniflora	Burrindjurru	Deep sand	minor
Eragrostis tenellula	Marradjirralba	Various	moderate
Eucalyptus camaldulensis	Yabulin	Creeks	minor
Eucalyptus microtheca	Dindjil	Adjacent water	moderate
Eucalyptus odontocarpa	Warilyu	Deep sand	moderate
Eucalyptus pachyphylla	Djibuburru	Deep sand	moderate
Fimbristylis oxystachya	Lugarra	Sandplains	major
Hedyotis pterospora	Yurrundju yurrundju	Sandplains	minor
Panicum australiense	Yidagadji	Sandplains	major
Panicum cymbiforme	Gumbulyu	Deep sand	major
Panicum decompositum	Willinggiri	Flood plains	minor
Portulaca filifolia	Bulyulari	Sandy ground	moderate
Portulaca oleracea	Wayali	Sandy ground	moderate
Scirpus dissachanthus	Gunamarradju	Adjacent water	moderate
Sida sp. A (unnamed)	Dadji dadji	Sand-dunes	minor
Stylobasium spathulatum	Nirdu	Sandplains	major
Tecticornia verrucosa	Mangil	Claypans	minor
Triodia basedowii	Nyanmi	Sandplains	minor
Triodia longiceps	Lanu lanu	Rocky ground	minor
Triodia pungens	Djinal	Sandplains	minor

Figure 4.2

Distribution of edible seeds in the region.


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
Major areas of grass seeds
Eucalyptus seeds
Acacia seeds
12
3
4
18
19
29
2

often found growing together scattered on the sandplains and adjacent water be ring bodies throughout the region and were located in three large areas west of Djarrga Djarrga (2), south of Dalabanda (18) and at Wiribil (12) (Plate 4.1a; Fig. 4.2). Both species respond quickly to fire and these areas were maintained by burning during the past. Most of the other edible grasses were also found on the sandplains and adjacent water bearing bodies. Panicum cymbiforme was probably the most abundant of these grasses and was found in unusual abundance around a large lunette on the western margin of Dalabanda (18)(Plate 4.1b).

The variety and abundance of edible grasses found in the hills and on the laterite plains and flood plains was quite limited. The most common was Eragrostis tenellula which was also found in small quantities everywhere in the region.

Acacia Seeds

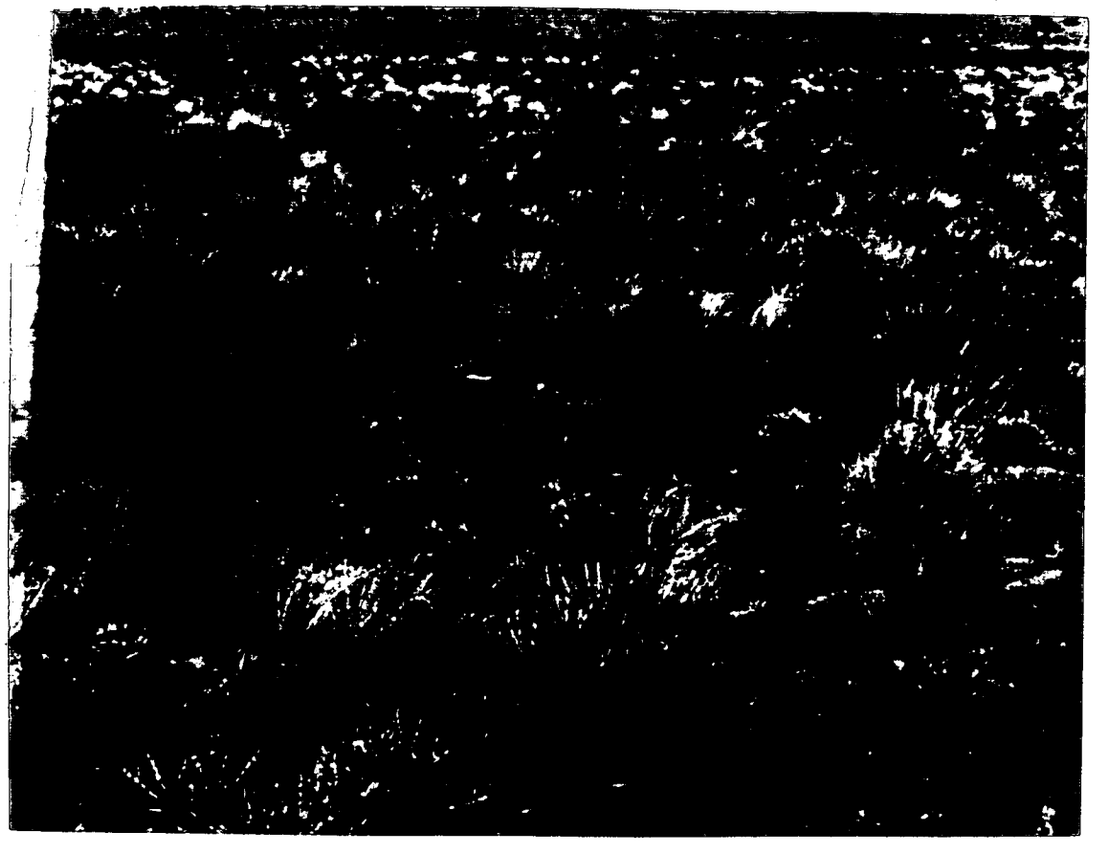
The majority of edible acacia seeds grew abundantly on the sandplains (see Table 4.2 and Fig.4.2) although some of the major edible acacias were confined to deep sand (A. coriacea), along the flanks of dunes, (A. stipuligera) and around water bodies (A. holosericea). At present acacias are so widely distributed that they give the impression their seeds would have been of major importance in the past but in pre-contact times the high fire frequency appears to have reduced their numbers dramatically.

Plate 4.1a

Panicum australiense (circular, dense, darker coloured tufts of grass) growing south of Dalabanda (18).

Plate 4.1b

Panicum cymbiforme (the high grass) growing on the lunette at Dalabanda (18).





The local Aborigines said they burnt the landscape within the study area frequently and explained that it was once "really desert" whereas now it has turned into "jungle". In accordance with this explorers travelling through the general area record very large areas of burnt ground and numerous smoke from fires (see Kimber 1983; Warburton 1975; Carnegie 1898). On the basis of this information (as well as my own observation of the effects of the fires we lit on the present landscape) I would imagine that acacias were not as widely distributed in the past as their present distribution would suggest.

Eucalyptus Seeds

Unlike acacias, the pre-contact distribution of eucalypts may have been similar to that seen in the region today. Only four species of eucalypts were harvested for seeds (Table 4.2) and these either grew in restricted areas around water bodies or as mallees on the sandplains. Some of these mallees are particularly large now and their large knotted roots provide evidence of a relatively stable distribution in the recent past. Today they are found in their greatest numbers on the deep sand north and north east of Dalabanda (18).

Herbs and Succulents

Three succulents were eaten by Aborigines in the past (Table 4.2). Two of these (Portulaca filifolia and P. oleracea) were found in small but frequently encountered concentrations around water bodies as well as on flood plains and on patches of sandy ground in the hills. The third succulent (Tecticornia verrucosa) was limited in its distribution and was only found on one claypan near Gundjimarra

(30)..

Two herbaceous chenopods (Chenopodium rhadinostachyum and C. inflatum) (Table 4.2) were also utilized throughout the region and grew on saline patches of clayey sand. These were quite abundant throughout the sandplains and to a lesser extent on the flood plains.

Other Species

The seeds of four miscellaneous shrubs were eaten in the region. Two of these species (Sida sp. A and Stylobasium spathulatum) responded well to fires and grew widely on the sandplains and dunes. The seeds of one species of wild orange (Capparis loranthifolia) were also eaten (Table 4.2) but the distribution of this was restricted to the local vicinity of Wilbarinyu (27) (Fig.4.2).

Seasonal Availability

The seasonal availability of edible seeds depended on the relative amount of water in the soil and as a result the availability of seeds varied according to the distribution and quantity of the annual rainfall. As I indicated in Chapter 2 the quantity and timing of rainfall in this region varied considerably. Consequently, there was no specific time of year at which any particular species could be harvested. Instead there was a sequence of several traditionally defined seasons through which particular seeds could be expected to ripen (see Chapter 2). Bye Bye, Nyami and Budja Budja described that sequence as follows:

> "Hot time; gilgidi (Acacia holosericea), djibrin (A. stipuligera), mungilba (Tecticornia

verrucosa), kanindjul (unidentified) This one for hot time. Four for hot time.

Early bird after rain; yibiri (an unidentified grass), light one, marradjiral (Eragrostis tenellula).

Dudjurnba (Echinochloa colunum), balgurrba (Brachiaria miliiformis) around here (Ngandalarra (6)), yulumburru (Daspalidium rarium) brown one, then pulyulari (Portulaca filifolia) finished now, (June). Little bit finished, burrambra, light one. You'd see him but no one been lighting, start him fire. Like a lugarra (Fimbristylis oxystacha), but different; light one. Woyali (Portulaca oleracea) later, getting cooked now (June). Gunamarradja (Scirpus dissachanthus) black one, long time cooked - goanna and blue tongue come out. That the time he'll be cooked. Hard one, he got to stop in water. I (Bye Bye) never taste him when I been little bit big. This lot been eating. Wanggunyu (Eragrostis eripoda) cold time, nice one. Gumbulyu (Panicum cymbiforme) coming soon. Nice food again, but he never grow at this time, little bit.

Lugarra, (Fimbristylis oxystacha) later on he'll be cooked. Whole lot cold time; lugarra (F. oxystacha), yidagadji (Panicum australiense),

dudjurrnpa (Echinochloa colunum). Cold time wangganyu (Eragnostis eripoda), yibiri (unidentified), lanu-lanu (Triodia longiceps). Cheeky one spinifex (prickley). When he dried, after rain, pull him out. He got a seeds. Djinal (T. pungens), nyanmi (T. basedowii) too . Eat straight away, little bit dry, same time. Woyali (Portulaca oleracea), Pulyalari (P. filifolia) same time.

Minyinggurra, red one and yellow one (A. tenuissima and A. adsurgens), ngadurrdi (A. tumida). Same time hot time. Mandja (A. aneura), gunandru (A. coriacea) too, hot time. Good hot time. We can eat gunandru (A. Coriacea), gilgidi (A. holosericea), minyingurra (A. tenuissiuma), nadurrdi (A. tumida), mandja (A. aneura). Hard work, lady one, all the ladies. Man can come and eat. Before Christmas, when rain coming, only meat; keep going, meat, meat, meat. Come back to one camp. Christmas time hard time.

This account provides an interesting concise first hand description of the seasonal availability of the major edible seeds. To this, however I can add information from other individuals which supplements and clarifies aspects of this narrative.

First of all the only edible seeds to ripen during the wet season were those of the wild orange (Capparis loranthifolia). Unfortunately the distribution of this plant was so limited it can hardly have been of great importance at that time of year. As soon as the weather became "a little bit dry" after rain three species of spinifex came into seed (Table 4.2). These were not very highly ranked by the Aborigines but if needed they filled a vacuum at a time of year when vegetable foods were unpleasantly scarce. These were closely followed by the early succulents (Portulaca sp.) and from the end of the "green grass time" (May-June) until the end of the cold time (August-September) virtually all the grass seeds ripened.

The two most important grasses were Panicum australiense and Fimbristylis oxystachya. These grasses responded quickly to fire, grew in three dense localized areas and produced an abundance of seeds. These seeds were either collected directly from the plant or could be collected from the ground after they had fallen. Seeds from these two grasses were also collected by ants who ate an attached nodule (eliaosome; Berg 1975; O'Connell et al. 1983) and left the seeds piled around the entrance of their nests (Plate 4.2a,b). These last two characteristics extended the season over which these two grasses could be harvested into the "goanna get up time" (September).

From about September on the shrub, Stylobasium, succulent (Tecticornia) as well as the acacias and eucalypts ripened. These species were generally stored for consumption during the hot season and I was told that some acacias (A. holosericea, A. stipuligera, A. coriacea and possibly A. tumida) were kept for use into the wet

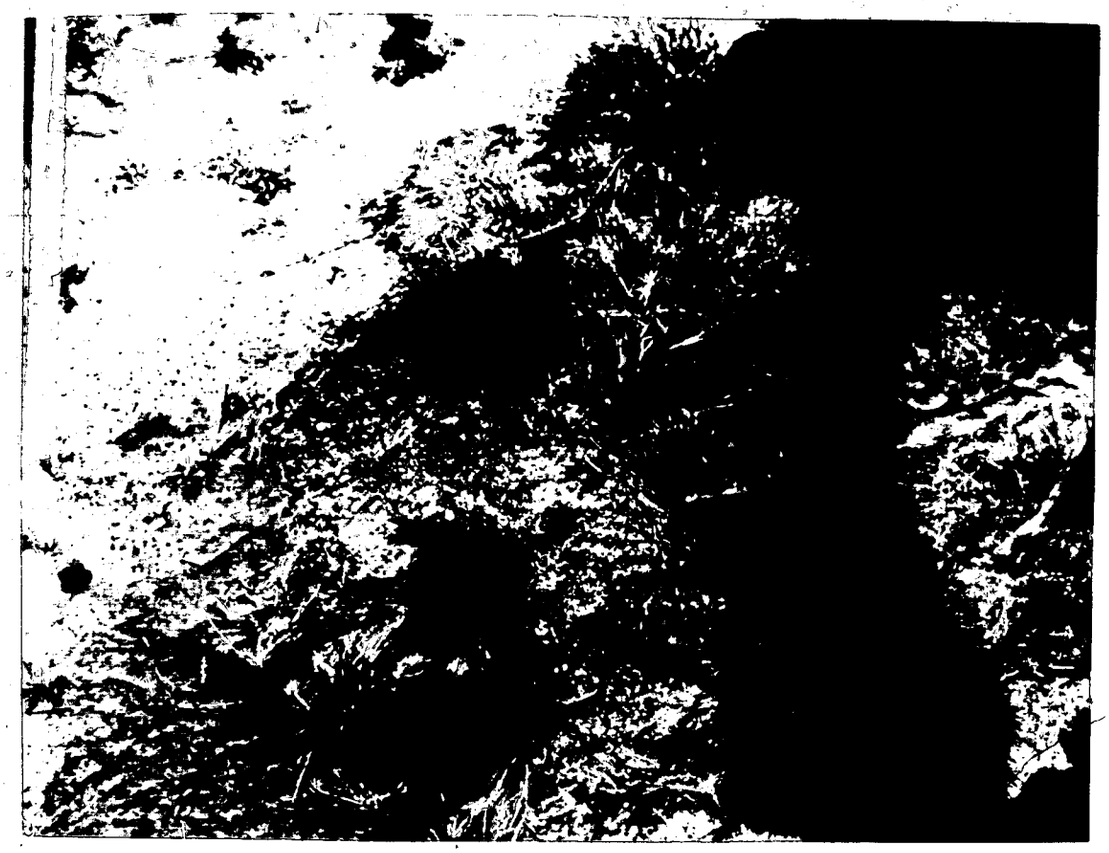


Plate 4.2a

Mass of Panicum australiense seeds at the base of a tuft of grass.

Plate 4.2b

Panicum australiense and Fimbristylis oxystacha collected by ants.





season as well. This makes a lot of sense because food supplies were relatively poor at these times of the year (see Chapter 5).

Seed storage was a very important aspect of the economic strategy in this part of arid Australia. Without it, survival during the last few months of each year would have been very difficult. Even with the benefit of seed storage supplies of vegetable food within the vicinity of the major waterholes often ran out. When this occurred the local Aborigines had to rely heavily on meat from stray catches of game and lizards.

Seed storage is unrecorded in the Western Desert but was clearly an important aspect of the economy in other arid regions of Australia (Newland 1921:13; Horne and Aiston 1924:33; Tindale 1972:250, 1977:346). The storage of Solanum fruits is the only aspect of plant storage documented for the Western Desert (Carnegie 1898:230; Sweeney 1947:290; Gould 1969:261; Thomson 1975:24).

Seed Processing

Seed processing was a time consuming and arduous task. The time spent processing seeds varied a little depending on the amount of litter mixed in with the seeds, the freshness with which the women approached each stage in the procedure and the number of women helping in the task. Nevertheless seed preparation was clearly the most strenuous aspect of the traditional subsistence activities.

In order to get some idea of the processing techniques and technology required to process seeds we pepared five seed cakes from several different plant species. These are detailed in Tables 4.3 to 4.7 and referred to below. These are the only quantified data of this kind in Australia.

Grass Seeds

Collection

Seed collection was relatively easy and I observed it was possible to collect roughly 1,000g of seed in about half an hour. Most grass seeds were simply stripped straight from the grass into a wooden dish (Plate 4.3a). Some of the grasses (particularly F. oxystachya and P. australiense) could also be collected from the ground or from ants' nests (see above). Once collected the outer husks of most seeds had to be removed and this was done by rubbing handfuls of seed between the heel of one hand and the palm of the other. As this was done the seeds were dropped onto wooden dishes so the wind could blow some of the unwanted vegetable matter away (see also Tindale 1974:99, 1977 and O'Connell et al. 1983 for different techniques) (Plate 4.3b).

Winnowing

When seeds had been dehusked they were placed into a large softwood dish to be separated from contaminating sticks, sand and stones. The women I worked with were very efficient at separating seeds and at their best could separate about 1.5kg of rubbish from 500g of seeds in about 40 minutes. I should point out however that this time varied according to the kind of litter mixed up with the seeds collected. Each different material had to be winnowed out

Plate 4.3a

Seeds of Chenopodium rhadinostachyum being collected from plant.

Plate 4.3b

Dehusking grass seeds over wooden dish; using wind to blow unwanted matter away.





separately and this often necessitated between three and five different winnowing operations.

Seeds collected from the ground took the greatest effort to winnow clean. To do this a large quantity of seeds were first placed in a softwood dish (luandja). The dish was then held firmly in both hands and rocked, with an upwards flick, back and forwards repeatedly (Plate 4.4a). When the seeds began to separate the dish was tilted slightly and balanced between the last three fingers and the ball of the thumb of the lower hand. The rocking motion was continued with the other hand and the ball of the thumb on the lower hand was used to jar the lower end of the dish and spill the clean seeds onto another dish (wirra) where they were collected for grinding.

Grinding

After the seeds had been cleaned they were either ground directly or soaked for several hours beforehand. Seeds were only soaked to soften them and this was not done if the Aborigines were hungry.

Seed grinding was the most arduous part of the seed preparation process and took about 50% of the total time required to make the few seed cakes we made. An average time of about one hour to grind approximately 200g of seeds could be a reasonable indication of the effort required.

When the women were ready to start grinding they set the grinding slab into the ground and placed a wooden dish under the lip of the slab. A small quantity of seeds were placed on the grinding

Plate 4.4a

Winnowing small pebbles from seeds.

Plate 4.4b

Paste of ground seeds running over the lip of a grinding slab into a wooden dish. A small pile of seeds is still on the margin of the grinding groove. (Note this grinding groove is too deep and the handstone is too small. The surface of the grinding slab has been bashed down so the woman's hands do not rub on the stone).





slab and a steady trickle of water was dribbled onto the seeds to facilitate grinding and to help the flow of seeds down the grinding groove and onto the wooden dish (Plate 4.4b).

When the seeds were ground the paste (lunganba) was either eaten raw or several small dampers were baked in a camp fire. In this case the raw paste was placed in a shallow depression dug into hot ashes, A small fire of spinifex or dry twigs was then lit over the paste to dry the crust of the damper. When dry it was covered with hot ashes and baked for 10-20 minutes.

We prepared four dampers from different grass seeds. The details of these operations are documented in Table 4.3 to 4.6 and the nutritional analysis of the damper produced is documented in Table 4.1. Briefly, the preparation time for each meal meant a handling time of about five hours per kg of damper and gave a return of about 350 kcals per hour.

Acacia Seeds

Collection and Storage

Acacia seeds were relatively easy to collect but were more difficult to process than grass seeds. I did not observe this technique but was told that the seeds were collected by stripping seed laden branches straight from trees just prior to ripening or when they had ripened. These branches were piled into heaps on the hard, flat surface of subterranean termites' nests and beaten with sticks. This dislodged the seeds and when the task was finished the branches were removed and the seeds were scraped up, free of sand,

TABLE 4.3 Processing *Panicum australiense* and *Fimbristylis oxystachya* seeds

Processing step	Time Start	Time Finish	Total time (minutes)	Weight (gm)
Seeds ready for processing	1.50pm	–	–	750
Winnow seeds 5 times	–	2.36	46	485*
Ground 1/5 of raw seeds	2.36	3.17	41	–
Cooked ground seeds	3.17	3.34	17	100
Ground remaining seeds	3.34	4.22	46	–
Cooked ground seeds	4.22	4.48	26	380
Total processing time (mins) and weight of seed cakes			176	480

*70 gm of raw seed removed for nutritional analysis

TABLE 4.4 Processing *Panicum australiense* seeds

Processing step	Time Start	Time Finish	Total time (minutes)	Weight (gm)
Collected seeds from ground	3.00pm	3.15	15	2100
Winnow fine sand from seeds	7.30am	7.45	15	865
Winnow pebbles from seeds	7.45	7.57	–	630
Clean plant material from seeds	7.57	7.59	2	–
Final winow	7.59	8.11	12	520
Soak seeds	8.11am	5.13pm	–	–
Grind portion of seeds	5.13	5.50	37	–
Cook ground seeds	5.50	6.30pm	40	600
Grind and cook remaining seeds	7.10am	7.40	30	240
Total processing time (mins) and weight of seed cakes			150	840

TABLE 4.5 Processing Fimbristylis oxystachya

Processing step	Time Start	Time Finish	Total time (minutes)	Weight (gm)
Collect seeds from ground	2.13pm	2.28pm	15	550
Start to winow seeds	11.11am	11.20	9	–
Rest	11.20	11.36	16	–
Resume winnowing	11.36	11.53	17	340
Rest and eat lunch	11.53am	1.08pm	75	–
Grind 2/3 of seeds	1.08	1.28	20	–
Cook ground seeds	1.32	1.40	8	210
Grind remaining seeds*	1.40	1.55	15	–
Cook ground seeds	1.55	2.00pm	5	110
Total processing time (mins) and weight of seed cakes			180	320
Total work time.			89	–

*Seeds ground and cooked by young girl

TABLE 4.6 Processing Panicum cymbiforme

Processing step	Time Start	Time Finish	Total time (minutes)	Weight (gm)
Collect seeds	10.10am	10.20am	10	280
Winnow seeds	1.53pm	2.13	20	160
Soak seeds	2.15	4.37	–	–
Grind seeds	4.37	5.12	35	–
Cook seeds	5.13	5.30	17	215
Total processing time (mins) and weight of seed cakes			82	215

from the termites' nest without much difficulty. The same technique was used when the Aborigines wanted to store the seeds but in this case the piles of seed pods and branches were covered with spinifex. This protected them from birds and reptiles until the Aborigines returned.

Grinding

Acacia seeds were usually ground before they were eaten but two species (A. tumida and A coriacia) did not have to be processed this way. These species could be simply roasted in hot ashes and eaten directly. O'Connell et al. (1983:188) explains that

> Many of the larger acacia seeds (especially A. coriacea) can also be eaten without grinding, just before they ripen fully. The seeds are collected in their pods, warmed or slightly parched in the ashes of a hearth, stripped out by hand and eaten.

O'Connell et al. (ibid.:92) recorded that the return for acacias cooked this way was as high as 4,000 to 5,000 kcals an hour, but points out that the period over which they can be collected and eaten this way was small.

The processing technique used to render acacia seeds edible appears to have been rather complicated and unfortunately my field season ended before the acacias in the study area were ready for processing. However, the Aborigines told me how this was done. Apparently the acacia seeds were first soaked in water and squashed up. This produced a milky liquid which could be drunk. The remaining squashy mixture was spread onto the surface of a flat termites' nest

and dried in the hot sun. When this was dry it was collected and roasted in hot sand. This roasted mixture was then winnowed to get rid of any contaminating sand. When cleaned it was ground up and rewinnowed in order to separate the edile seeds from the inedible black seed cases contained within the mixture. The clean seeds were then re-ground with water for consumption. The ground watery paste, was eaten raw and never cooked.

Bye Bye, Nyami and Budja Budja described this technique as follows.

> We can eat like milk, soak him in water. Hot time. Squash him, eat him up like shhhh (mimic slurping). Put him on ant bed now; start again, cook him. When you dry, juice, juice we can eat. Finish, leave him ant bed; flat one. Burn him now; hot sand.
>
> Start again, shake him, shake him, clean him up; finish. Alright we can start now. Rock now, grinding put him in grindstone now. We can shake him again, black one, on top one, shake him, shake him, finish now. Take him wooden dish. For man that one, for husband and wife. We can eat anything; not really damper; gurrunba. Can't cook him. He go no fire, no law, no law. Just eating.

> We two fellow; gunandra (A. coriacea), gilgidi (A. holosericea), guarrba (A. tumida), mirrinba (unidentified), minyingurra (A. tenuissiuma), ngadurrdi (A. tumida), mandja (A. aneura). That the different one, he got no law. We can't cooking damper; nothing. No. He can burn you, finish you. You'll drop. Only that first time we can cook him, that's all. Hard work that. Women. Husband gone for hunting.

The Aborigines described the raw paste as gurrunba and Hansen (1977:35) interprets the term this way

> Kurrunpa; Spirit. A person's spirit, located near the stomach, leaves the body after death and returns to the birth site. The spirit is responsible for involuntary actions, vomiting, hiccoughs etc. The spirit is personalised and said to leave one's body and go on walkabouts. One's dreams while sleeping are activities of the kurrunpa. Entrance and exit from the body is through the navel.

It is apparent from this narrative that several species of acacia seeds utilized in this region were toxic. I know nothing of the nature of this toxicity and with exception of this account know of no other reference to the use of toxic seed foods in Australia. In fact very little is known about the processing techniques for acacia seeds at all. The only other published account is in O'Connell et al. (1983) but this is based on incomplete observations and does not mention anything about toxicity. Clearly this is an area of desert subsistence that requires more research. Toxic plants were consumed

elsewhere in Australia (Beaton 1977) and the Tonga of Zambia also apparently utilized the toxic seeds of Acacia albida (Lee 1979:181).

Herbs

Preparing seed cakes from the two herbs (Chenopodium inflatum and C. rhadinostachyum) utilized in the region was also relatively complicated. In these instances the Aborigines had to remove the aromatic flavour of the plant and the herbaceous material surrounding the seeds before they could be consumed. This was achieved by rubbing the herbaceous mixture of seeds with spinifex ash. This was rubbed together until the seeds started to separate from their herbaceous cover. The seeds were then winnowed clean and soaked several times until the water they washed were in tasted clean.

We prepared one seed cake from C. rhadinostachyum and this is detailed in Table 4.7. Briefly the energy value of the damper made converts to a handling rate of 5.3 hours for every kilogram of damper produced and gave a return of 300 kcals per hour.

Eucalypts

The seed from Eucalyptus sp. were collected and stored in the same way as the acacias. With the exception of the red mallee (E. pachyphylla) eucalyptus seeds were processed in the same way as grass seeds and simply required winnowing, grinding with water and baking in the fire. The red mallee apparently had quite large seeds and could be roasted in hot ashes and eaten directly.

TABLE 4.7 Processing Chenopodium rhadinostachyum

Processing step	Time Start	Time Finish	Total time (minutes)	Weight (gm)
Collect seeds from plant	2.25pm	2.35pm	10	560
Burn spinifex and mix ash with seeds	7.52am	8.02	10	710
Winnow seeds	8.02	8.07	5	255
Soaked seeds and clean dishes	8.07	8.15	8	–
Grind seeds	8.18	9.00	42	–
Cook seeds	9.07	9.27	20	280
Total processing time (mins) and weight of seed cakes			95	280

Succulents

Seeds from two of the three succulents (P. oleracea and P. filifolia) were also straightforward to grind. These were in fact the softest seeds collected and were the easiest to grind of all the seeds in the region. Another succulent (T. verrucosa) grew on saline claypans and had to be soaked in water before it was ground.

Shrubs

With the exception of seeds from Stylobasium shrubs the remaining seeds were processed in the same way as grass seeds. S. spathulatum produced an abundance of seemingly impervious seeds and these were roasted in hot ashes or sand until the hard seed coat cracked. The kernel was then removed and eaten. These seeds usually ripened in about August but were left to fall to the ground and were collected later, during the hot season. They were quite nutritious seeds (Table 4.1).

Dietary Importance

Seeds were clearly a fundamentally important part of the traditional diet in the study area but were a difficult resource to process. The processing times recorded in this thesis converts to a handling rate of between three and six hours for each kilogram of damper processed from various seeds (Tables 4.3 to 4.7) and this translates to an energy return of between 246 kcals and 810 kcals per hour. The average is a handling time of five hours to produce 1kg of food and a return of only 340 kcals an hour. This handling time is twice that recorded in a poorly quantified description by Brokensha (1976:25) but accords with O'Connell's estimate for mulga seeds;

although the energy return I recorded is only half that given by him (i.e. 500-700 kcals and 500-800 kcals an hour;(et al. 1983:92; O'Connell and Hawkes 1981:109). The reason for this discrepancy is unclear. It may simply be that O'Connell's estimates were based on the nutritional value of raw seeds whereas mine are based on the calorific return for cooked damper - 50% of which were water (Table 4.1). Hence the calorific value per 100g is half that suggested by O'Connell.

My figures suggest that a woman would have to work for six hours just to feed herself (i.e. produce 2,000 kcals of food (Meehan 1977:518) and indicates that grass seeds could not have been as dominant aspect of the traditional diet as is generally believed. If, for example, grasses were "staple" foods and had to constitute between 30% and 50% of the traditional diet as suggested by Gould (1969, 1980, 1982) then one woman would have had to work for between 10 and 15 hours a day simply to provide an average family (see Chapter 3) with less than half their daily calorific intake. These figures might be slightly exaggerated given that the women I worked with were relatively unfit and out of practice, but nevertheless they give some idea of the effort involved to process seeds.

Therefore, unless large supplies of relatively easily processed grass seeds were available it would appear that seeds were generally used as a supplement to the diet and I would estimate they probably constituted about 20% of the daily diet. The Aborigines explained they would always prefer to get large game, lizards, tubers and various fruits in preference to grass seeds. The unique value of

seeds however was that unlike many other food items which were only available seasonally and could fail to ripen in abundance in any given year, seeds could be stored and some could always be found somewhere in the landscape. This made seeds fundamentally important in the traditional diet, although even the quantity of seeds also varied seasonally. They were most abundant and of greatest economic importance during the coldest seasons (between June to October), but became quite scarce during the hot and wet seasons (November-March). Grass seeds were particularly important during large ceremonies when other local resources were pushed to their limits. They were also important at locations such as Djarrga Djarrga (2), Ganayurru (29), Djulyurrulyurru (19) and Dalabanda (18) where the proximity and abundance of grass seeds compared to other food supplies made them, a viable resource.

With regard to the relative importance of individual species of seeds it was apparent that, with the exception of the three species of spinifex, the grass seeds were the most desirable. Amongst the grasses, Panicum australiense, P. cymbiforme and Fimbristylis oxystachya appear to have been the most important. Most of the other grass seeds including two species assumed by Gould (1969,1980) to be desert staples were of moderate importance and were used in a supplementary fashion in the diet at different camps in the landscape. The edible shrubs, acacias, eucalypts, spinifex and the succulent T. verrucosa were generally at the bottom of the list although their relative importance in the daily diet increased during the hot season (or in the case of spinifex, in the late wet season) when everything else was in short supply.

Roots and Tubers

Six species of underground plant food were utilized in the study area. Three of these (Ipomoea costata, Vigna lanceolata and Cyperus rotondus) were very important food items whereas another two (Clerodendrum floribundum and Cassia notabilis) were fibrous, difficult to prepare and were not used except in times of drought. One truffle (Elderia sp.) was consumed in the region but this was a luxury item only encountered occasionally (see Table 4.8a)

Distribution (Fig.4.3)

Traditionally, (Ipomoea tubers) were collected from four locations in the study area. Three major areas were located in the sandplains in the north of the study area (Plate 4.5b) and the fourth area was located on the sandplain on the north eastern side of the Stansmore Range. This latter area was considered to produce "rubbish bush potato" by the Aborigines.

In the northern portion of the study area Ipomoea tubers were a vitally important resource and provided the stimulus for a large ceremony in that area whenever rains allowed sufficient people to get to the region (see Chapter 3).

Vigna tubers were found in varying quantities on virtually all creeklines in the study area (Figure 4.3). The major locations were at Gawayurru (29) and Djarrga Djarrga (2) and they also grew to a lesser extent at Naligudjarra (5), Ngandalarra (6), Ngahawalbinyu (3), Nabulabanda (10), Djulyurrulyurru (19) and Birbayga (28).

7

TABLE 4.8a Roots, tubers and truffles

Scientific name	Aboriginal name	Habitat	Relative importance
Cassia notabilis	Wirduga	Sandplains	moderate
Clerodendrum floribundum	Widulyurru	Deep sand	moderate
Cyperus rotondus	Djunda	Deep sand near water	moderate
Elderia sp.	Mulbu	Sandplain	minor
Ipomoea costata	Garndi	Sandplains	major
Vigna lanceolata	Djirilbadja	Adjacent water	major

TABLE 4.8b Fruits

Scientific name	Aboriginal name	Habitat	Relative importance
Capparis lasiantha	Ngarngguli	Flood plains	minor
Capparis loranthifolia	Yidaringgi	Flood plains	minor
Carissa lanceolata	Managudji	Swamp margins	minor
Ficus platypoda	Wirrgidji	Rocky ground	major
Mukia sp.	Ngalbuwandji	Flood plains	minor
Santalum lanceolatum	Nuwari	Deep sand	moderate
Solanum centrale	Garrarrba	Sandplains	major
Solanum chippendalei	Guru	Sandplains	major
Solanum chippendalei	Willgarrba	Rocky ground	major
Solanum diversiflorum	Gunbubadja	Sandplains	major
Solanum gilesii	Djarrdubidji	Sandplains	major

TABLE 4.8c Nectars

Scientific name	Aboriginal name	Habitat	Relative importance
Crotalaria cunninghamii	Ngalyibi	Sand-dunes	moderate
Eremophila latrobei	Miin miin	Sandplains	minor
Eremophila aff. latrobei	Yadawarra	Sandplains	minor
Eucalyptus pachyphylla	Djiduburru	Deep sand	minor
Grevillea aff. eriostachya	Galin galin	Sandplains	major
Hakea macrocarpa	Biruwa	Sandplains	major
Hakea suberea	Yuradajarrdu	Sandplains	moderate
Melaleuca lasiandra	Djandandu	Swampy ground	moderate

Figure 4.3

Distribution of edible tubers, roots and truffles.

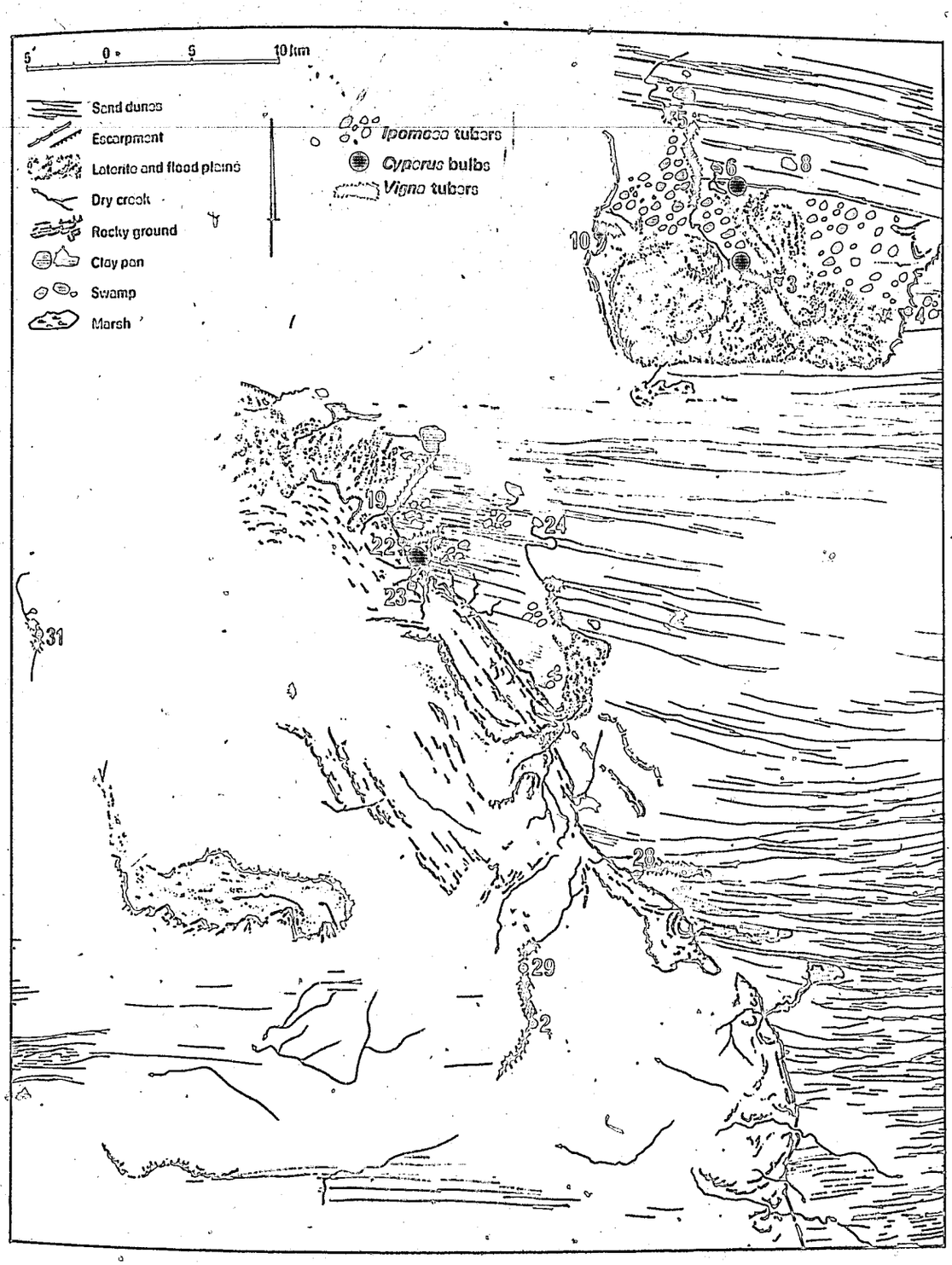

5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
Ipomoea tubers
Cyperus bulbs
Vigna tubers
35
6
8
10
3
40
16
19
24
22
23
31
28
29
2

Plate 4.5a

New seasons runners growing from "mother" Ipomoea shrub.

Plate 4.5b

Density of Ipomoea shrubs in the north of the study area (shrubs are the dark bushes).





Cyperus rotondus was a sedge-like grass which produced a small cluster of onion shaped tubers close to the surface of the ground. This resource was found in places that are seasonally inundated with water and as a result is not very prolific in the study area. The only place we gathered it in any quantity was along the creekline adjacent Mindirr (23).

The two drought foods (Clerodendrum floribundum and Cassia notabilis were both scattered widely throughout the sandplains in the study area. Cassia notabilis appeared to be found in greatest abundance immediately south of Dalabanda (18) and around Birbayga (28).

Seasonal Availability

Most of the edible roots were available for consumption all year round although their relative abundance varied throughout the year. Cyperus rotondus bulbs were available a few months after wet season rains and were then ready for harvesting for the rest of the year. I was told "he is ready when you dry, this time now (June); he can stop through the hot time too."

Ipomoea tubers were also available throughout the year (see Sweeney 1947) although their relative importance varied considerably. The Aborigines consciously stimulated the production of new tubers from surface runners by burning - "when the cold time finish" (about August) (Plate 4.5a). Sweeney (1947:295) recorded that these runners were also produced after good rain.

New tubers were harvested towards the end of the "green grass time" (May-July). When these were exhausted the Aborigines turned to the deeper tubers on the roots of the "mother" plants. The older tubers were often quite large and were usually located between 50cm and 75cm below the surface of the ground. They swelled sufficiently to crack the ground around the middle of the cold season (June-July), and with the help of this marker were most efficiently gathered at this time of year. Unfortunately the waterholes in the northern part of the study area usually dried up by about September and the people were forced away from these rich areas of tubers to the Stansmore Ranges. With the commencement of summer rains people could move back into this region and continue to harvest the tubers missed earlier in the year but the torrential summer rainfalls usually covered the surface cracks and made tubers hard to find.

As the cold season finished Vigna tubers began to swell. These could be harvested for a few months around September. Vigna tubers were a staple food of the "goanna get up time" (August-October) but were said to "dry up" by the extreme end of the hot season (November-December).

Both Vigna and Ipomoea tubers were very important food items in the traditional diet and if they failed to produce the local population had to move away and forage in other areas. The women told me that

> We been looking anytime. Alright we got to go another place now, nothing. Can't find him djirilbadja (Vigna) or garndi (Ipomoea). No

> stopping this one, this place. No stopping. Keep going, keep going. My mothers place, (Bye Bye's) other side; Djarra Djarra (? location - somewhere south of the Stansmore Range). We've been having wirrgal (Solanum centrale) and different one djirrilbadja (Vigna), long one, skinny one; yunala (unidentified species).

Cassia notabilis and Clerodendrum floribundum were both consumed during the hot time. C. notabilis was considered to be "a rubbish one" and apparently produced a fibrous tuber which made a "crack like garndi" (Ipomoea) during the latter part of the year.

I do not know much about C. floribundum except that it had an edible root resembling that of Vigna tubers and was available, if not consumed, all year. O'Connell et al. (1983:84) describes that its roots were edible, but were regarded as poor food by the Alyawarra because of their rough fibrous quality. Peile (1980:60) also records it was a drought food.

Processing Techniques

Most of the edible roots were relatively easy to process. For example, the bulbs of Cyperus rotondus were simply dug by hand, roasted quickly in hot sand from a camp fire, rubbed between two hands to remove the outer skin and eaten. When in good supply this was a very easy resource to gather. I recall on one occasion near Gregory Salt Lake 12 adults collected enough bulbs to feed themselves and half fill an empty tin of powdered milk in just 20 minutes. On

two other occasions we collected them in the Stansmore Range the returns were substantially lower - but this resource still yielded between 600 and 1,000 kcals per hour (Table 4.9).

The edible roots used during the hard time were more difficult to process. I did not observe the techniques used to process either species but Bye Bye told me that before C. notabilis could be eaten they had to "cook him, throw him in the fire, clean him, rub him, cook him again and then eat him". Peile (1980:60) describes that Clerodendrum floribundum was also roasted in a fire and then the "cooked endoderm is peeled off and the cooked phloem is eaten, but not the pith".

Ipomoea tubers yielded the highest returns of all the edible roots collected by the Aborigines. The young shallow tubers were the easiest of these to collect. Often the Aborigines could collect up to a dozen tubers from one root. The larger tubers growing on the older roots were more difficult to gather and the Aborigines often had to dig up to 1m below the surface to get them. The people I worked with were only interested in gathering Ipomoea tubers in the north of the study area and on the 24 occasions I recorded the total quantities gathered the amounts varied from as low as 250g an hour to over 4,700g an hour (Table 4.10). The average gathering rate in this region was 1,254g an hour and, using the calorific value of cooked Ipomoea tubers (135 kcals per 100g;Table 4.1). gave an average calorific return of 1,690 kcals an hour. The best figure we recorded was 6,345kcals an hour. This is the same as the estimate given by O'Connell et al. (1983:85).

TABLE 4.9 Collection times and calorific returns recorded for Cyperus rotondus

Collector	Weight (gm)	Total kcal	Time* (min)	k cal/hr
Budja Budja	950	2631	240	657
Nyami	1500	4155	240	1039

* does not include travel

TABLE 4.10 Collection times and calorific returns recorded for Ipomoea Tubers

Collector	Weight (gm)	Total kcal	Time+ (min)	k cal/hr
Jimi, Nyami	2000	2700	65	2492
Jimi	4700	6345	60	6345
Bye Bye	2500	3375	180	1125
Budja Budja	2100	2835	180	945
Jimi	2500	3375	100	2025
Mick	890	1201	100	720
Bye Bye	7500	10125	360	1688
Nyami	4000	5400	360	960
Budja Budja	7400	9990	360	1665
Bye Bye's mother	5500	7425	360	1237
Bye Bye	6700	9045	360	1507
Nyami	3700	4995	360	832
Budja Budja	5000	6750	360	1125
Nyami	4600	6210	360	1035
Bye Bye	1500	2025	360	337
Budja Budja	7800	10530	360	1755
Bye Bye's mother	3000	4050	360	675
Jimi	800	1080	95	682
Jimi	2500	3375	38	5328
Bye Bye and Sunfly	13000	17550	240	4387
Bye Bye	1000	1350	60	1350
Nyami	2600	3510	135	1560
Bye Bye	3800	5130	135	2280
Nyami	2300	3105	100	1863
Nyami and Budja Budja	885	1195	230	312*

+ Does not include travel
* Tubers collected near Stansmore Range

The women only bothered to collect tubers once near the Stansmore Range where the tubers were considered to be "rubbish". On this occasion two women only collected 884g of tubers in 3.8 hours. This converts to a handling rate of 151g per hour per woman and gives a return of only 150 kcals per hour per woman. This illustrates why the Aborigines thought Ipomoea tubers from this region were "rubbish ones".

These tubers were rarely eaten until cooked. Raw tubers contain relatively high amounts of water (see Table 4.1) but were very hard to digest unless they were cooked. Because of this the Aborigines could not survive on Ipomoea tubers in waterless country (cf. Sweeney 1947:268).

Before tubers were eaten they were grilled for a few minutes on top of hot coals and then baked in shallow earth ovens for about 20 minutes. When cooked the tubers were eaten by hand without the aid of wooden or stone scoops as done in Central Australia (O'Connell 1974).

Vigna tubers grew within 20cm of the ground surface and were very easy to collect (Plate 4.6a). The tubers were simply exposed with a digging stick and broken off the root. Often women collected tubers along the full length of a root in which case they dug shallow trenches several metres along the surface of the ground. Trenches like these dug by the original inhabitants in the study area can still be seen at Nabulabanda (10) and Gawayurra (29). When sufficient quantities of tubers had been collected they were taken back to camp and were baked by the handfuls for 5-10 minutes.

Plate 4.6a

Vigna tubers exposed.

Plate 4.6b

A collection of Vigna tubers after one hours work (the tubers are being wrapped in an impromptu "basket" made from Ipomoea muelleri).





During the 1981 field season we harvested Vigna tubers extensively around Naligudjarra (5). Plate 4.6b gives a fair idea of the quantity collected by one woman in an hour. During 1982 we harvested them at the same location but out of season (in July) and later, in season (August-September) but at poor locations. On these occasions the average collection rate was only 367g (Table 4.11) an hour and the calorific return (based on Dadswell's estimate in Peterson 1978) was only 317.32 kcals an hour. This indicates how unprofitable the resource was out of season.

Dietary Importance

Without doubt edible roots were the most important and easily gathered food in the region. Ipomoea tubers were the most important of the five root crops and, as indicated in Chapter 3, the quality of the crop in the northern part of the study-area was sufficient to support a large ceremony in this area whenever rainfall was heavy enough to allow sufficient people to get to the region. Vigna tubers were also very important but could only be harvested for a short time between August and September. The edible bulb of Cyperus rotondus could be harvested all year but was only available in relatively small amounts throughout the area. The fibrous roots of Cassia notabilis and Clerodendrum floribundum were not very highly ranked by the Aborigines but were important drought foods and reliable supplements during prolonged dry periods.

TABLE 4.11 Collection times and calorific returns recorded for Vigna Lanceolata

Collector	Weight (gm)	Total kcal	Time* (min)	k cal/hr
Bye Bye	120	104	15	414
Budja Budja	570	497	120	248
Bye Bye	120	104	120	52
Budja Budja	260	224	120	112
Budja Budja	260	224	30	448

TABLE 4.12 Collection times and calorific returns recorded for Solanum chippendalei

Collector	Weight (gm)	Total kcal	Time* (min)	k cal/hr
Peter	450	907	30	1815
Nyami	2200	4436	30	8872
Sunfly	3600	4546	30	9092
Jimi	4400	8872	30	17744

TABLE 4.13 Collection times and calorific returns recorded for Witchetty grubs

Collector	Weight (gm)	Total kcal	Time* (min)	k/cal/hr
5 people	385	1001	10	6006
Nyami and Budja Budja	490	1274	60	1274
Bye Bye	470	1222	60	1222

*does not include travel

Edible Fruits

Distribution (Fig.4.4)

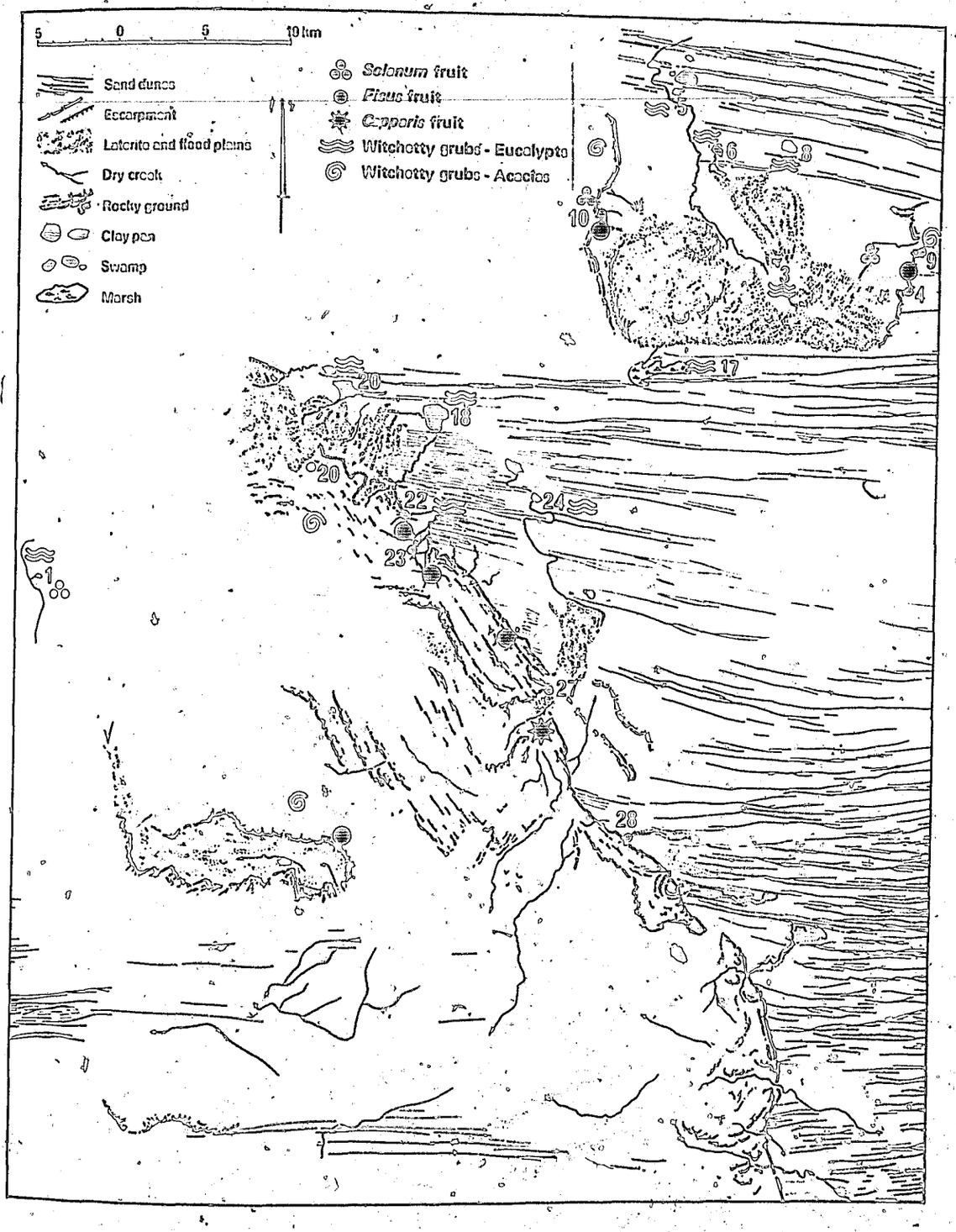
Edible fruits were collected from twelve plants in the study area. (Table 4.8b). The most important of these were the bush tomatoes (Solanum sp.). These were widely distributed throughout the region but different species were concentrated on the rocky ground west of Nabulabunda (10), adjacent Djulugan (1) and on the sandplain east of Nganawalbinyu (3). The bush plum (Santalum lanceolatum) was found consistently on deep sand and adjacent water bodies and was noticeably abundant near Ngawagudjarra (42). The wild fig (Ficus platypoda) was found distributed in the hills. Two wild species of orange (Capparis lasiantha, C. loranthifolia) and a wild cucumber (Mukia sp.) were located on the small flood plains amongst the hills south of Wilbarinyu (27).

Seasonal Availability

Solanum plants produced great quantities of fruit. These ripened gradually over a long period of time and could be harvested consistently between June and August. Several of these species were stored (see below) and this extended the season over which these fruits were available into the hot season (December). Ficus fruits and wild cucumbers (Mukia sp.) both ripened quickly and were only available for a short period at the end of the cold season. Capparis fruits ripened around December and provided a limited supply of food in the early part of the wet season.

Figure 4.4

Distribution of edible fruits and insects.


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
Solanum fruit
Ficus fruit
Capparis fruit
Witchetty grubs - Eucalypts
Witchetty grubs - Acacias
1
2
3
4
6
8
9
10
17
18
20
20
22
23
24
27
28

Processing Techniques

With the exception of two species of bush tomato (S. diversiflorum, S. chippendalei) all the fruits could be picked and eaten directly. They were usually consumed when people were away foraging. Two species of Solanum could not be eaten until the astringent liquid and black seeds were cleaned from the inside of the fruit. This was done by biting or twisting the fruit open, shaking out the inedible black seeds and cleaning the internal flesh by rubbing it with sand. Solanums were very easy to gather and were either collected in wooden dishes or skewered onto a length of Sida virgata (Plate 4.7).

The Aborigines stored two species of bush tomato (S. chippendalei and S. diversiflorum) and informed me that these could be kept for several years if necessary (see also Thomson 1975; Gould 1969, 1980; Peterson 1977). When these species were stored they had to be carefully cleaned and cooked. This was done by turning them continuously in hot ashes so they did not burn. When cooked the flesh was removed from the fire and winnowed free of sand and foreign matter. The cooked flesh was then mashed with water and rolled into a ball, covered with grass and wound up with twine. Sometimes the Aborigines mixed cooked Ipomoea tubers with the cooked fruit as well. These balls of food were either kept for consumption during the hot time, or given to young men when they went into ritual isolation or were traded with visiting people for meat.

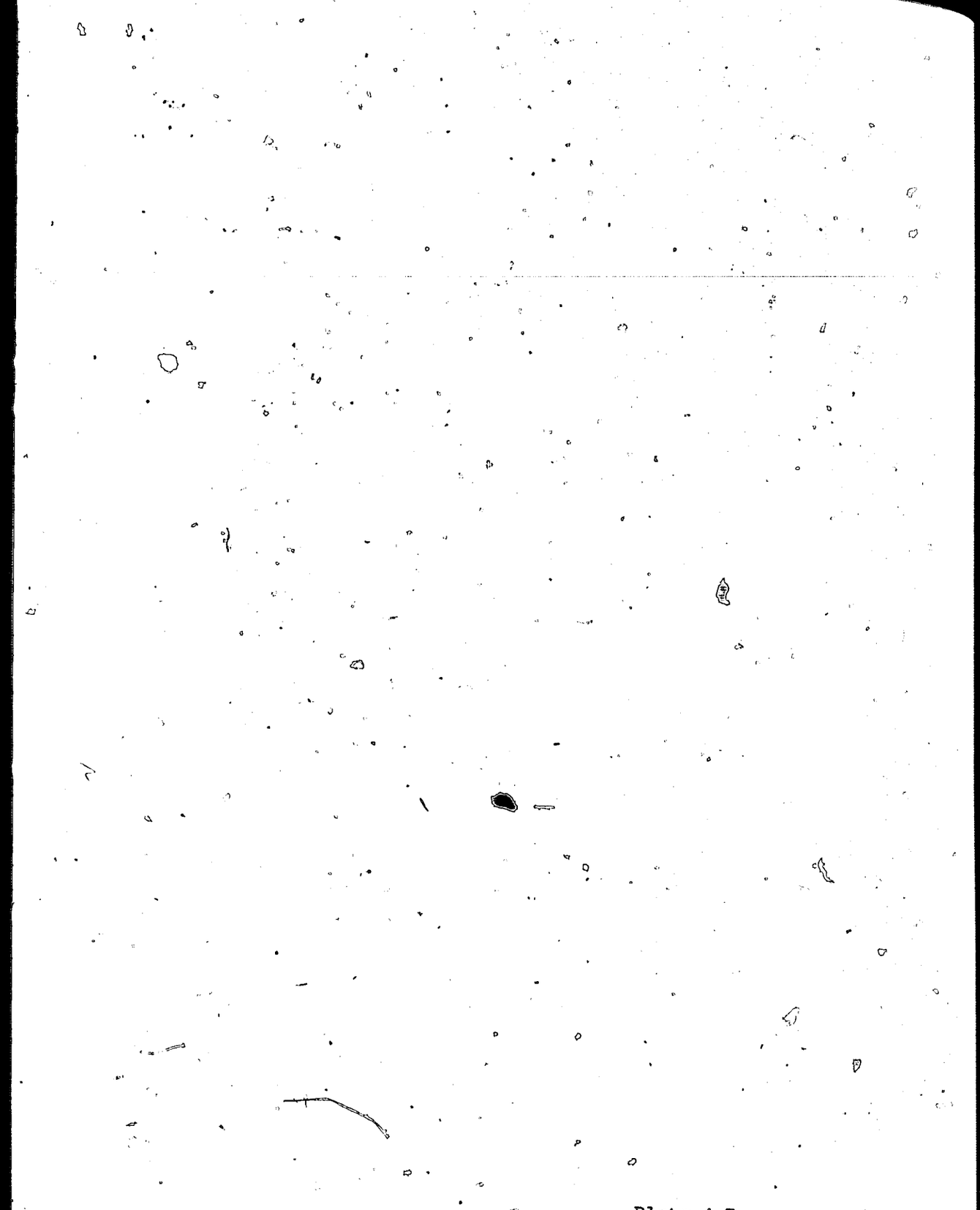


Plate 4.7

Bye Bye carrying a skewer of Solanum fruits.



Dietary Importance

Except for the Solanum fruits, the fruits eaten in the study area were treated as luxury items, additional to the daily fare and were generally consumed as people travelled across the landscape. Gould (1969, 1980) records that Ficus fruits were a desert staple but their ripening period was so short this is unlikely. The solanums made a more substantial contribution to the diet and, with the exception of S. centrale, were consumed in great quantities when they were available. S. centrale was said to produce very bad headaches if eaten too much.

Solanum fruits were very easy to collect. For example, on one occasion we collected S. chippendalei from an unharvested crop of shrubs outside the study area at an average rate of 5,325g an hour. This gave a calorific return of 9,380 kcals an hour - or enough to feed four people for a day (Table 4.12). This return is in the same order as that recorded for S. centrale by O'Connell et al. (1983) among the Alyawarra in Central Australia and Gould (1969:262) in the southern portion of the Western Desert.

Nectars and Edible Gums

A variety of nectars and edible gums were consumed in the study area (see Table 4.8c). The most important of these was the nectar of Grevillea aff. eriostachya, Hakea macrocarpa, H. suberea and the sap of Acacia acradenia. These species are commonly found on the sandplains and produce edible substances between July and September. These sweet foods were a luxurious addition to the diet.

Insects(Fig.4.4)

Six plant species were hosts for a variety of edible insects (Table 4.14). The most important of these was the witchetty grub (Cossidae sp. see Tindale 1953) and these could be found in great quantities in coolibah trees (Eucalyptus microtheca) at Djulugan (1), Balgo Balgo (17), and swamps near Guralba (8) and Dalabanda (18). Witchetty grubs could be located in these trees by a red spot on the white bark of the tree and were removed by simply opening the bark with an axe or rock and pulling the grub out with a hooked twig (yanggu) or in the fingers. They were eaten raw or roasted quickly on hot coals. Witchetty grubs gathered from the trunks of trees were easy to collect. We collected them at a rate of about 30-40 grubs (400g) an hour; giving an average calorific return of about 1,000 kcals per hour (Table 4.13) see also O'Connell et al. 1983; Tindale 1953).

Other species of grubs could be collected from the roots of Acacia hilliana, Cassia venusta and Templetonia incana. A. hilliana was an important source for grubs and was found in abundance on the interface between rocky ground and the sandplains, particularly on the escarpment near Yungubalibanda (9). Grubs from A. hilliana were obtained by simply uprooting small trees and retrieving the grubs from the roots. The other plants were found on the sandplain but were fairly restricted in their distribution.

TABLE 4.14 Edible parasites

Scientific name	Aboriginal name	Habitat	Relative importance	Parasite; location
Acacia hilliana	Bundaldji	Rocky ground	moderate	grub - root
Cassia venusta	Galbirr Galbirr	Rare: sandplains adjacent hills	minor	grub - root
Eucalyptus aspera	Gilgilba	Sandplains	major	grub - trunk and branches
Eucalyptus microtheca	Dindjil	Adjacent water	major	grub - trunk and branches
Eucalyptus aff. terminalis	Gundubung	Sides of dunes	moderate	Wasp larvae - galls on branches
Templetonia incana	Ngadjeri	Sandplains	minor	grub - root

Another insect food frequently sought were the wasp parasite and lavae inhabiting the coccid galls on the desert bloodwood (Eucalyptus aff. terminalis). These trees only grew on flanks of sand-dunes and the galls were only collected during the cold season while still hosting the parasite (Sweeney 1947; Peile 1980).

Wooden Implements (Table 4.15)

Two of the most important plants used to make wooden implements in the region were two wattles; mulga (Acacia anuera) and A. pachycarpa. Both species grow on laterite plains and flood plains in the region although the distribution of mulga was quite restricted. (Fig.4.5). Good quality stands of mulga are even rarer and the Aborigines claimed the only good trees were around the waterholes at Djarrga Djarrga (2) and south of Nganawalbinyu (3). I was told of another good stand on the south eastern side of the Stansmore Range, near Diedi (25) but did not visit this location. Mulga was used to make large ceremonial boards, parrying shields, spear throwers, women's clubs, boomerangs and punishment spears. A. pachycarpa was abundant on the flood plain between Nganawalbinyu (3) and Ngandalarra (6) and a large, important stand exists north of Balgo Balgo (17). A. pachycarpa was primarily used to make boomerangs.

Seven plants growing on the sandplains were used to make wooden implements. Two species of acacia (A. coriacea and A. pruinocarpa) were quite commonly used to make boomerangs. The straight saplings of A. adsurgens were used to make digging sticks, clubs and occasionally hunting spears although the best woods for spear making were Acacia

TABLE 4.15 Major plants used for wooden implements

Scientific name	Aboriginal name	Habitat	Relative importance	Use
Acacia adsurgens	Ngardja	Sandplains	minor	spears, fighting sticks, digging sticks
Acacia aneura	Mandja	Laterite plains	major	spearthrowers, fighting sticks, shields, punishment spears, ceremonial boards
Acacia coriacea	Gundandru	Sandplains	major	boomerangs & punishment spears
Acacia cowleana	Garna garna	Sandplains	moderate	hunting spears
Acacia dictyophleba	Gulada	Sandplains	major	hunting spears
Acacia pachycarpa	Badieri	Flood plains	major	boomerangs
Acacia pruinocarpa	Mandila	Sandplains	minor	boomerangs
Acacia rhodophloia	Djarrgadjiri	Rocky ground	moderate	hooked boomerangs
Erythrina vespertilio	Gumbubanu	Creek lines	major	shields, dishes, fire sticks
Eucalyptus aspera	Gilgilba	Sand plains	moderate	hard wood and bark dishes
Eucalyptus microtheca	Dindjil	Near water	moderate	hard wood and bark dishes
Eucalyptus terminalis	Waldji	Sand-dunes	moderate	hard wood dishes
Triodia pungens	Djinalba	Sandplains	major	resign

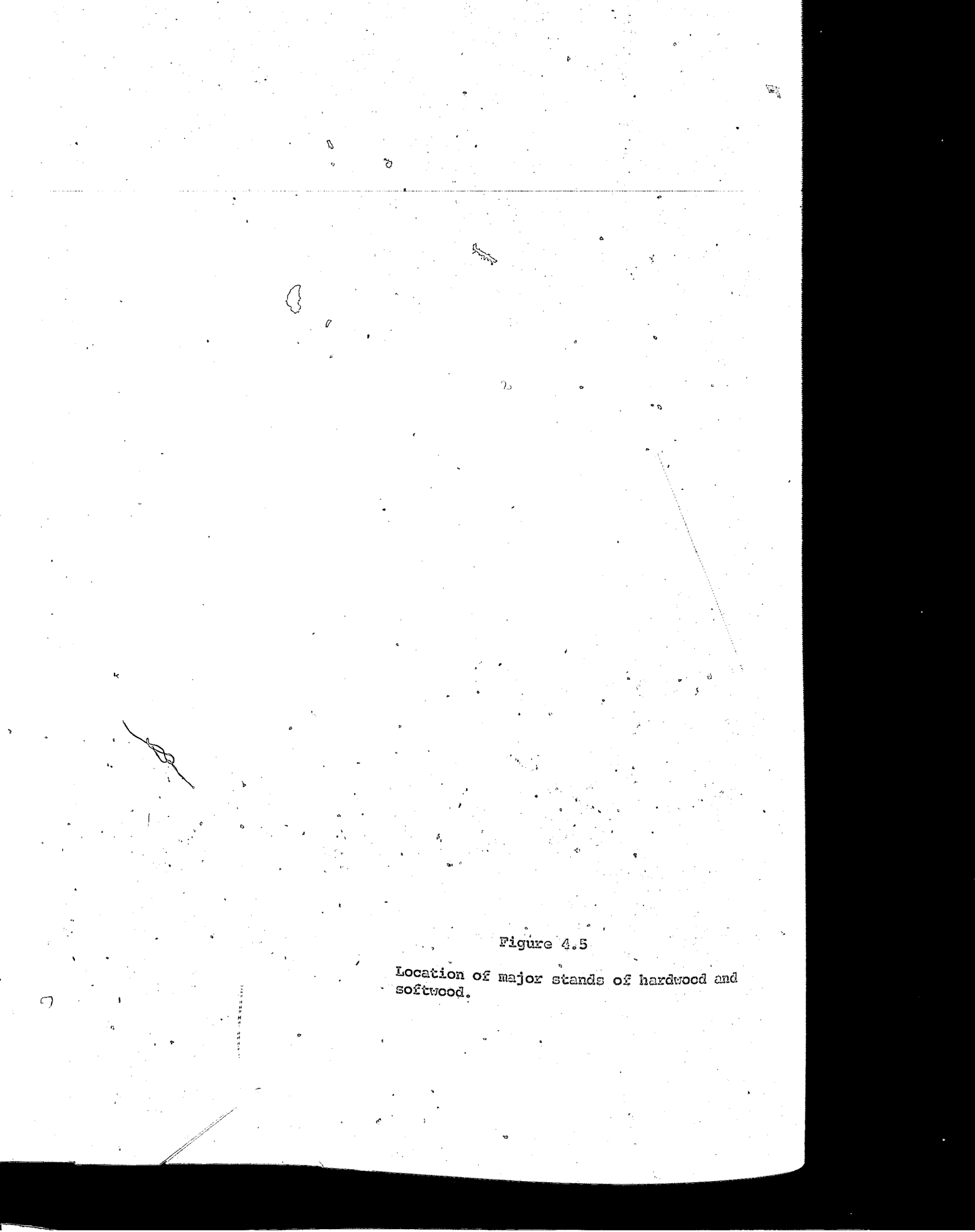
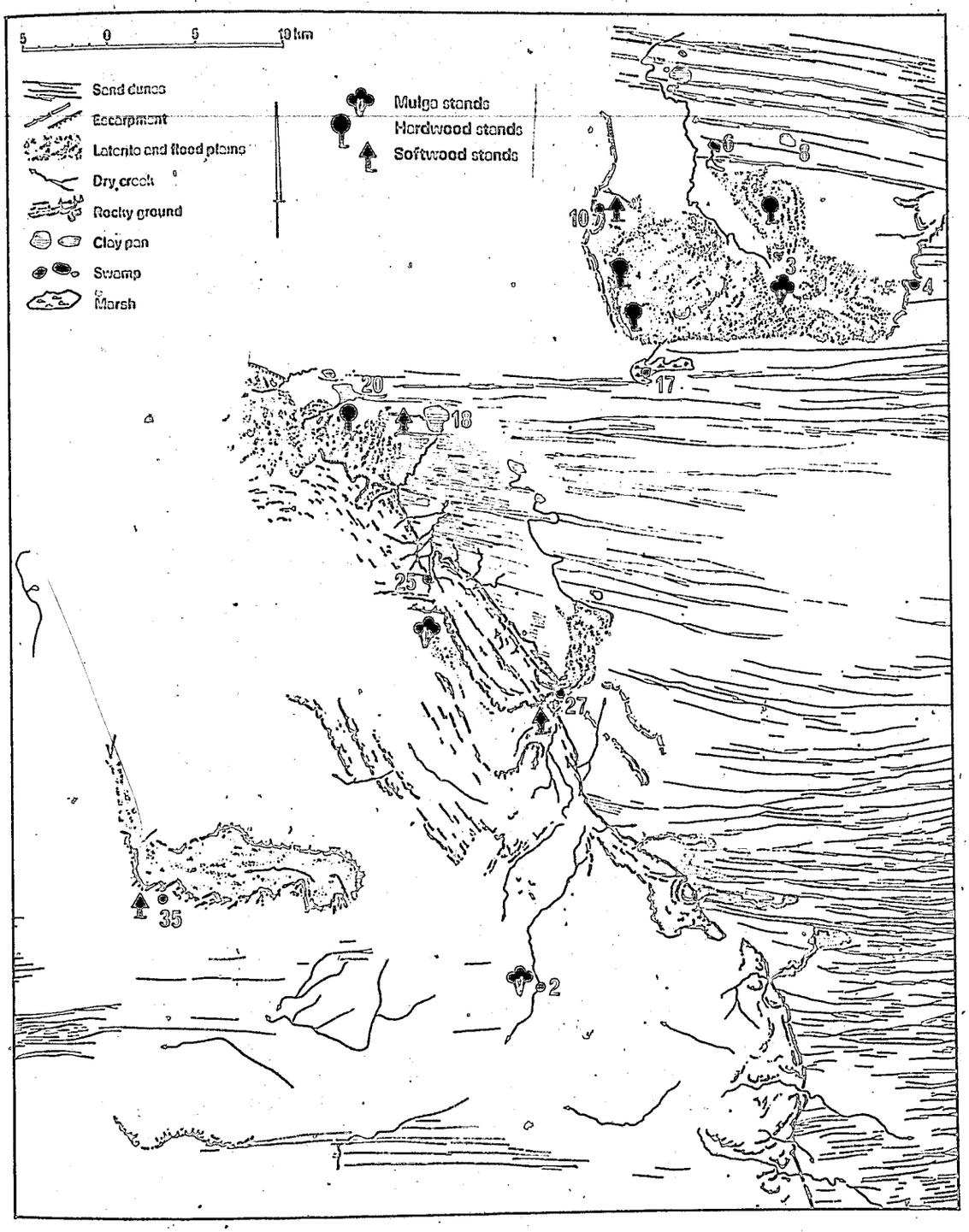


Figure 4.5

Location of major stands of hardwood and softwood.


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
Mulga stands
Hardwood stands
Softwood stands
6
8
10
3
4
17
20
18
25
27
35
2

cowleana and A. dictyophleba. A. cowleana was found in two stands 2km west of Djarrga Djarrga (2) and 5km east of Nawagudjarra (42). This wood was not as resilient as A. dictyophleba and was only used when the latter was not available. A. dictyophleba was highly prized but was only found near Forebank Hills, 140km west of the study area and near Lake Nevern, 60km west of the study area. People used to travel to these areas during the wet season to obtain the wood (see Gould 1970 also).

Eucalypts were also used to make wooden artefacts. Hardwood digging bowls were made from the bloodwood (E. terminalis) and coolibah (E. microtheca). Bark dishes were made from the smooth white bark of E. aspera and E. microtheca.

One of the most important woods in the region was the bean tree (Erythrina vespertilio). This was a light, tough softwood and was used to make the women's large winnowing dishes and men's shields. Bean trees were found in greatest abundance at Nydbigarri (35) and along the numerous small creeks running into Dalabanda (18). There were also two very large trees overhanging the soak at Nabulabanda (10) (Fig.4.5).

The only specie found on the hills used for making implements was a wattle (A. rhodophloia). This was used to make hooked fighting boomerangs.

Miscellaneous Items

Apart from obtaining food and wooden implements from plants found in the study area the Aborigines used various plants for other miscellaneous purposes. These included ceremonial decorations, twines, baskets, water filters, children's spears, head pads, shoes, adhesives, medicines and ashes for mixing with tobacco. A brief description of these is provided in Tables 4.16 to 4.20.

ANIMALS

Within the literature there is only a limited amount of information available on the animal foods eaten by Aboriginal people in the Western Desert (Gould 1969, 1980; Tonkinson 1978; Meggitt 1962; Lawrence 1969; Long 1971).

Throughout this project it has been difficult to assess the wildlife resources likely to have existed in pre-contact times because the marsupial fauna is largely nocturnal and has changed somewhat during the last 50 years (Frith 1978). The most important influences on the local fauna appear to have been the introduction of cats and the decrease in fire frequency. Bolton and Latz (1978) suggest that the decreased fire frequency in the desert since the Aborigines left the region has destroyed the habitats and populations of some of the small marsupials. Feral cats also appear to have been responsible for the decrease in the population of small marsupials and are recorded to prey on small birds and reptiles as well (Frith 1978:91). Carnegie (1898:214) recorded that feral cats were in the

TABLE 4.16 Plants used in decoration

Scientific name	Aboriginal name	Habitat	Relative importance	Use
Acacia ancistocarpa	Wadayurru	Sand plains	major	used by young men during ceremonies
Didymotheca tepperi	Nilbi nilbi	Sand plains	major	used by old men during ceremonies
Erythrina vespertilio	Gumbubanu	Creeks	major	seeds threaded on hair string. Also fertility beads
Eucalyptus ondontocarpa	Warilyu	Sand plains	moderate	seed capsules threaded on hair string with Erythrina beads
Euphorbia coghlarii	Yibi yibi	Sand plains	minor	white sap used as paint
Euphorbia wheeleri	Yibi yibi	Sand plains	minor	white sap used as paint
Macregoria racemigera	Gigl gigl	Sand plains near water	minor	placed in childrens hair
Mirbelia viminalis	Marrabii	Sand, laterite plains	major	lit during ceremonies
Mollugo molluginea	Madagurru	Rocky ground	major	flower heads coloured with pigment and stuck on with blood
Styloblasium sparthulatum	Nirdu	Sand plains	moderate	seeds and threaded on hair string

TABLE 4.17 Some plants with medicinal functions

Scientific name	Aboriginal name	Habitat	Relative importance	Use
Acacia ancistrocarpa	Wadayurru	Sandplains	major	leaves chewed and saliva rubbed in open wounds
Acacia pachycarpa	Badieri	Flood plains	moderate	Walwadjeri and Djaru people use as medicine
Carissa lanceolata	Managudji	Near water	moderate	leaves used as antiseptic
Cleome viscosa	Djilbirrngarning	Sand plains	moderate	twine - wound around aching part of body
Eucalyptus brevifolia	Manggaburru	Rocky ground	minor	juice from bark rubbed onto wound
Euphorbia coghlaniis	Yibi yibi	Sandplains	moderate	sap rubbed into skin to stimulate lactation
Halogaris aspera	Bandingunmaunma	Flood plains	major	smoke inhaled for cold
Ipomoea costata	Garndi	Sandplains	minor	twine wound around aching part of body
Sacrostemma australe	Ngarmalu	Rocky ground	moderate	sap rubbed into skin to stimulate lactation
Streptoglossa bubakii	Manyanii	Laterite plains	moderate	smoke inhaled against colds
Streptoglossa macrocephala	Ngunungunu	Laterite plains	moderate	smoke inhaled against colds
Tribulopis angustifolia	Yibi yibi	Sandplain	moderate	sap rubbed into skin to stimulate lactation

TABLE 4.18 Plants used as tobacco or ash mixed with tobacco

Scientific name	Aboriginal name	Habitat	Relative importance	Use
Acacia cuthbertsonii	Wilbiiya	Laterite plains	minor	dry twigs burnt for ash
Acacia ligulata	Wadarrga	Sandplain	minor	dry twigs burnt for ash
Acacia pruinocarpa	Djawi	Sandplains	minor	dry twigs burnt for ash
Eucalyptus camaldulensis	Yabulin	Creeks	minor	bark burnt for ash
Eucalyptus microtheca	Dindjil	Waterholes	major	bark burnt for ash
Grevillea stenobotrya	Yanandi	Deep sand	major	leaves burnt for ash
Nicotiania benthamiana	Ngundju	Rock shelters	major	tobacco: leaves dried and mixed with saliva and ash
Templetonia incarna	Ngadjeri	Sandplains	minor	leaves used as tobacco

TABLE 4.19 Disposable articles used by Aborigines

Scientific name	Aboriginal name	Habitat	Relative importance	Economic use
Amphigogon caricinus	Bimbiri (grass)	Sandplain	moderate	head pad
Crotalaria cunninghamii	Nyalibi	Sand-dunes	major	sandals and twine
Gonocarpus eremophilus	Yulgurru yulgurru	Sandplains	minor	tuft used as basket
Ipomoea muelleri	Wandidjarra	Near water	minor	twine and basket
Rhyncharrhena linearis	Gulibi	Sandplains	moderate	twine
Sida cardiophylla	Yurrungudu	Sandplains	moderate	basket
Sida virgata	Dadji dadji	Sandplain	moderate	skewer for solanum fruits
Stackhousia intermedia	Bimbirri (grass)	Sandplains	moderate	head pad
Tinospora similacina	Waragi	Sandplains	moderate	twine

TABLE 4.20 Plants with miscellaneous values

Scientific name	Aboriginal name	Habitat	Relative importance	Economic use
Acacia acradenia	Wilbut	Sandplains	minor	sap eaten
Acacia cuthbertsonii	Wilbiiya	Laterite plains	minor	shade for kangaroos
Acacia holosericea	Gilgidi	Near water	minor	bark for sandals
Acacia pruinocarpa	Djawil	Gravelly sand	minor	sap eaten and shade
Aeschynomene indica	Manabulgu	Near water	moderate	childrens spears and spear throwers
Calytrix longiflora	Bugarra	Sandplains	minor	bush tea
Cassia venusta	Galbirr galbirr	Laterite, sandy	minor	Emus eat seed
Carissa lanceolata	Managudji	Swamp margin	minor	insect repellant
Chenopodium auricomum	Yiliyili	Swamp floors	minor	sign of water
Eremophila maculata	Darrdjanpa	Sandplains	minor	Emu food
Eriachne mucronata	Birilba	Rocky ground	moderate	water filter
Eriachne flaccida	Galuburrudju	Claypans	moderate	water filter
Eucalyptus species		Various	moderate	branches and leaves used like plates
Grevillea wickhamii	Yidingga	Sandplains	minor	Reptiles eat seed
Petalostylis cassioides	Djangulari	Sandplains	moderate	bush tea, water
Rhagodia spinescens ?	Murrlu murrlu	Swamps	minor	sign of water
Sida virgata	Dadji dadji	Sandplain	moderate	childrens spears
Triodia longiceps	Lanu lanu	Rocky ground	minor	sweet excretion from leaves

desert before the turn of the century. They were certainly part of the subsistence base of the people I worked with before they left the region. Rabbits, cattle and camels are rare in the study area and seem to have had little influence on the local environment.

Mammals.

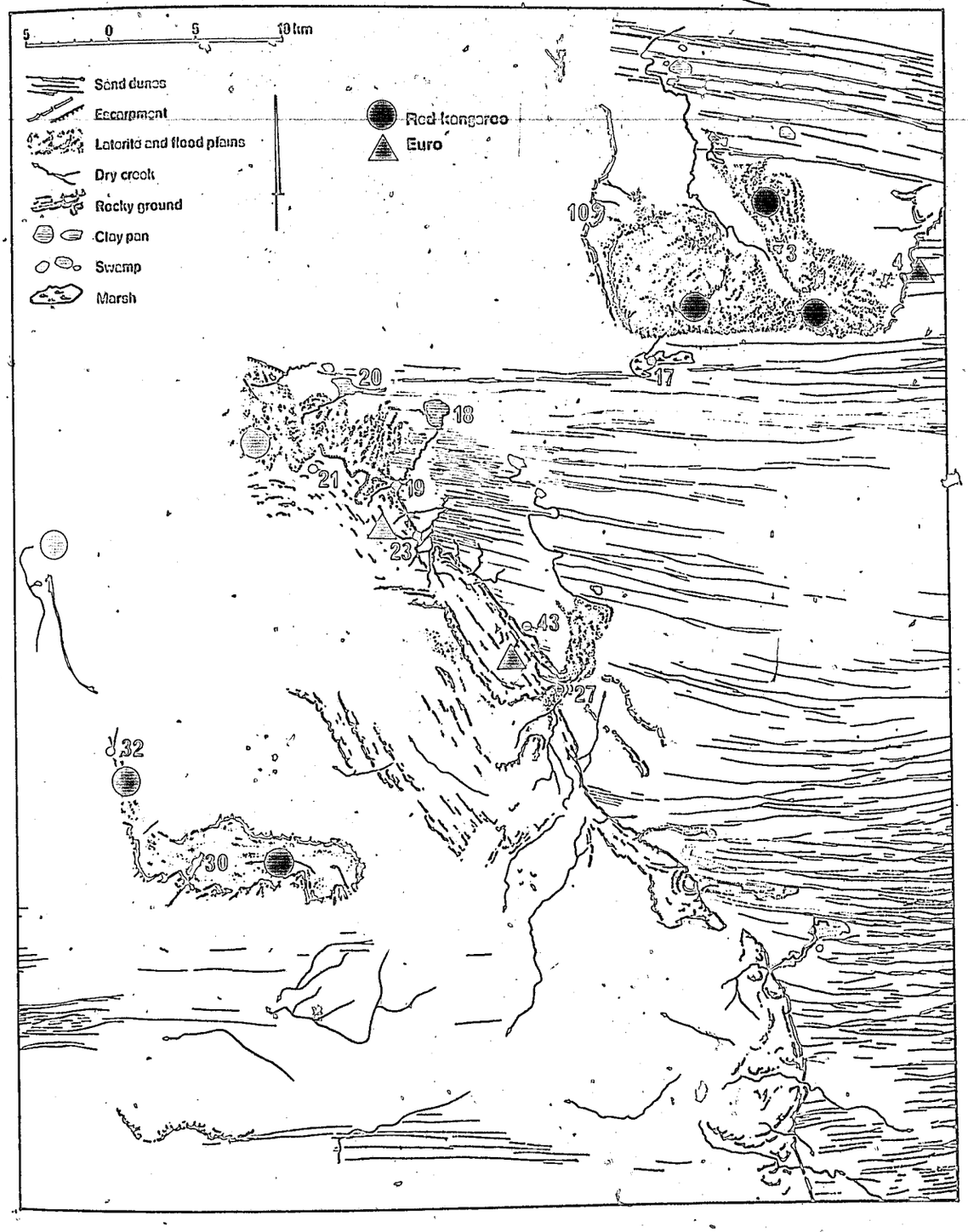
Distribution (Fig. 4.6)

Large mammals are relatively scarce and restricted in their distribution in the study area. The red kangaroo (Megaleia rufa) can be found on the laterite plains south of Nganawalbinyu (3), west of Barrawalawala (21) and between Gundjimarra (30) and Lambanlamban (32). During the dry season they tend to spread widely over the country after winter rains and moved back to these locations as surface water contracted. The Aborigines felt the study area was good kangaroo country and said there were in fact "too many kangaroos". This seems to have been a fairly relative observation because as far as I could ascertain the combined population must have been less than 40 individuals. The population of euros (Macropus robustus) in the region was equally small. These macropods lived in the hills and were most common between Wilbarinyu (27) and Djulyurrlyurru (19) and Yunggubalibanda (9) and Diringberi (11).

Wallabies, bandicoots, rats, mice and dasyurids used to live on the sandplains but their numbers have decreased considerably in the recent past. The Aborigines say a number of species are "finished" in the region and we only recorded five burrows of the rabbit eared bandicoot (Macrotis lagatis) (Bolton and Latz 1978;

Figure 4.6

Distribution of large game.


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
Red kangaroo
Euro
10
3
4
17
20
18
21
19
23
43
27
32
30

Gould 1969). Carnegie (1898) makes frequent references to the collection of bandicoots by Aborigines before the turn of the century. The Aborigines said the population of echidnas (Tachyglossus aculeatus) living in the hills had also reduced but that the dingo population was about the same.

Hunting Techniques

Large game were hunted by men. The hunting spears used were only accurate up to a distance of about 20 m (Horne and Aiston 1924:79; Love 1936:81) and as a result the men used to stalk the animals very carefully from down wind. Often they covered themselves with a disguise of spinifex and branches. Sometimes the men used to work in groups and use fire to drive the animals into the range of other hunters lying in wait. The men used to spear the animals at about thigh level hoping to prevent the animal hopping away when hit.

When first killed they were gutted, and returned to camp for cooking. When cooked the hind legs were dislocated at the hip, the tail removed and all the fur burnt off. Hot coals were placed in a deep earth oven and the animal was laid on top of these and covered with the remaining coals and hot sand. The tail was cooked separately and the stomach, intestinal fat, liver and kidneys were grilled on top of the coals. If the people were not too hungry the animal was left to cook for several hours. Otherwise it was eaten partially raw. Blood which spilled into the intestinal cavity was often drained and drunk as well.

Bandicoots were rather more difficult to get and required a lot of digging to remove the animals from their deep underground nests. Carnegie (1898:242) records that when caught the fur was plucked off and they were grilled on the coals of a fire.

Dietary Importance

Carnegie's (1898) numerous reference to the Aborigines consuming bandicoots suggests these were probably the most important marsupials in the traditional diet. The Aborigines valued kangaroo meat but probably did not manage to kill them so often. We only managed to shoot eight in the 10 months we hunted in the study area. Even with a vehicle and .22 rifle, many hunts were unsuccessful. Large marsupials were probably more important in the overall diet between August and December when populations contracted around available waterholes and the heat caused them to rest more often during the day.

Reptiles

Distribution

Lizards are apparently a major source of food for feral cats (Frith 1978:91) but despite this Aborigines claim they are more abundant today than in the past. The major species hunted included the centralian blue tongue (Tiliqua multifasciata), the great desert skink (Egernia kintorei), and two monitors (Varanus gouldii and V. acanthurus) but there were many small dragon lizards (Amphibolurus sp.) caught and eaten by children. The Aborgines seemed to regard geckos (Diplodactylus sp.) with distaste. The larger lizards were

found widely on the sandplains and dunes although E. kintorei the great desert skink was confined to the general vicinity of Djarrga Djarrga (2). Diriberigudjarra (20) was also said to be a good area for blue tongue lizards. The ridge tailed monitor (V. acanthurus) was also found in rocky crevices in the hills as well as on the plains together with another black monitor, V. gilleni.

Snakes are not common in this rart of the desert and the most commonly caught were pythons (Aspidites melanocephalus, Aspidites ramsayi). Only one species of edible toad (Notaden nichollsi) was collected in the region. This was confined to the sand dunes and evidence of old pits dug in search of these frogs was seen at Djulyurrulyurru (19) and Naligudjarra (42).

Seasonal Availability

Lizards and snakes were available all year round but hibernated during the winter. The centralian blue tongue and ridge tailed monitor were the first to leave their nests as the weather got warmer and heralded the start of the "goanna get up time" (September-October). The desert spade foot toad (Notaden nichollsi) was most commonly gathered when it left the ground to breed during the wet season. It was also collected after winter drizzle when it came to the surface to feed and advertized its location on the surface of the sand.

Collection and Consumption

Both men and women gathered reptiles. Once the tunnel of an animal was found its nest was located by beating the ground with the

TABLE 4.21 Collection times and calorific returns recorded for lizards

Collector	Species*	No.	Weight (gm)	Total** kcal	Collection*** time (mins)	kcal/hr
Jimi	Va,Ug, Tm,Eg	8	3330	9524	150	3819
Arthur	Va	4	800	2288	150	915
Bye Bye, Sunfly	Tm	3	1110	3175	90	2116
Bye Bye, Sunfly	Vg	3	1550	4433	60	4433
Arthur	Vg	2	425	1216	210	347
Arthur	Vg	2	620	1773	150	709
Jimi	Vg	3	1400	4004	60	4004
Arthur	Vg	1	840	2402	20	7207
Arthur	Vg	3	1100	3146	60	3146
Bill	Vg	2	870	243	60	243
Arthur	Vg	3	1600	4575	240	1144
Bill	Vg	2	500	1430	260	330
Nyami, Budja Budja	Vg	4	2100	6006	150	2402
Nyami, Budja Budja	Vg	3	1500	4290	240	1073
Nyami	Vg	1	590	1687	53	1910
Three people	Va,Vg Tm,Eg	8	5090	14557	180	4852
Arthur	Vg	2	930	2660	240	665
Jambu	Va	1	120	343	180	114
Jimi	Va	3	750	2145	15	8580
Child	Va	1	150	429	80	322
Child	Tm	1	260	744	80	558
Bruce	Va	2	560	1602	45	2135
Nyami	Vg	1	455	1287	80	965
Jimi	Vg	3	2600	7436	80	5577
Nyami and Jimi	Va	13	3890	11125	135	4945
Nyami	Vg	2	770	2202	60	2202
Nyami	Va	6	1150	3289	60	3289
Jimi and 3 children	Vg	13	3500	10010	105	5720
Bruce	Vg	1	470	1344	100	807
Nyami	Va	1	280	800	75	640
Jimi, Nyami	Va	6	2100	6006	30	12012
Jimi, Nyami	Vg,Tm	5	2390	6835	90	4557
Jimi	Vg	5	2880	8237	480	1030
Nyami	Vg	1	460	1316	180	439
Mick	Vg	1	570	1630	300	326
Sunfly	Vg	1	830	2374	300	475
Bye Bye	Va	1	240	686	15	2746
Budja Budja	Va	4	815	2331	120	1165
Nyami	Vg	1	405	1158	120	579
Bye Bye	Va	3	820	2345	120	1173
Bye Bye	Tm	1	320	915	60	915
Nyami, Sunfly, Bye Bye	Vg,Va	10	7500	21450	60	21450
Budja Budja	Vg,Va	3	695	1988	60	1988
Budja Budja, Nyami	Vg	3	2500	7150	60	7150
Bye Bye	Vg	2	1600	4576	60	4576
Nyami	Va	1	185	529	30	1058
Jimi	Va	2	440	1258	30	2517
Bye Bye's mother	Vg	3	1600	4576	180	1525
Arthur's wife	Vg	4	1900	5434	180	1811
Bye Bye, Sunfly, Nyami	Vg,Va,Tm	5	7600	21736	150	8694
Bye Bye	Vg	1	630	1802	120	901
Jimi	Tm	2	460	1230	30	2460

*Varanus gouldii = Vg
Varanus acanthurus = Va
Tiliqua multifasciata = Tm
Egernia kintorei = Eg

**calorific value used is average of kcal/100g for V. gouldii and V. acanthurus (see Table 4.1)

***Collection time includes travel on foot

heel of one's foot or a digging stick. The animal was then dug out and bashed on the head. Both snakes and lizards were baked in shallow earth ovens. Before lizards were cooked the intestines were pulled out with sand through the anus or hooked through the side of the neck with a stick. When gutted they were grilled on hot coals until almost bursting and then baked for about 20 minutes. When the desert skink (E. kintorei) was cooked it was scaled with a stick before eating.

Lizards were relatively easy to collect and the average collection rate (including travel time) for the 167 lizards we collected in 1982 was 733g per hour (Table 4.21). This gave a return of approximately 2,100 kcals an hour based on the average calorific value of cooked specimens (Table 4.1).

Edible toads were dug from deep (1.5m) pits within sand-dunes. Often several nests of frogs were located in each hole yielding up to 1,000g of toads per collector per hour. Toads were killed by crushing the skull and were cooked on hot coals, skinned and eaten (see also Peile 1978:12).

Dietary Importance

Without question lizards were the main source of protein and fat for the Aborigines living in the study area. Lizards collected during hibernation were the most nutritious. They were also critically important during the last few weeks of the hot season before fresh rains fell. This is discussed further in the next chapter so it is sufficient to say here that if rains came unusually late lizards were virtually the only food the Aborigines had to survive on. At these

times life was quite difficult and often people would starve. The men said that under these conditions they used to leave camp before sunrise and return after dark in pursuit of food. They said they would try and collect about three goannas for their families.

The following calculation drawn from the data presented in Table 4.21 gives some idea of the quality of life at this time of year. The average weight of the goannas we collected was 456g. This converts to a calorific value of 1,304 kcals per goanna. Therefore three of these goannas only yields 3,912 kcals of energy. If the number of people in an average family was five people (as indicated in Chapter 3) then this daily ration is only enough to provide each person with 782 kcals of energy a day!

Birds

Both birds and their eggs formed an important part of the traditional diet. Emus (Dromaius novaehollandiae) and bustards (Eupodotis australis) were the most commonly sought species but emus were rather rare. For example during the 10 months I did field work for this project we only saw eight and did not manage to shoot any. Bustards were common and were easily hunted. We saw flocks of between 20 and 30 birds feeding on freshly burnt ground on three occasions and smaller flocks of between three and five birds were commonly seen on the flood plains.

TABLE 4.22 Economically important species of birds

Scientific name	Aboriginal name	Common name	Seasonal availability	Location	Importance
Anas superciliosa	Djribulu	Black duck	Feb-April	Swamps	moderate
Aquila audax	Walayurru	Wedgetail eagle	Year round	Hills	major
Eupodatis australis	Barrulga	Bustard	Year round	Burnt ground, floodplains	major
Artamus cinereus	Djargudjargu	Wood swallow	Aug-Sept	Rockholes	minor
Cacatua galerita	Giberry	Sulphur crested cockatoo	Year round	Waterholes	moderate
Corvus cecilae	Ganga	Crow	Year round	Camps	minor
Dromaius novaehollandiae	Galaya	Emu	Year round	Laterite plains	moderate
Eolophus roseicapilla	Gagalala	Galah	Year round	Rockholes	moderate
Fulica atra	Guludju	Coot	Feb-April	Swamps	minor
Geopelia cuneata	Gulugugu	Diamond dove	Aug-Dec	Rockholes	moderate
Lophoictinia isura	Bilibili	Square tailed kite	Year round	Camps	minor
Melopsittacus undulatus	Ngadidjeri	Budgerigar	Aug-Dec	Rockholes	moderate
Ocyphaps lophotes	Djaralabalgul	Crested pigeon	Aug-Dec	Waterholes	moderate
Podargus strigoides	Biwi	Tawny frogmouth	Year round	Plains	minor
Podiceps poliocephalus	Willagaradja	Hoary-headed grebe	Feb-April	Swamps	minor
Poephila guttata	Djirigi	Zebra finch	Aug-Dec	Rockholes	moderate

After large summer rains migratory birds visited the area. The most common of these was the black duck (Anas superciliosa) and these concentrated in the large marsh at Balgo Balgo (17). Later in the year thousands of desert birds used to crowd around the few large waterholes in the study area and were easily stoned and gathered by children. The economically important species of birds are documented in Table 4.22.

The larger birds were hunted, plucked and cooked in the same way as the larger marsupials. Smaller birds were usually stoned by children around waterholes, then skewered on sticks and grilled over coals. Birds' eggs were a common source of food. Emu eggs were the most commonly collected. Eggs were baked in camp fires.

Insects

Termites' larvae were collected from nests after they had been softened by summer rains. These were placed in a small round pit dug in the ground and covered with heated stones (gardang) and cooked. During the cold season small black ants common in the region stored their eggs in small, above ground, nests and returned them below ground later in the year (August) when the days began to warm up. The Aborigines said these ants made an unusual noise (nyin nyin) when the eggs had been moved and were ready for collection.

The eggs were collected by simply breaking the ants' nests open, spilling the contents onto a wooden dish and winnowing the ants out from the eggs. The eggs were then put into a handful of sweet bark

from either Acacia holosericea or A. tenuissima. This bark was first rubbed into a ball and the eggs were placed in this and were chewed up. This dainty morsel was passed from person to person and the bark was refilled when the eggs were eaten.

Termites' larvae were a relatively important supply of food during the wet season when food was scarce and ants' eggs were a reliable back up food during the first half of the cold season.

Summary

The data presented in this chapter is synthesized in Chapter 5 and only a brief summary need be given here.

The main foods utilized in this part of the Western Desert were seeds, wild fruits, tubers, reptiles, marsupials, birds and grubs. Ipomoea tubers and reptiles were the fundamental staples in the region. Other important food stuffs such as Vigna tubers, acacia seeds, Ficus fruits and large marsupials also made a substantial contribution to the diet but were usually restricted in their seasonal availability. Grass seeds were difficult to process and unless the major species were particularly abundant and in close proximity to camp sites they usually constituted a "bread and butter" kind of back stop to the subsistence system.

Apart from these major food stuffs the desert was rich in a variety of minor foods which were used to supplement the main fare and were often relied upon if the staples failed to ripen in

sufficient abundance. Such foods included the less abundant and/or poor quality fruits, tubers, insect eggs, nectars and so on. The relative importance of these resources is documented in respective Tables in this chapter.

Most of the food resources were spread fairly evenly throughout the region although Ipomoea tubers were more or less confined to the north of the study area. There were three distinct areas where grass seeds grew in abundance and with the exception of good stands of hardwood near Diedi (25) and Djarrga Djarrga (2) the best supplies of hardwood were confined to the north of the study area.

With regard to the seasonal availability of food it was apparent that the bulk of the important vegetable staples were available during the cold season. As the year moved on a greater variety of less substantial foods ripened and the Aboriginal diet was more diverse. Towards the end of the hot season the supply of food began to run out and during the wet season people had to forage widely to collect small quantities of different foods. The Aborigines made a conscious effort to cater for this "hard time" by storing Solanum fruits, eucalyptus and acacia seeds and reserving seeds from the Sytoblasium shrub.

Chapter 5

Seasonal Pattern, Subsistence and Camp Site Occupatic

In the preceding two chapters I have described the people that inhabited the study area and the biological resources they used. In this chapter I will examine the seasonal pattern of movement and subsistence practised at the various camp sites occupied in the region. The essential elements of this subsistence system form the basis for assessing the extent to which the archaeological debris in the region reflects the subsistence behaviour of the local inhabitants.

The information presented in this chapter was gathered by recording hours of conversation listening to numerous reminiscences, and visiting over 50 camp sites and other locations of mythological and topographic significance. The data is largely anecdotal; given by the people who used to live at and visit these sites in the past. Much of this data has been checked independently from other informants and supplemented with my own observations of the actual use of traditional resources at sites and the seasonal variation in the availability of these resources.

Information regarding traditional patterns of settlement and land use were given in many different situations but were most profusely and excitedly supplied the first night at new camps or when travelling to new places. On these occasions the excitement and anticipation of revisiting places that had not been seen for 30 years stimulated a flood of memories and stories. Revisiting actual camp sites seemed to stimulate an endless supply of funny, awesome, and tragic episodes in people's lives, but more importantly the re-occupatiion of old camping places prompted spontaneous descriptions of the local landscape, resources and subsistence activities which were important in the early days. These form the basis for the seasonal reconstruction of economic life presented in this chapter.

Most researchers working in the Western Desert have noted the flexibility and mobility characteristic of desert life (Long 1971; Thomson 1975; Myers 1976; Gould 1969; Tonkinson 1978) and this was certainly a characteristic of life in this region as well. Here the relative availability of food and water each year had an impact on the distances people travelled, the number of sites visited, the duration of camps and so on. This pattern was also complicated by idiosyncratic behaviour, such as an individuals desire to visit other family members in different parts of the desert, or to obtain certain raw materials such as flakable supplies of stone or wood for spears, or simply to forage in and visit new countryside. Nevertheless there was a system, motivated by the wet season rains which the local inhabitants generally responded to. It is the nature of this broader pattern which is addressed in this chapter.

Wet Time (warrgal) (Fig.5.1)

During the wet time (December to February) family groups moved away from the largest rockhole, to their estates in the west, south and north of the study area. Fresh rains usually came in huge thunderstorms which literally covered the landscape with water, leaving drinkable water on the floodplains, gentle depressions in the sandplains, numerous little rock pools in the hills as well as in all the major catchments. The relative abundance of water at this time of year meant that people could disperse widely across the landscape in search of fresh resources. At this time of the year, for example, men could travel great distances to get stone for making stone tools or to collect fine, resilient wood for making spears. Groups of people could congregate and travel great distances to attend ceremonies, but most importantly families could travel to and forge in areas that had not been foraged in since the previous wet season.

The wet season was not a particularly fertile time of year. No new supplies of food had yet began to grow and there were only limited supplies of edible fruits, seeds and tubers available left from the previous year. Herds of game also spread out across the landscape and were rarely encountered at that time of year. Bye Bye's old mother explained that the relative shortage of food at this time of year compared to the abundance of water meant that there were a "lot of places for walking and little bit living".

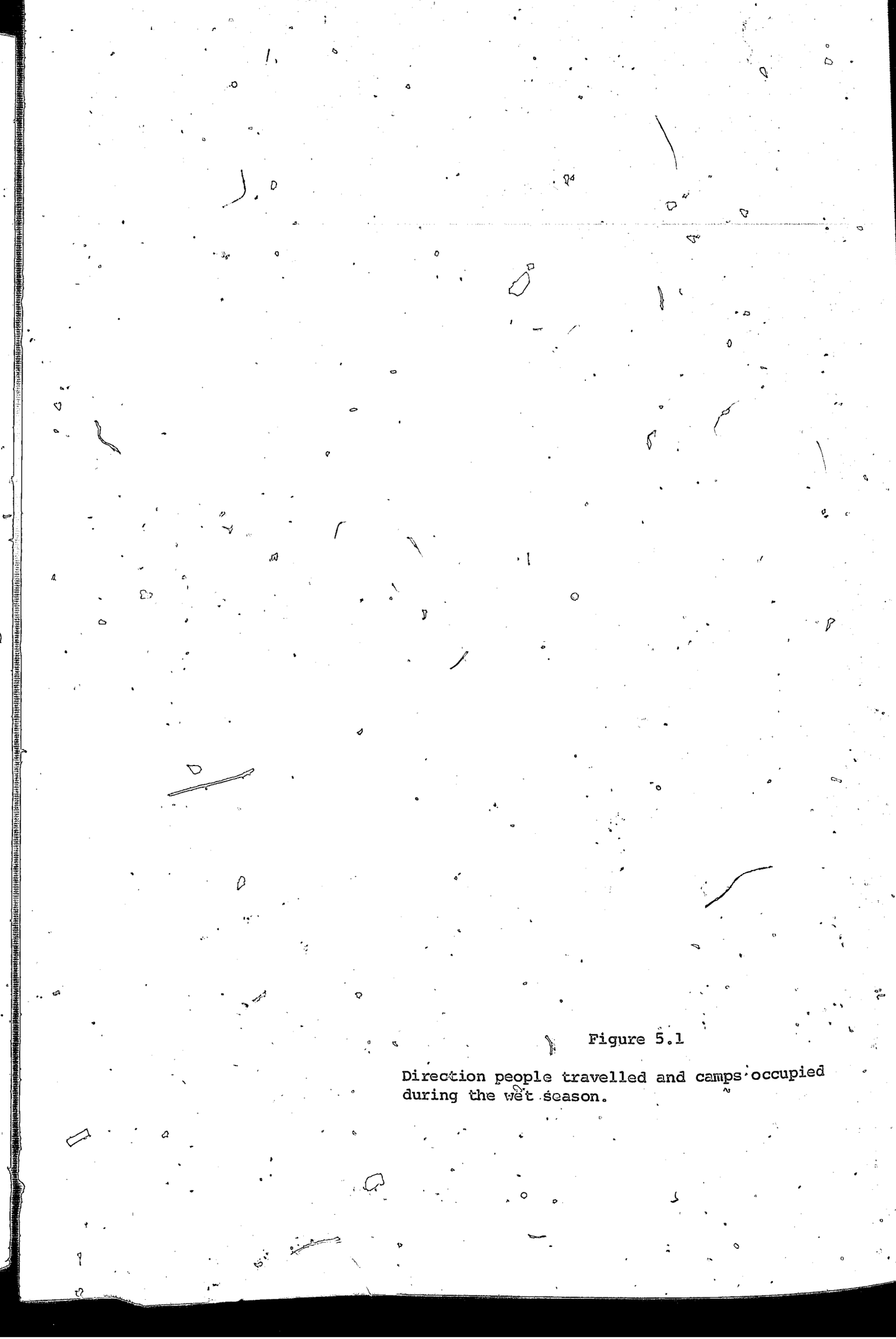
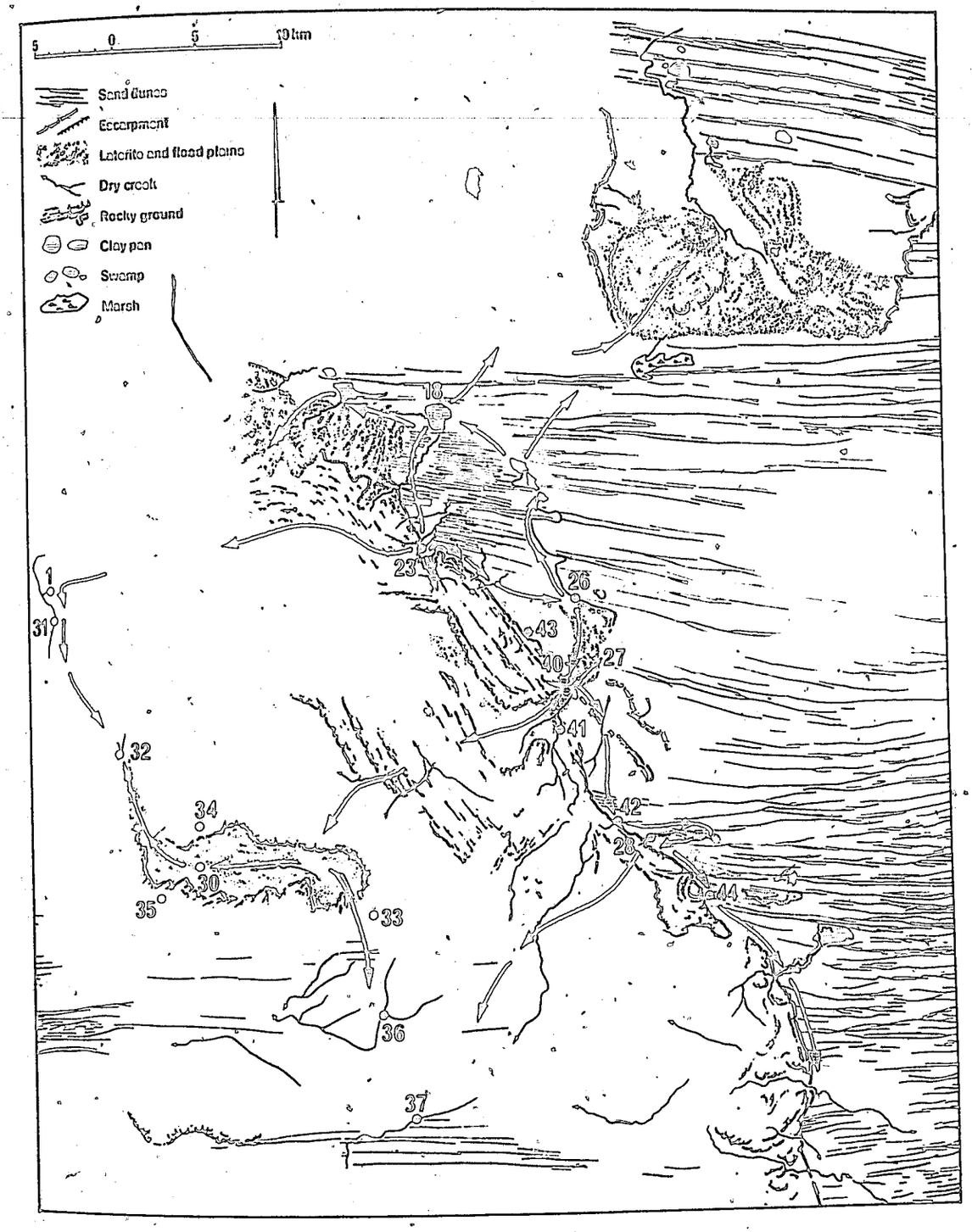


Figure 5.1

Direction people travelled and camps occupied during the wet season.


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
18
23
26
43
40
27
41
42
28
44
1
31
32
34
30
35
33
36
37

Before the onset of wet season rains the local inhabitants of the study area were usually camped at the largest waterhole in the region (Mindirr (23)) in the north of the Stansmore Range. When fresh rains fell the usual pattern of movement was for family groups to leave Mindirr (23) and travel back to their own country; either into the north or west of the study area. Bye Bye's family (Estate Two) often travelled south down the Stansmore Range to visit her mother's country outside the study area.



Western Plains

The western part of the study area was considered to be "rubbish country". It was owned by families belonging to Estates 4 and 5 and was usually only visited by them during the wet season although several good waterholes and good kangaroo country allowed people to use the region later in the year as well. The northernmost camping place on the plains was a large swamp called Djulugan (1) (Plate 5.1a). This held water until about February and was usually visited before then, although hunting parties also visited the area later in the year in search of kangaroos. The economic base during the wet season was fairly limited and people had to forage extensively to gather reptiles, witchetty grubs, termite larvae, Solanum fruits, spinifex seeds and the large seeds from Stylobasium shrubs the bulk of which had been left ungathered earlier in the year.

When Djulugan (1) dried up people moved south to Yurinubadu (31), a soak less than 2km to the south. This supplied sufficient water to support a small group of people until about May; and at that

Plate 5.1a

Djulugan (1) a wet season swamp.

Plate 5.1b

Nganawalbinyu (3) - a large, favourite waterhole.





time of year small quantities of Vigna tubers could also be gathered in the region.

Both sites were less than 10km north of an excellent source of white chalcedony near Lambanlamban (32). Lambanlamban (32) was a small soak on the northern end of a large flood plain on which some of the best herds of kangaroo grazed. This soak was relatively small and was only used in transit; when, for example hunting parties were in the area or when people were moving through the region.

South of Lambanlamban (32) were a cluster of camp sites on numerous small claypans called Gundjimarra (30). These claypans only provided a limited supply of water after the wet season and at that time of year there was only a limited supply of food available. Consequently there was not much economic activity at these sites during the wet season although they were occasionally occupied by people travelling via Gundjimarra (30) to get stone from the chalcedony quarry at Lambanlamban(32).

As far as food resources were concerned, the country near Gundjimarra (30) was best known for its kangaroos and supplies of Solanum fruits and an edible succulent (Tecticornia). These resources occasionally encouraged visits to the region later in the year and then people lived at a large waterhole called Nyidbigarri (35) nearby or at a soak called Djowa Djowa (33) (a sacred place for women) or at a small rockhole called Barawala (34) (Fig.5.1).

On the southern fringe of the study area are two creeks, Lamanbanda (36) and Marl (37). Both places only held a "little bit" of subsurface water for a few months after large rains, and people did not camp there much. An enormous quarry of white chalcedony is located adjacent to Marl (37) and people used to travel via these creeks to get stone from here.

Stansmore Range

People from Estates 1, 2 and 3 usually did not travel to the western plains during the wet season as this was "really Walmadjeri" country and was also occupied by people travelling south from the Stretch Range as well as the estate owners already mentioned. Instead these family groups either moved to the north of the study area via the waterholes in the vicinity of Dalabanda (18) to collect Ipomoea tubers missed the previous year, or south along the Stansmore Range via the cluster of small waterholes near Wilbarinyu (27).

When the Aborigines moved south down the Stansmore Range they could make stops at any of the small, unnamed creeks between Mindirr (23) and Kidjiwarra (43) or camp at the slightly larger waterholes near a large sacred mesa the Aborigines called Wilbarinyu (27). These waterholes included a billabong; Rundju Rundju (26), small rockhole; Managudjibanda (39), creek; Mabanbidi (40), a soak; Brinbin Brinbin (41) and at any of the small creeks at the base of Wilbarinyu (27). Brinbin Brinbin (41) was the most reliable water supply and was often visited when people were moving north along the Stansmore Range later in the year.

Further south there were three more camping places before leaving the area enclosed by the study area. The first encountered was a large soak called Ngawagudjarra (42). This held water until the "goanna get up time" (August, September) and was usually visited later in the year, although people made brief camps there during the wet season as well. Slightly further south was a deep creek called Birbayga (28). If people visited this camping place in the wet season they usually camped on the easternmost extremity of the creek and moved back up the creek to a rockhole in its headwaters as the supplies of subsurface water shrank. South of Birbayga (28) was a very ephemeral creek called Mirrilmirril (44) which only held water during the wet season.

The resources available to people in the central area of the Stansmore Range during the wet season were fairly scarce and the Aborigines had to forage widely to obtain small quantities of a variety of things. The principal items of the diet were Capparis fruits, unused acacia and grass seeds, small marsupials, feral cats, echidnas, lizards, snakes, toads, Cyperus bulbs, "rubbish" Ipomoea tubers, fibrous tubers from Cassia notabilis, termite larvae and witchetty grubs.

There was a large exposure of green silcrete at the base of Wilbarinyu (27) and another quarry of green silcrete in the hills west of Mirrilmirril (44). I was also told of a source of black ferecrete near Birbayga (28) but did not locate the exposure.

Green Grass and Cold Times (yugari and yaltaburru)(Fig.5.2)

As soon as the wet season rains fell plants began to grow again. After several months the spinifex changed from a straw yellow to a bright green colour and new tubers, seeds and fruits began to appear. This marked the "green grass time" (March, April) and was a time of year when families generally moved onto the waterholes around fertile sandplains in the north of the study area to harvest new Ipomoea tubers.

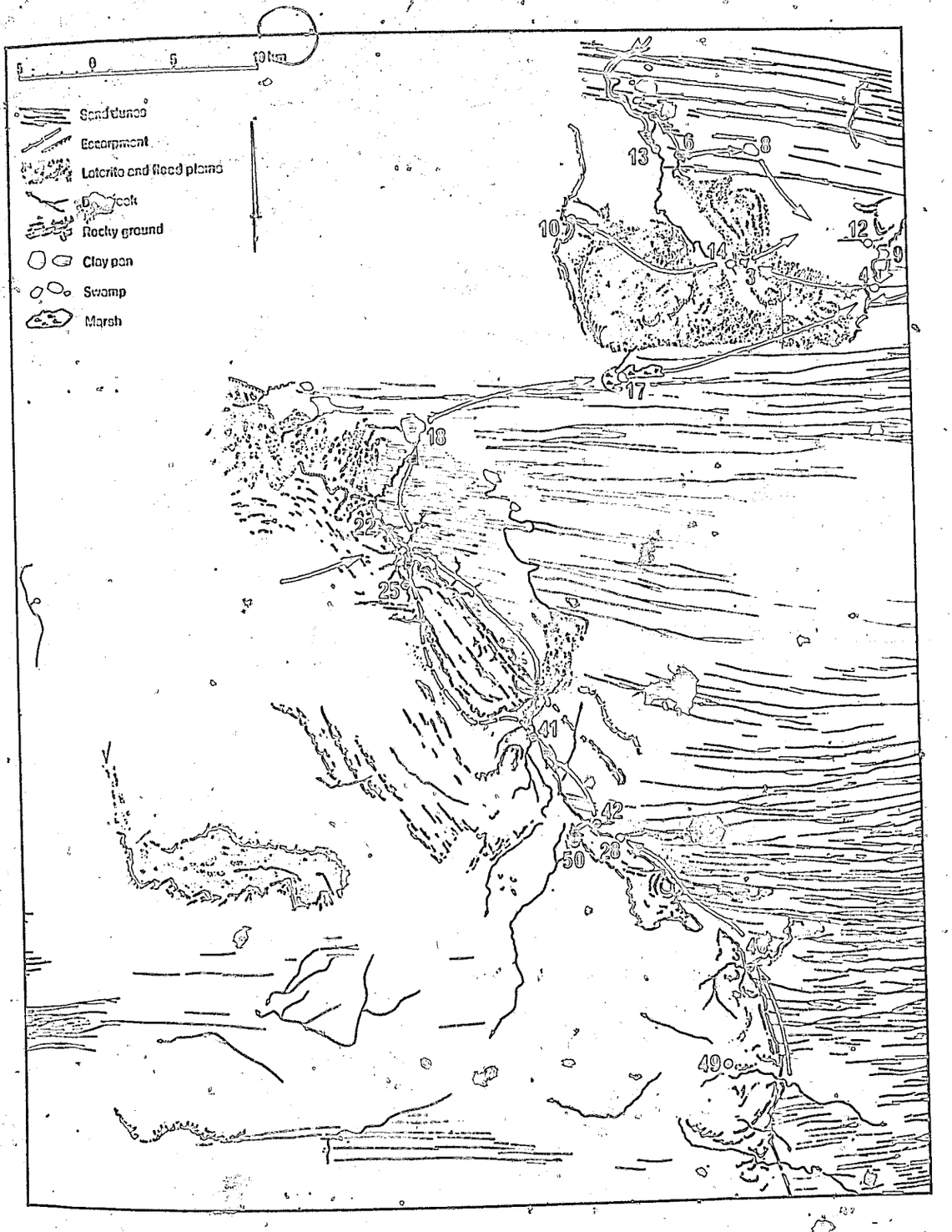
Sometimes people stayed at Ngawagudjarra (42) and Birbayga (28) in the Stansmore Range and if they did this they also occupied a small rockhole above Ngawagudjarra (42) called Lindabarru (50) as well. At this time of year supplies of wild fruit, Vigna tubers and stray kangaroos could be added to the native larder. Even so this region was no where near as fertile as the "bush potatoe country" to the north and families generally went north to forage in this area. The unusual fertility of this area was widely recognized and apparently attracted hundreds of Gugadja, Pintubi, Walmadjeri and Ngardi people who came both to forage for Ipomoea tubers and attend ceremonies in the region.

People coming into the region from the north usually travelled via Jiminba (13) to a large swamp called Ngandalarra (6). This did not hold water for long and as soon as it began to dry people either went north to Naligudjurra (5) and Yayarba (7) or travelled via Yunggubalibanda (9) and Nganawalbinyu (3) to Nabulabanda (10) (Fig.5.2). People coming from the west travelled into the region via



Figure 5.2

Direction people travelled and camps occupied during the ""green grass time" and "cold time".


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Rock
Rocky ground
Clay pan
Swamp
Marsh
13
8
10
12
14
3
9
4
17
18
22
25
41
42
50
28
49

Djungurr (4) and camped at Nganawalbinyu (3). People from estates within the study area usually travelled north from the the Stansmore Range as soon as the waterholes were full. Bye Bye described the usual pattern of movement in the following account of one trip she made with her family (Fig.5.2).

> We travelled this way now (north) to Manggayi (49) (southern Stansmore Range). We were hungry and hurried up. Travelled to Yurnin (46) and then came to Migiliri, (22) not Migiliri (22), yes Migiliri (22) - one camp. Cook him, eat him up, one camp, come up. One night, no food. Went to Diedi (25) down there and met Mick Djagamarra's mob. They went back to country. From Diedi (25) we walk to Dalabanda (18). All the way people been walking too much, travelling to home now. We want to go home. Then cleaning at Balgo Balgo (17); cleaning digging sticks for bush potato. Cutting mulga, cutting, cutting. We get up and get to Diring (4) before dinner. More people coming behind; my husband (Sunfly)...eating up bush potato; finish. We can go here now, a little bit crooked now (bypassing several closer sites); to Nabulabanda (10). Sit down here, finding something now, sit down for big camp.

Economically this northern zone was the richest in the study area and people used to travel great distances to forage and live semi-permanently around the major waterholes. The only resource it did not contain was a supply of good raw materials for stone tools, but this deficiency was outweighed by good supplies of hardwood, seeds, Ipomoea and Vigna tubers, reptiles, game and wild fruits. The resources used at each site are described below.

Balgo Balgo (17)

Balgo Balgo (17) is a huge marsh like swamp which only contained water during the wet season and early part of the "green grass time". The major items of food at that time of year were witchetty grubs and large quantities of black ducks which migrated into the area during the early part of the year. To the north were extreme laterite and flood plains. This general area was also referred to as Balgo Balgo and was a very good hunting ground and contained excellent stands of hardwood. Men visited the area when hunting but families generally camped there on their way north to make and repair digging sticks to collect Ipomoea tubers.

Diringberi (4 and 11) and Yunggubalibanda (9)

Diringberi (4 and 11) and Yunggubalibanda (9) are two of four water holes located adjacent a long escarpment full of small rockholes and rockshelters. People used to come and live in these rockshelters during exceptionally heavy rains but such rains were relatively rare events and people generally came to this area later,

during the "green grass time".

Diringberi (11) actually refers to a general area in the southern portion of this escarpment around a stone arch (Diring means arch and the term is also used to refer to the initiation hole punched through the septum of the nose) and includes two sites; Diringberi (11) and Djungurr (4). These camps and Yunggubalibanda (9) were located next to small springs which ran onto the escarpment from the base of three sand-dunes. Djungurr (4) was the main camp site and was also watered by two large rockholes.

There is another small soak in a creek west of Yunggubalibanda (9) called Wirribil (12). This site is located on the sandplain in an area which was rich with edible grass seeds (Fimbristylis sp. and Panicum sp.). It was an important seed processing site and was used by women to process grass seeds when the large "bush potato" ceremony was held in the region. The spring at the base of Diringberi (11) was also used as a seed grinding camp by women who had collected seeds from the sandplains along the base of the escarpment. Apart from seeds other important resources in this area included Ipomoea tubers gathered from a localized area on the sandplain from 1km east of Djungurr (4) and euros, reptiles, echidnas, bustards and kangaroos hunted on the escarpment and lateritic plains to the south and west. A tough black ferecrete and quartzite pebbles could also be obtained for making stone tools from the escarpment.

Ngandalarra (6)

Ngandalarra (6) is a huge swamp and was a very sacred place. Initiation ceremonies used to be held there in the past and under normal circumstances women were only allowed to camp there when water covered the sacred floor of the swamp. Normally families camped at Ngandalarra (6) during the "green grass time" and gathered Ipomoea tubers, seeds, witchetty grubs, reptiles, game and a limited supply of Vigna tubers. Located next to this swamp was a small sandstone rise which was used for obtaining seed grinding implements.

East of Ngandalarra (6) was a large claypan called Guralba (8). The water here was virtually undrinkable except for a short period after fresh rains so people did not stay there for very long. A rich supply of witchetty grubs could be obtained from a drainage area nearby generally visited briefly by people foraging and hunting in the area but was also visited by hunting parties of young initiates who were being led along a mythological path from Ngandalarra (6) that went near the site.

When Ngandalarra (6) began to dry up people often travelled north to a large waterhole called Naligudjarra (5) and usually ended up camping at a soak called Yayarba (7). These sites held sufficient water to support people until about August and this broadened the economic base to include a variety of wild fruits and shift the economic focus from Ipomoea to Vigna tubers. The creekline between this site and Ngandalarra (6) was thickly vegetated with Vigna tubers.

Nganawalbinyu (3)

Nganawalbinyu (3) was probably the most ideal camp site in the entire region: it was certainly the place everyone wanted to visit when we were travelling in the area. It was a large, deep waterhole which held water until about September (Plate 5.1b). The site was central to good hunting grounds and there was also a fine grove of mulga on the flood plains to the south, Ipomoea tubers to the east and a rich field of Vigna tubers to the west. The local landscape was also well supplied with other staples such as lizards, Solanum fruits and grass seeds. When this waterhole dried up (about August) the people used to move to a soak called Gunagulu (14) to extend the period over which this favourable landscape could be foraged in. This soak was fed by the large creek running east of Ngandalarra (6) and was located next to an extensive area of Vigna tubers.

Nabulabanda (10)

Nabulabanda (10) was a large soak located in a creek running east from a small escarpment. This escarpment contained a large rockhole as well as several rockshelters - the latter being occupied during unusually heavy rains. The soak itself was a very important water resource and was the last place to dry up in the northern part of the study area. The major resources here were Ipomoea tubers collected from the sandplains immediately to the north and Solanum fruits from the escarpment, Vigna tubers from the creek, kangaroos and bustards from the floodplains and the usual supply of grasses and reptiles scattered on the sandplains. A limited supply of hard wood

was available from the floodplains and some of the best quality ochre in the region, was found at the base of the escarpment half a kilometre south of the site.

Goanna Get Up Time (djintubalya) (Fig.5.3)

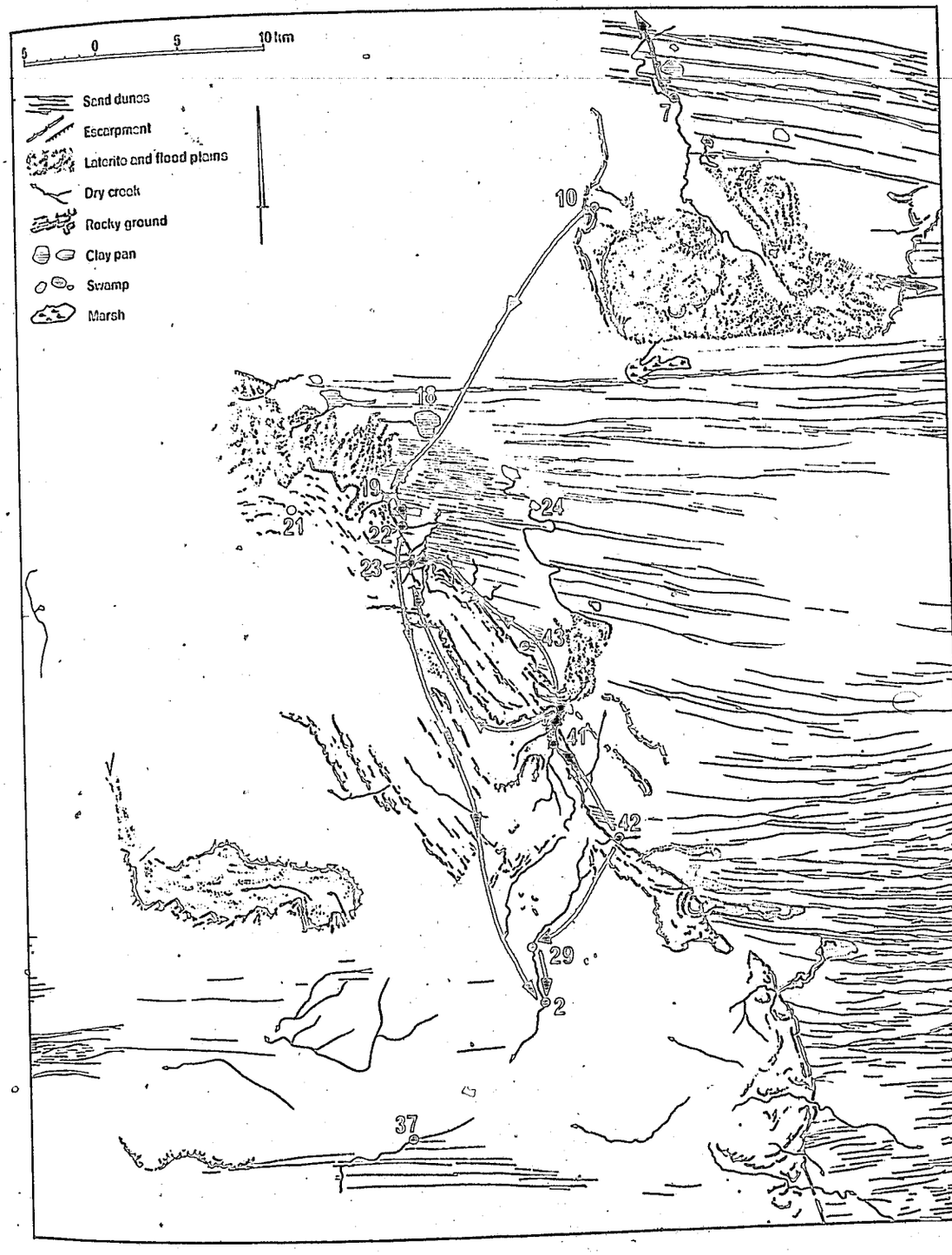
The imminent end of the cold season (August) was indicated by the movement of blue tongue lizards (Tiliqua sp.) and monitors (Varanus sp.) from hibernation and the appearance of a warm westerly wind. Temperatures rose significantly and most of the swamps, claypans and soaks dried up. At this time of year the local people fell back unhappily onto three large rockholes in the northern end of the Stansmore Range or walked to two substantial waterholes in the south of the study area (Fig.5.3). Outsiders returned to their own country. By this time of year the vegetation had begun to dry out and the landscape was burnt to attract game and stimulate the growth of new grass seeds and new Ipomoea tubers for the following year.

The three rockholes in the Stansmore Range were called Djulyurrulyurru (19), Migiliri (22) and Diedi (25). The smallest of these was Djulyurrulyurru (19). This was visited by people coming south from the "bush potato" country and usually dried up by the end of September. People then moved to either Diedi (25) (which dried up by October) or Migiliri (22) (which lasted until about mid November).

People living in this region foraged on the hills and sandplains between Barrawalawala (21) and the creekline south of Galundjunu (24). This is a distance of about 10km from these base camps. The

Figure 5.3

Direction people travelled and camps occupied during the "goanna get up time".


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
7
10
18
19
21
22
23
24
43
41
42
29
2
37

subsistence base at both Diedi (25) and Migiliri (22) was very generalized at this time of year. Lizards were particularily important and other resources included euros, echidnas, small marsupials, feral cats, snakes, Vigna tubers "rubbish" Ipomoea tubers, Ficus and Solanum fruits, Cyperus bulbs and grass seeds. Acacia and eucalyptus seeds ripen at this time of year and those which were not consumed were stored for the hot season to come. Between Djulyurrulyurru (19) and Dalabanda (18) there was an extensive area of the sandplain covered with edible grass seeds (Panicum australiense and P. cymbiforme) (Plate 4.1a;Chapter 4) and this was a major resource processed at both sites. Kangaroos and bustards were also hunted on the lateritic floodplains to the north west of these sites. Softwood trees and a limited number of hardwood trees grew on the floodplains and creeklines east of Dalabanda (18) and there was a good stand of mulga south of Diedi (25). In fact family groups travelling to these three rockholes from the south (usually from Ngawagudjarra (42)) often made a special detour through the hills to get wood from this stand. White chalcedony could be obtained from a quarry about 10km west of Migiliri (22).

The two waterholes which supported people through the "goanna get up time" in the south of the study area were called Gawayurru (29) and Djarrga Djarrga (2). Gawayurru (29) was the smallest of these and was no more than a large well shaded waterhole which appears to have held water until August or September. Djarrga Djarrga (2) was a series of deep rockholes located in the same creek, 5km to the south. The Aborigines described these as being as "big as the sky" but this was not true. They held water until about November when

the Aborigines were forced to move to Mindirr (23); the largest rockhole in the region.

Apart from the usual wide range of resources utilized during the "goanna get up time " these sites were famous for their Vigna tubers and a large concentration of grass seeds (Fimbristylis oxystacha) 1km to the west. There was also a grove of good quality mulga at Djarrga Djarrga (2) and the nearest supply of white chalcedony was at Marl (37), 15km to the south west.

Hot Time (wandaburru) (Fig.5.4)

As the "goanna get up time" melted into the "hot time" temperatures rose; (reaching occasional maximums of over 50 degrees Celsius), waterholes dried up and supplies of food dwindled. This was the harshest time of year and local family groups either travelled to Lirrawilli (48) outside the southern margin of the study area or to Mindirr (23); the largest rockhole in the study area (Plate 5.2). Mindirr (23) was usually not visited until the end of the year and if reserved until then had the capacity to carry people through harsh dry seasons. People remember the rockhole deteriorating to no more than a muddy soak in bad seasons but there is no memory of it ever running dry. Other large rockholes in the general area included Lirrawili (48), Labi Labi, Marbanbidi and Rurrabanda but there were no permanent springs in the immediate area. In fact the only two I know of in an area of about 18,000 sq km around the study area were Nyili (Emily Springs), Mulyawagalba (Helena Springs) (Fig.3.1:Chapter 3).

Figure 5.4

Direction people travelled and camps occupied during the "hot time".

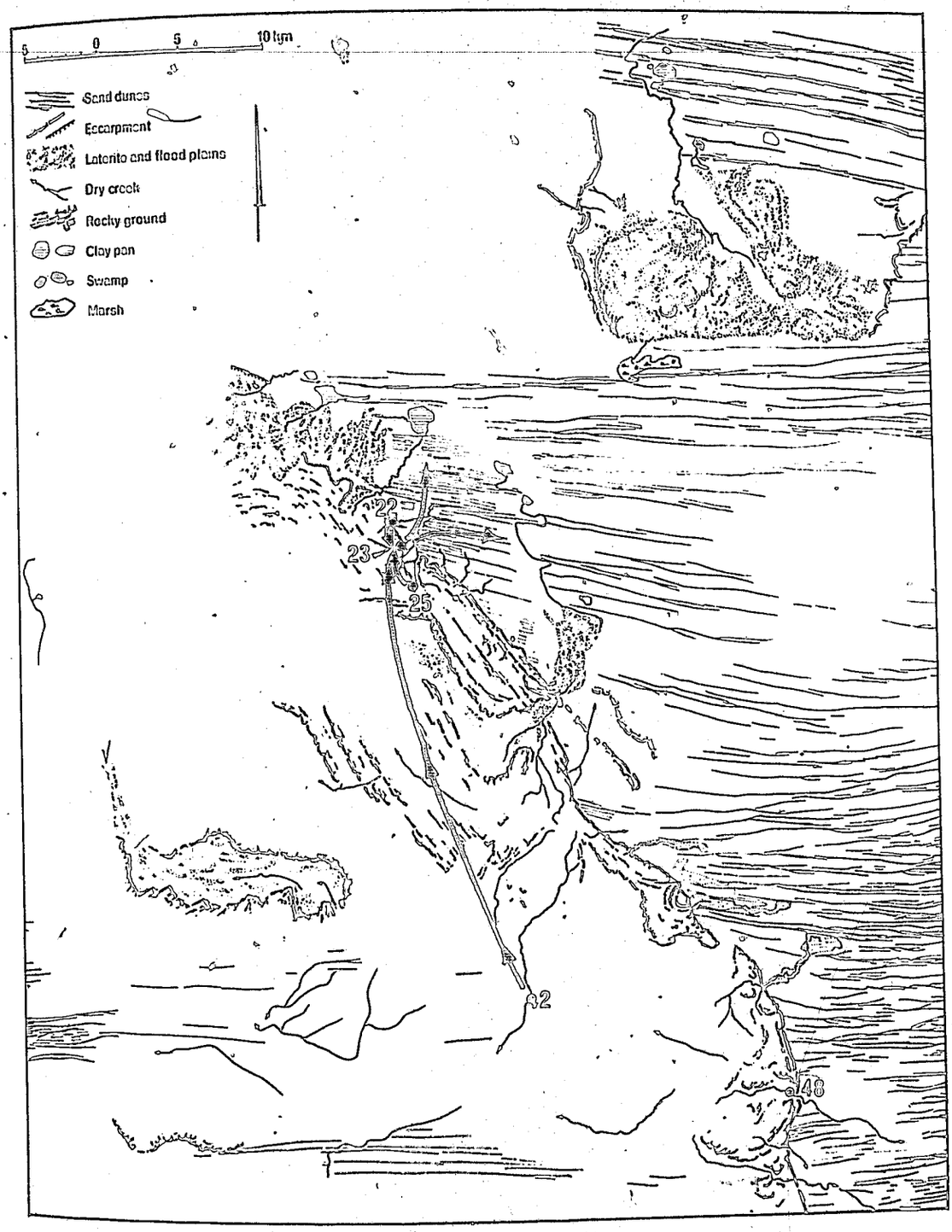

5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
22
23
25
2
48

Plate 5.2

Mindirr (23) the largest waterhole in the study area.



As the hot time progressed the supplies of food available to the local inhabitants camped at Mindirr (23) decreased the accessible supplies of stored acacia and eucalyptus seeds ran out, the drought tubers (Cassia notobalis and Clerodendrum floribundum) were used up and if rain had not come by December economic activity came to a virtual standstill. People used to try to "take it easy" during the "hot time" of year to conserve food and water. The responsibility of providing food fell to the men and women used to stay at camp and look after children and elderly people. Everyone wore bark sandles to protect their feet from the hot sand and, when possible, covered their heads and shoulders with layers of wet mud to reduce heat stress. The only food left to collect within the foraging radius of the rockhole were goannas which had been missed earlier in the year. The men used to leave camp before dawn and return at dusk, foraging as far as 15km from the main camp in search of food. As indicated in Chapter 4 the average calorific daily intake under these conditions was probably only about 800 kcals per person. Water shortages and heat stress prevented people from travelling to areas where food was still available and, in a sense, people here, as in other parts of the desert became trapped on this foraging island. When things got really bad this was a time of extreme tension and fights were common. Sometimes people began to starve and would be fed blood drained from the arms of healthier individuals to get them through the last harsh few weeks of the year. The Aborigines aptly called this the "hard time", "hungry time" or "meat time". As soon as fresh rains fell they spread out widely over the sandplains in search of food and the seasonal round started again.

Summary

Within the study region there were many different places where people could camp during any year. These provided access to a considerable range of economic resources which permitted the systematic seasonal exploitation of the local environment. This subsistence system falls into four basic stages, which were dependent on the availability of water and the seasonal and geographic availability of food resources.

The first stage in this system was the wet season. This season was characterized by relative scarcity of food and extreme mobility. It was a time when people had to move constantly from camp to camp to collect enough food for their survival and when everyone was equally involved in the food quest. It was a time of year when people took the opportunity to travel widely to obtain resources they were prevented from getting at other times of the year when water was scarce.

This season contrasts to the "cold time" when people lived semi-permanently around soaks and large waterholes and focused their economic attention on abundant, easily gathered vegetable tubers. This was a season of plenty. Women were the principal food gatherers and men had ample leisure time to socialize, make and repair wooden implements and pursue ceremonial interests. Compared to the rest of the year this stage in the subsistence system was a time of affluence, characterized by feasting, leisure and social interaction.

This relatively affluent lifestyle changed during the "goanna get up time" when family groups had to return to the serious business of survival in a desert environment. During this season both men and women probably spent most of the day in the pursuit of food. This was the time of the greatest economic diversity, the landscape was burnt in anticipation of the next season, seeds were put aside for the hot time and people foraged actively as generalized, opportunistic hunter gatherers.

The "goanna get up time" contrasts with the hot time when local families collapsed back onto the largest waterhole in the region. At this time of year men took over the major subsistence activities and the economy changed from one which was diverse and generalized to one which was very narrowly focused. Lizards were the principl food resources and this was often a time of extreme stress and hunger.

This subsistence model contains several basic elements. It features a period of food scarcity and mobility; a time of abundance, leisure and social interaction; a period of very generalized hunting and gathering and a time of limited economic activity and extreme hardship. It is quite apparent from the subsistence system which emerges in this reconstruction that there was a general pattern to the economic behaviour of the people that once lived in the study area. The essential characteristics of this pattern in addition to the presence of specific resources at individual sites which are likely to be significant from an archaeological point of view (such as relative availability of stone, ochre, hardwoods, seeds and so on) provides the ethnographic foundation from which the relationships

between human behaviour and stone tool residues can be assessed in the following chapters.

Chapter 6

Functional Assessment of Stone Tools

The basic tools of subsistence used by Aboriginal people in this region were made of wood and stone. Unfortunately termites, fires and the desert sun are harsh on wooden implements and none but the most recently discarded survive as evidence of any kind of prehistoric behaviour. Implements made of stone do survive and as a result are the only means of interpreting past Aboriginal behaviour in this part of Australia. Consequently the principal aim of this chapter is to determine the functions of the stone artefacts found in the region. This was done by recording the traditional names, functions and other miscellaneous information the Aborigines gave me for each of the 5,714 artefacts examined in the project. The technique of actually seeking the Aborigines' views of the form and function of the stone tools found in archaeological sites seemed an appropriate way of discerning the functions of the stone tools found in archaeological deposits. What better way of determining which functions stone tools were used for than actually asking the people who made and used them?

Unlike any other region in Australia the Aborigines from the Great Sandy Desert were still using stone artefacts in a traditional context in the 1950's and have continued to use them intermittently

until the present. These people therefore have detailed memories of which artefacts were used traditionally, what they were used for and what they were called. As will become apparent in this chapter they clearly have a detailed technological vocabulary paralleling that of modern archaeology.

This technique had additional advantages. Firstly it avoided any subjective assumptions on my behalf about the morphology and functions of stone tools. It also provided a unique opportunity to determine the extent to which the formal stone tool typology defined by archaeologists conformed with the system of classification used by the Aborigines. Gould points out that

> although archaeologists spend much of their time classifying the stone tools they uncover hardly any one has ever attempted to learn how the native people themselves classify their stone tools (1970:42).

This is true and nowhere in the literature is there a complete typology of stone artefacts recorded from a group of Aborigines. Nevertheless archaeologists and anthropologists have tried to learn something of the functions of stone tools from Aborigines before (Spencer and Gillen 1899; Horne and Aiston 1924; Davidson 1935; Love 1936; McCarthy 1941; Thomson 1964; Tindale 1965; Mulvaney 1961; Gould et al. 1971; Blundell 1976; Hayden 1979; O'Connell 1977).

In order to gather this information in a reliable fashion I had to be very circumspect in my investigations. Initially the Aborigines were very curious about my behaviour and it was not until we had examined several hundred artefacts that they trusted my intentions and understood my interest in stone tools. After several months of

this kind of work they were most forthcoming with relevant information.

In order to ensure that the quality of the data presented here was high I always kept three things in mind. The first of these was to work in short shifts of one to two hours at a time. This technique was intended to avoid "killing" the Aborigines with boredom. I always made sure there was plenty of time for hunting, talking, eating and resting. The second technique was to work with as many different Aborigines as practical. The point of this was to get as wide a range of views as possible and the advantage was that I could cross check information and sort out errors, misunderstandings and contradictions. In the course of the field work I worked with eight different men. These were Sunfly, Jimi Djambidjin, Djambidjin's brother, Mick Djagamarra, Arthur Djabanangga, Jimi Wirili, Bill Lari and Jambu Djabanangga.

The third and most important technique was not to "lead the witness" by asking questions such as, "was this stone point used for engraving?" or "was this blade called yulambi"? In fact I always tried to listen attentively and ask as few questions as possible. Once the men knew what was going on I usually relied on their own motivation and interest for information. This meant the information recorded was authentic but also meant that when the Aborigines did not provide information I tended not to prompt them and in these cases little information was recorded.

With this in mind the following chapter presents the traditional functional and morphological data I recorded from the Aborigines for 5,714 artefacts sampled at 19 sites in the region. This introduction is followed by a brief description of the wooden implements used traditionally and a discussion of women's seed grinding implements, men's flaked stone artefacts, ground implements, ochres and manuports.

WOMEN'S WOODEN IMPLEMENTS

Women's implements included a digging stick, fighting stick and a variety of wooden bowls. Traditionally, digging sticks were as diagnostic of women as spears were of men (Berndt 1974:72) although, unlike spears, digging sticks were occasionally borrowed by members of the opposite sex in each family (O'Connell et al. 1983; Basedow 1904:26; Thomson 1964:408). Today they have been almost entirely replaced by rods of reinforcing iron and wooden digging sticks are rarely used or seen. Traditionally digging sticks were made from branches of mulga (A. aneura) and consisted of a smooth ochre covered shaft about 1m long and about 4cm thick. They were trimmed to a spatulate digging tip on one end and a rounded butt on the other. Tindale (1972), Helms (1896) and Basedow (1904) describe some digging sticks as long as 2m in length.

The principal function of the digging stick (wana) was to expose underground food (tubers, frogs and hibernating reptiles) for gathering. They were also used to open soaks to obtain water and I observed them used in a variety of domestic tasks such as solving

arguments, digging sand ovens for large game, softening sleeping areas and covering seed cakes with hot ashes for cooking (Helms 1896; Basedow 1904:26; Thomson 1964; Tindale 1972; Berndt 1974:40; Hayden 1977, 1979; O'Connell et al.1983).

Fighting sticks (gundjurru) were used defensively by women in arguments. Judging from the numerous dents in most peoples' skulls I worked with the women's club appears to have been a most effective weapon. Its general form was similar to a digging stick except these were adzed right down to expose the dense heartwood. The final product was usually about 1m long, 4-5cm wide and was either shaped like a slender club or was of constant width and terminated in two abruptly pointed tips. The only subsistence activity the tool was used for was protection.

Desert women used a set of three wooden dishes. The largest of these (luandja) was a softwood dish and this was used to winnow seeds and as a receptacle for food and water and as a cradle. Both shallow and deep softwood dishes were used in the region (see Spencer and Gillen 1899:108). Both were oval in plan and about 60cm long and 20cm wide. The shallower dishes were often slightly wider but only about 5cm deep. The deep dishes were usually between 10 and 15cm deep.

Women still use these dishes and take considerable pride in them. They are generally beautifully made and are often covered with red ochre and decorated with parallel grooves carved running longitudinally along the exterior of the dish. Smaller hardwood bowls (wirra) were made from hollow branches of eucalyptus trees and were

used for a variety of domestic tasks such as holding clean seeds winnowed from the larger dish, mixing ash with native tobacco and preparing spinifex resin. The smallest bowl (magurra) was also made of eucalyptus wood and was used to dig and clear sand (Helms 1896; White 1910; Spencer 1904; Basedow 1904; Mountford 1941; Tindale 1972; Brokensha 1978; Hayden 1979; Hamilton 1980).

Bark dishes made from the bark of two eucalypts (see Table 4.15; Chapter 4) and were used when wooden dishes were not on hand. These were used for the same tasks as the wooden dishes and were easy to make and obtain (Thomson 1964; Tonkinson 1978; Carnegie 1898).

MEN'S WOODEN IMPLEMENTS (Plate 6.1a)

The the most important implement used by men was the hardwood spear thrower (langgaru). Spencer provides the clearest and most concise escription of the implement.

> It consists of a broad, lanceolate blade of mulga wood (a. aneura) tapering off at either end. It is almost always decidedly concave in section, though now and again specimens which are nearly flat are met with. .. At one end a small point of wood is attached by means of a lump of resin bound firmly with sinew. The opposite end has a still larger mass of the same material which at once affords a grip for the handle and the means of inserting a flake of flint. The latter is the most useful cutting implement of the tribe in which this form of thrower is prevalent (1904:667).

These had several other functions apart from the obvious function of throwing spears. For example, spear throwers were the principal woodworking implement and were used to light fires, butcher game, mix ochre, contain tobacco, as a club, mnemonic device, spear deflector,

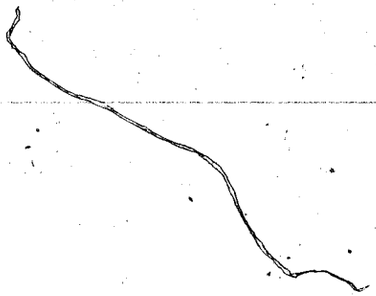


Plate 6.1a

A collection of wooden artefacts made during a field trip. Artefacts include spears and a softwood dish (against bush), boomerangs, unfinished parrying shield, spear thrower (next to tins).

Plate 6.1b

Flakes of sandstone: providing evidence of the manufacture of seed grinding artefacts.





digging implement, hook and musical implement (Helms 1886; Stirling 1896; Carnegie 1898; Spencer and Gillen 1899; Spencer 1901; Basedow 1904; White 1910; Davidson 1936; Mountford 1941; Davidson and McCarthy 1957; Thomson 1964; Hillard 1968; DeGraff 1968; Lawrence 1968; Gould 1970b; Brokensha 1978; Hayden 1979; Cundy 1980).

The men in this region used three types of spears. The most important were the wooden hunting spears (gulada) and the short punishment spears (yulumburru). Hunting spears were made from the slender saplings of either Acacia dictyophleba or A. cowleana. The former was most resiliant and highly prized. Hunting spears were usually about 2.5m long and taped from the base to a broad lanceolate tip. A barb (or occasionally two barbs) was often bound to the spear tip with kangaroo sinews. Individual men usually marked their own spear with a distinctive design carved into the shaft of the spear, just behind the tip (Stirling 1896:88; DeGraaf 1968:87; Gould 1970b:15). Spears intended for trade were left unmarked. "Punishment" spears were carved from the heartwood of a branch of mulga and were about 2m long, with an impressive lanceolate point about 4-6cm wide and 30cm long. The shafts are round and between 2-3cm thick. When used the lance like tip of the spear was driven horizontally or vertically through the thigh of the criminal. All of the men I worked with had such punishment scars and Arthur, a formidable old warrior, had three on each leg (Basedow 1904:25; Stirling 1896:88; Gould 1970b:8; Hayden 1979:75,91). Occasionally bamboo spears (ginimili) tipped with hardwood or pressure flaked stone points were traded into the region. These were used for ceremonies and fighting (Carnegie 1898:340; Love 1936:81; Davidson and McCarthy 1957:447)

The men made two kinds of boomerangs in the region. The hunting boomerang was non-returning and was used to kill birds and stop runaway lizards. It was also used as a poker, digging tool and musical instrument. The hooked or beaked boomerang was used as a club or missile during conflict (Stirling 1896; Carnegie 1898; Weston 1910; Horne and Aiston 1924; Davidson 1936; Thomson 1964; Brokensha 1978; Moyle 1979).

Two types of shields were used in the region. The most common was the oval shaped softwood shield (gudidji). This was light, tough and shock absorbent and served as a receptacle and fire stick as well as a shield. The narrow hardwood shield was used as a parrying shield (Stirling 1896; Spencer and Gillen 1899; Carnegie 1898; Horne and Aiston 1924; Gould 1970b; Brokensha 1978).

STONE ARTEFACTS

All stone artefacts relate directly to some subsistence activity and in this region their main functions were food preparation, woodworking, stone tool manufacture, personal decoration and some ceremonial activities.

Seed Grinding Implements

Seed grinding implements are the only stone artefacts which relate directly to food preparation and because of their importance in this regard I would like to start this section with a detailed description of the function and form of these artefacts.

Women in this region used two seed grinding implements. These included a grinding slab (yipiyanu) and a hand stone (djungari). They were the only stone tools used by women and were used specifically for the purpose of grinding seeds (Hamilton 1980:8). Each married woman had her own set of grinding tools and these were kept at respective base camps throughout her country (Hamilton 1980; Horne and Aiston 1924; Davidson and McCarthy 1957). Peterson (1968) records a similar thing in Arnhem Land. Sometimes light grindstones were transported from place to place but as women often had to carry their digging stick, softwood dish, and a young child as well this was not frequent occurrence.

Grinding slabs were also used by men to grind ochre for ceremonial occasions but are sufficiently different not to be confused with those used to grind seeds. Ochre grinding slabs were not characterized by the narrow seed grinding groove and were not accompanied by a matching handstone. They were also used away from areas of general habitation and tend to be found in association with other sacred objects such as paintings, ceremonial boards and stone arrangements.

In many parts of Australia materials suitable for seed grinding tools were quite rare and had to be traded considerable distances (Hamilton 1980; Davidson and McCarthy 1957:436; Gould 1968; Tindale 1977:347). In the study area good quality sandstone could be obtained from most creekbeds as well as one small exposure of sandstone adjacent to Ngandalarra (6) in the north of the study area. Highly silicified fine grained sandstones or siltstones were preferred for

grindstones as these were most durable, gave off the least amount of sandstone grit and consequently produced the best quality seed cakes.

Seed grinding slabs, were generally made from a naturally occurring piece of flat sandstone on which the margins were trimmed to the desired shape (yadungugalbung (yabungu [grinding surface]; galbung [broken rock]). A great deal of work was required to make a good seed grinding (Fig.6.1a) and this resulted in amorphous flakes and broken chunks of sandstone being deposited in archaeological sites (Plate 6.1b). The vast majority of sandstone flakes recorded in this project were thought by the Aborigines to provide evidence of manufacturing and repairing grindstones.

When used, a grinding slab was tilted slightly away from the sitting position of the woman. A pile of seeds and a steady trickle of water were taken from wooden dishes next to the woman and placed on the raised end of the grinding slab. Another wooden dish was placed under the low end of the slab to catch the wet stream of ground seeds which flowed down the groove and over the end of the grinding slab (Plate 4.4b; Chapter 4).

Seeds were crushed and ground using a handstone made from water rolled pebbles (Peterson 1968:567; Gould et al. 1971; Basedow 1904:26) or hammer dressed from suitable blocks of stone (Fig.6.2a). A rounded or domed handstone was best suited to the technique used to grind seeds. This involved pushing the handstone away from the body with a downwards rocking motion and then drawing it back lightly over the grinding slab. In this process the grinding force was applied

Figure 6.1a

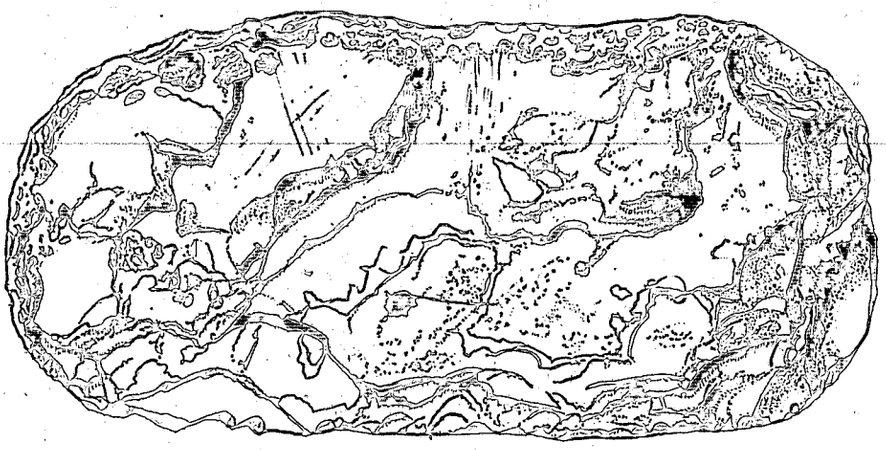
Unused seed grinding blank shaped from sandstone block (scratches indicate some initial surface preparation).

Figure 6.1b

Reduced and discarded grinding slab.

Figure 6.1c

A good grinding slab with some groove reduction.

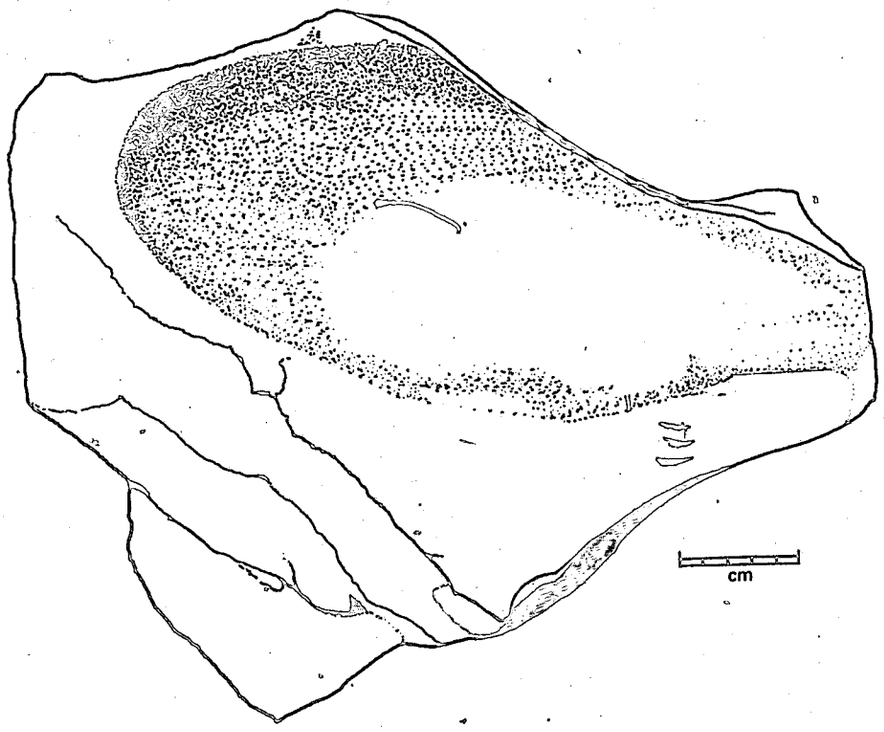


a



cm

b



c

cm

Figure 6.2a

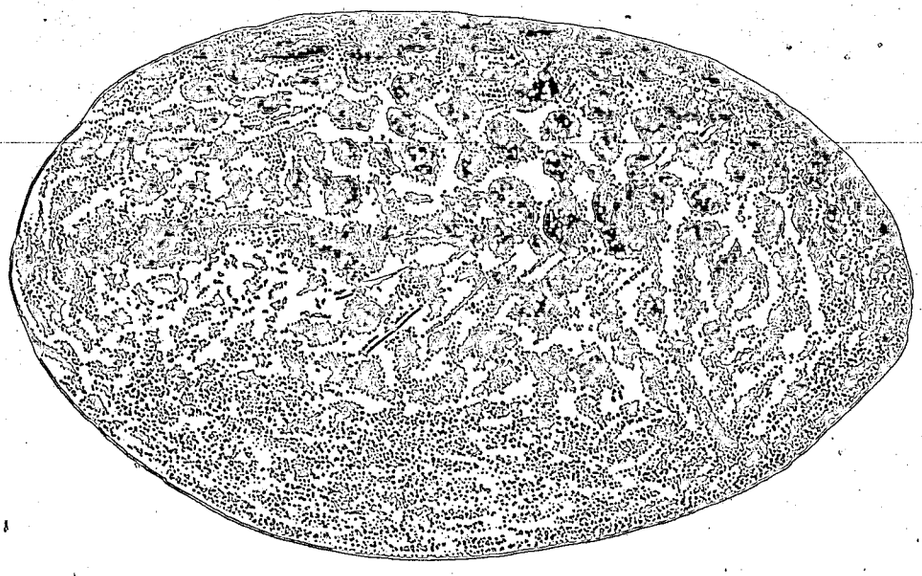
Handstone hammer dressed from block of sandstone.

Figure 6.2b

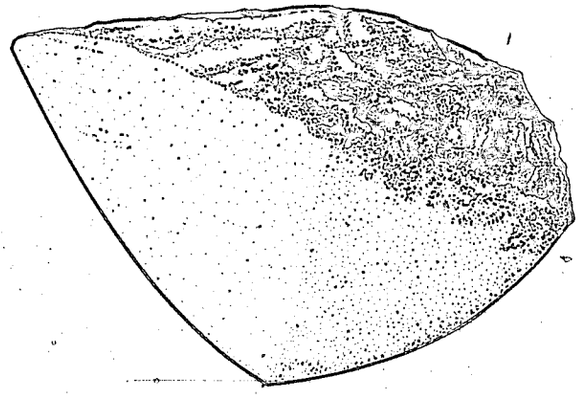
Handstone reduced through use.

Figure 6.2c

Flat handstone; note hammer dressing (sharpening) on flat grinding face.

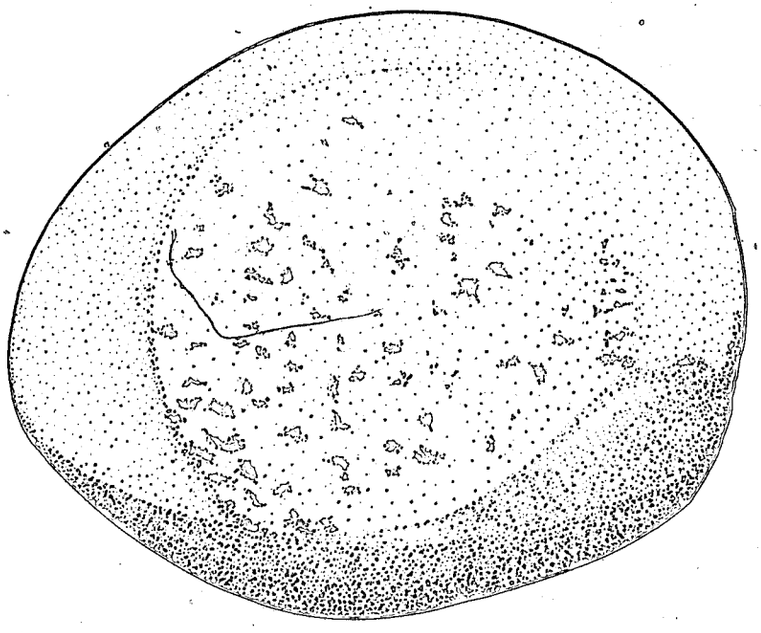


a



b

cm



c

vertically, then horizontally through the handstone from the wrists and heels of both hands.

With continual use this motion produced a long narrow grinding groove, which became deeper near the centre of the groove, and extended from one edge of the slab for about 20cm (Fig.6.1b and c). This kind of groove is characteristic of wet seed grinding (see Tindale 1977). Dry grinding by comparison produced a circular bowl shaped depression in the grinding slab which does not extend to the edge of the grinding slab. Dry ground seeds (particularly nardoo) were crushed and ground in this and were then mixed to a paste with water (Horne and Aiston 1924:54) but were not used in this region.

Naturally, as the grinding tools became older the more wear they began to display. Handstones became smaller and smaller and as a result the groove on the grinding slab changed from a broad flat groove to a narrow deep groove. The deeper the groove became the more uncomfortable it was to use as the base of the woman's hands began to rub on the outer surface of the groove. When a grinding groove reached this stage it was either discarded or the high parts of the slab were hammer dressed down (yungiranu) till it did not touch the woman's hands. Alternatively a new groove could be started adjacent the old groove or underneath the grinding slab.

A grinding groove probably wore down quite quickly and was made worse by the asymmetrical deepening of the groove near its centre. This interrupted the flow of seeds along the groove to the wooden dish and consequently required extra work to clear. As the groove

deepened it also lengthened and this also caused the women extra effort. To overcome this the length and angle of the groove were reduced by continually flaking off the mouth or edge of the grinding groove (Fig.6.1c).

Eventually the groove became too small for all but the softest seeds (see Chapter 3) and a new groove would have to be started. This process of groove reduction left flakes of sandstone with diagnostic convex ground edges in the archaeological record.

The Aborigines often attempted to reduce the extent to which a grinding groove deepened by using flat or gently domed handstones (generally produced from large primary flakes of sandstone) instead of rounded or domed handstones. However these were not such efficient seed grinding tools as they did not transfer the rocking downwards pressure which crushed and ground the seeds as effectively. Flat handstones were restricted to a back and forwards movement on a horizontal plain over the grinding slab and as a result tended to slip and roll over rather than crush the hard rounded seeds utilized throughout the region.

All handstones became highly polished and tended to roll over the seeds on the grinding slab but this was a greater problem with flat handstones. To overcome this the smooth grinding faces were recoursened by hammer dressing and as a result flat handstones show more frequent signs of hammer dressing than domed or rounded ones (Fig.6.2c). Flat handstones had the additional disadvantage of being fairly thin and with little wear became hard to hold without hurting

the tips of a woman's finger.

O'Connell (1977 et al., 1983) suspected the difference in handstones related to a regional variation in the resources in Central Australia. He suggested that flat handstones were used for hard seeds found in the sand hills and domed handstones were used for soft seeds found on the flood plains but this does not appear to be the case in this region.

Invariably handstones were also used as impromptu hammers to crush bone or, more frequently, to flake stone tools. Handstones were not designed for this and were only used when better materials were not immediately available. Generally, however, separate eating camps (Plate 6.2a) were set up at respective waterholes and suitable bone crushing stones selected and kept near the cooking area instead. Men usually preferred water rolled quartzite pebbles for the task of manufacturing stone tools as they were harder and avoided the risk of breaking good handstones and incurring the anger of the women in the group. Nevertheless handstones invariably display percussion damage resulting from these additional functions.

As a result of both grinding and hammering a discarded handstone will eventually have reduced to about 7cm x 5cm (Fig.6.2b), will often have become pecked and ground on several surfaces and will display percussion damage on its peripheral margins.



Plate 6.2a

Recently abandoned eating camp showing charcoal from hearth and bone crushing stones.

Plate 6.2b

Jambu smoothing the surface of the haft of a tula adze flake attached to a spear thrower. This is done by melting the surface of the resin with hot coals.





Assuming, on the other hand, a grinding slab reached old age and was not broken in transportation, domestic arguments, death of a woman or when being maintained it would change from a flat block of ground sandstone to a highly distinctive grinding slab displaying between one and four grinding grooves, hammer dressing around the periphery of the deepest grooves and length reduction of at least one groove. Grinding slabs that reached this level of maturity were usually light enough to be transported but were often quite unstable. To make transportation easier and to stabilize them they were occasionally hammer dressed and unnecessary grooves were detached.

When finally discarded grinding slabs were often used to crush up reptile vertebrae or break the ends of long bones. They were also used as heat retainers (gardang) to cook termites (or less frequently kangaroos) and were used to grind ochre for non-sacred decoration.

Many authors record that fragments of grindstones were used to sharpen digging sticks (Helms 1896; White 1910:728; Horne and Aiston 1924:56; Love 1936:67; Thomson 1964:407; Tindale 1972:446; Hayden 1979:111; Hamilton 1980:8). Hayden (1977:185) records that only women used this technique in the Western Desert and as women did not make wooden implements in this region this was probably not an important function for fragments of grindstones. Many of these secondary functions have been assigned to functional grinding slabs but to the best of my knowledge good grinding slabs had no other function than grinding seeds (see Peterson 1968:556; O'Connell 1977:277; Davidson and McCarthy 1957:437; Basedow 1904:26).

In the archaeological debris I recorded 281 fragments of grinding slabs and I recorded functional information from the Aborigines for 280 of these. From this total the Aborigines thought 91% were fragments of seed grinding slabs, 5% were fragments of handstones, 1.3% were rubbish, 1% were manufacturing debris, 1% were hammers. They were unsure of 0.7% (Table 6.1).

I also recorded 89 fragments of handstones in the project and recorded functional information for 85 of these. In this case the Aborigines felt that 88.2% were handstones, 3.5% were seed grinding slabs, 2.4% were fragments resulting from the manufacture of handstones, 1.2% resulted from the manufacture of grinding slabs. The Aborigines were unsure of the function of 4.7% of the artefacts (Table 6.1).

I also noted functional information for 29 of the 35 flakes of sandstone recorded (Table 6.4; Table 9.3;Chapter 9). Of these 24 (83%) were thought by the Aborigines to indicate the manufacture of grinding slabs, 5 (17%) were thought to indicate the manufacture of handstones.

Flaked Stone Artefacts

Raw Materials

Four major materials were used in the production of stone tools. The most popular was white chalcedony and this was quarried at three locations in the study area: 10km west of Migiliri (22), adjacent

TABLE 6.1 Function of seed grinding implements (see page 100)

Function	Grinding slab		Handstone		Total	
	n	%	n	%	n	%
Rubbish	4	1.3	–	–	4	1.1
Unsure	2	.7	4	4.7	6	1.6
Hammer	3	1	–	–	3	.8
Make grind-slab	3	1	1	1.2	4	1
Make handstone	–	–	2	2.4	2	.5
Handstone	14	5	75	88.2)	346	95
Grinding slab	254	91	3	3.5)		
Total	280	100	85	100	365	100

TABLE 6.2 Functions of cores (see page 100)

Function	Core scraper		Single platform core		Horsehoof cores		Multi-platform cores		Total	
	n	%	n	%	n	%	n	%	n	%
Rubbish	–	–	1	5.2	1	11.1	2	3.9	4	5
Unsure	–	–	1	5.2	–	–	1	2.0	2	2.5
Woodworking	2	66.6	–	–	–	–	–	–	2	2.5
Used as core	1	33.3	13	68.4	8	90.9	48	94.4)		
Obtain stone points	–	–	1	5.2	–	–	–	–)	74	90
Obtain sharp flakes	–	–	3	16	–	–	–	–)		
Total	3	100	19	100	9	100	51	100	82	100

TABLE 6.3 Functions of Hammers (see page 152)

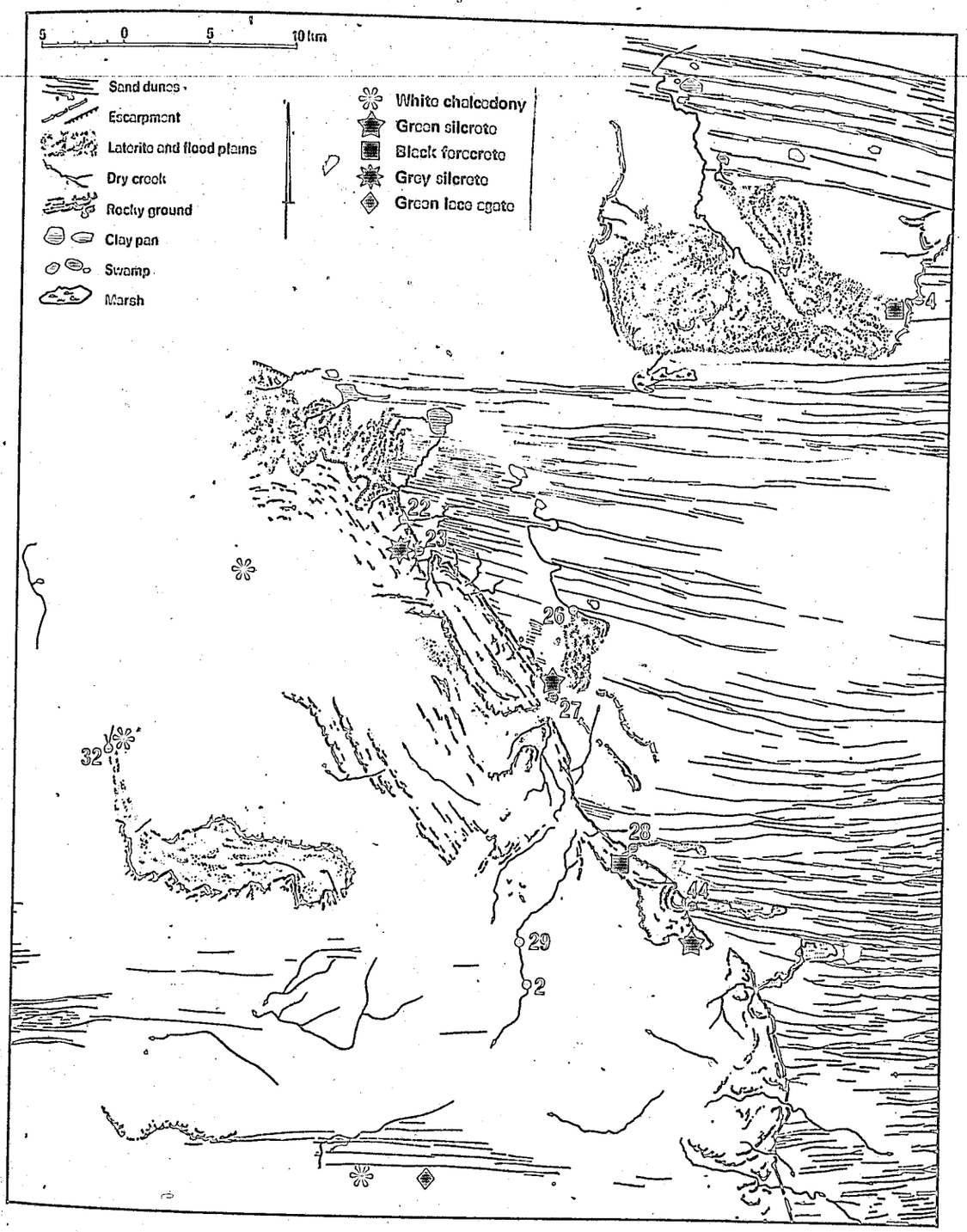
Function	Hammer	
	n	%
Rubbish	1	3
Unsure	1	3
Hammer	32	91
Handstone	1	3
Total	35	100

Lamban Lamban (32) and adjacent Marl (37) (Fig.6.3). This material was usually called djimeri or gandi by the people I worked with and was also called yelga and djula by people to the north and south respectively. It will be noted here that these terms are often used in a different context in the archaeological literature. For example Gould et al. (1971) and Tindale (1965) used the term djimeri to refer specifically to stone knives. Thomson (1964:411) used the term to refer to an "adze stone". The reason for this apparent confusion in the use of the term is because it in fact refers to the raw material and not a particular tool type. The meaning of the term djula (tula) has also been misunderstood by archaeologists. Horne and Aiston (1924:91) in fact said that the Aborigines "call them all (stone tools) by the one name, 'tuhla". This is because they were referring to the raw material being used. The terms "koondi tula" or "koondi tuhla kalarra" and "koondi tuhla pirrie" therefore mean white chalcedony on adzing stick, white chalcedony scraper on adzing stick and stone point on adzing stick respectively.

The second and third most popular raw materials used in the region were a green coloured silcrete called bawurindji and a black/brown ferecrete called bulimarlu. The green silcrete was obtained from a large quarry at Wilbarinyu (27) (Fig.6.3) and a quarry on an escarpment 2km south west of Mirrilmirril (44). The Aborigines told me that black ferecrete was obtained from one location near Djungurr (4) and another near Birbayga (27) but I did not locate either of these quarries. The black ferecrete was a very tough rock and was less popular because it was so hard to reduce. The least popular material was a rather poorly silicified medium grained

Figure 6.3

Location of major quarries of flakable stone.


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
White chalcedony
Green silcrete
Black forcerete
Grey silcrete
Green lace agate
4
22
23
26
27
32
28
44
29
2

grey sandstone the Aborigines called balgarra. This was obtained from boulders of silicified sandstone at Mindirr (23) (Fig.6.2).

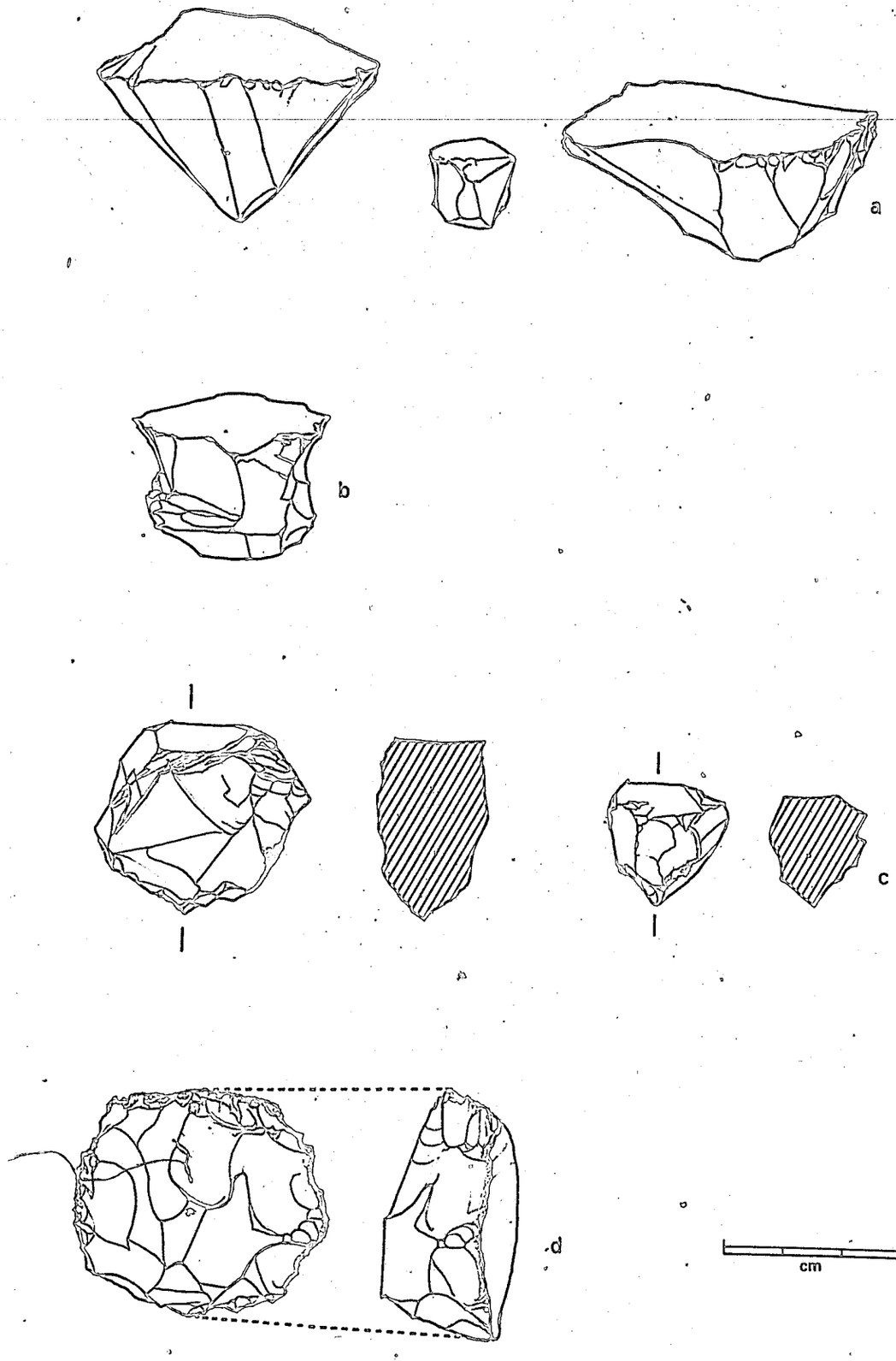
All the stone quarries were located in waterless, "bush country" (wadini or galyu bandinga). Sunfly told me that young men used to get stone from such quarries and take it back to the old men at "living places" who would make the stone tools (see also Horne and Aiston 1924:123). Good pieces of stone were transported from place to place in the form of cores. Spare unretouched primary flakes of stone were also carried for making into stone tools. These were called yabunda or mulbu (lit; spare djimeri; not flaked) (see also Carnegie 1898b; Basedow 1925:364; Thomson:405; Hayden 1977:180).

A variety of less important materials were used in the region. These included miscellaneous pieces of rock (buli), quartzite (marban marban) and a rather brittle green lace agate. Small proportions of other materials such as a caramel lace agate, pink chalcedony and yellow silcrete were transported from unlocated sources outside the study area.

Cores (Fig.6.4)

One hundred and nineteen cores were recorded at 17 sites sampled in the region. With the exception of two core scrapers, the morphology of these artefacts corresponds to those recorded by Gould at the prehistoric site Puntutjarpa (1977:80,81). Consequently I have adopted his terminology.

Figure 6.4a Single platform cores
Figure 6.4b Horsehoof core
Figure 6.4c Multiplatform cores
Figure 6.4d Core scraper


a
b
c
d
cm

Single Platform Cores (Fig.6.4a)

Twenty two single platform cores were recorded at 11 sites in the region. The principal defining feature of this class of cores was the detachment of flakes from one direction (Gould 1977:81) although I separated these cores from horsehoof cores (below) because of the absence of prominent step fracturing in the former.

The Aborigines provided functional information for 19 of these cores and observed, unsurprisingly, that most had been used to obtain flakes for stone tools. There were four exceptions to this which are worth documenting. The first of these was a small prismatic core resembling those described by Dortch (1977:117,220) as levallois blade cores. The Aborigines said these were used to obtain blanks to make stone points. The three others were small squat cores from which wafer thin, slender blades had been removed. Two of these were thought to have been used to remove flakes for cutting initiation scars. The last was thought to have been used for "anything", but possibly to produce hand held flakes to gently scrape or "clean" (gibinma:carve [gibin]; make [ma]) the hollow of a wooden winnowing dish (luandja).

Horsehoof Cores (Fig.6.4b)

Thirteen horsehoof cores were recorded at six of the 19 sites in the region. These cores were characterized by heavily undercut step fractured margins and were generally much smaller than the Pleistocene horsehoof cores described on Kangaroo Island and at Lake Mungo (Lampert 1981; Bowler et al. 1970). There has been considerable discussion on the function of horsehoof cores. Some authors suspect

they may have been used as planning, chopping or scraping implements where as others consider they are cores (see Kaminga 1978; Mulvaney 1975; Lambert 1981; White and O'Connell 1982 for debate). I recorded functional information for nine of these small horsehoof cores. The Aborigines said one was rubbish and the others had been used as cores.

Multiplatform Cores (Fig.6.4c)

Eighty two multiplatform cores were recorded. As the name suggests these are cores from which flakes have been detached from two or more different directions (Gould 1977:81). The Aborigines commented on 51 of these and said that 48 had been used as cores.

Core Scrapers (Fig.6.4d)

Most of the core scrapers seen in the region resembled high domed tula adze flakes with large butts and short steep angled unifacially retouched or use damaged margins (O'Connell 1977:272). The Aborigines said that these were hafted to spear throwers and used as a heavy duty scraping tool. Some core scrapers were quite irregular in shape and the Aboriginies said these were used as cores. Three core scrapers were recorded in the archaeological samples. Two of these were examples of the former and were thought to be heavy duty scraping tools (Fig.6.4d). The other was an example of the latter and thought to be a core.

Aboriginal Comments on the Function of Cores.

The Aborigines appeared not to have any corresponding classifications of cores to those used by archaeologists. Essentially

the only form of identification they used was based on the material from which each core was made and the fact that they had been flaked. The materials they identified were white chalcedony (djimeri or gandi), green silcrete (bawurindji), black silcrete (bulimarru), quartz (marban marban) and grey silcrete (balgarra). Very few comments shed any light on the functional differences implied by the morphological categories I have used in this section. Those that did referred to the production of small razor sharp flakes used either in initiations or for fine woodworking from small prismatic blade cores. The Aborigines also distinguished between artefacts archaeologists would call core scrapers on the basis of the regularity of their form; those resembling high domed tula adze flakes (Fig.6.4d) being thought to be heavy duty woodworking tools.

Invariably the cores recorded in the samples were thought to have been rejected because they were "too hard" or "too light" to have been reduced further or had been broken. With the exception of two core scraper no cores were said to have been used as hammers, scrapers, or wood chopping implements (Gould 1977:93; Hayden 1977:56, 79). Otherwise the men thought cores were simply different kinds of stone from which flakes were knocked off for use. They provided functional information for 82 cores and felt that 74 (90%) were used to obtain flakes of stone, that two (2.5%) were hafted, were unsure about another 2 (2.5%) and thought four (5%) were rubbish (Table 6.2).

Aboriginal Comments on Stone Tool Manufacture

The Aborigines described the process of stone tool manufacture on numerous occasions by demonstration and mimicry. The technique used on these occasions was hand held percussion and there was no mention of bipolar flaking, use of a hammer and anvil technique or of securing the cores in the sand before flaking them (Hayden 1977:55). Jimi Djambidjin used to refer to cores as "the mother one" which was "cut" or "bled" to produce nyndurrba (unretouched or waste flakes).

Cores were repeatedly described as being hit, smashed or knocked down. This was generally deseribed as djrilbung, a word derived from the correct term; djrilbungundadjanu (the result [djanu]) of hitting ([bungu] in a flaking motion [djrilbungu]). This term had several other derivations and other words were used as well to describe the flaking process. The most commonly used were bungama (bunga [hit]; ma [make]), djrilbungama (djrilbung [flake stone]; ma [make]), nyndurrbungama (nyndurr [waste flakes] bunga [hit] ma [make]), galbungama (galbung [broken stone]; ma [make]). Flake scars produced by the detachment of flakes were called wabuda (lit; a shallow area - like a plate, broad valley etc.) or bungu wabudaanu (flake scars [wabuda] produced by hitting [bungu] explosively [daanu - explode]). These terms and other terms of technological and morphological significance are listed in Tables 6.7-6.9 at the end of this chapter.

Hammers (Fig.6.5)

Evidence of hammers was recorded at 12 sites in the study area. This consisted of 53 fragmentary pieces of rock displaying percussion damage in the form of small percussion cones, transverse splitting, breakage, crushing and pitting. Battered and broken pebbles are commonly interpreted as hammerstones in the archaeological literature (Bartlette 1964:669; Gould 1977:87, Gould et al. 1971:162; White 1972; Jones 1971:215,292) and in this project I recorded 39 pieces of quartzite, 10 pieces of silcrete, two pieces of chert and two pieces of sandstone as evidence of hammers. Hammers of white chalcedony and silcrete were made from thermally shattered (pot lidded) pebbles collected from quarries and most of the quartzite was collected eroding out of the escarpment near [illegible]urr (4).

The Aborigines said that any pieces of rock could be used as hammerstone (gardángu garbungama) gardangu [piece of rock] garbungama [to hit and make]) but said that water rolled quartzite pebbles were preferred for the task. This was further indicated by the fact that quartzite was called djrilga (from djrilbung - or knapping) or puli nyndurr nyndurr (rock [puli] - used to produce small flakes [nyndurr nyndurr]) although it was also called marban marban; which identifies quartzite pebbles by their associations with and use by medicine men (Marban).

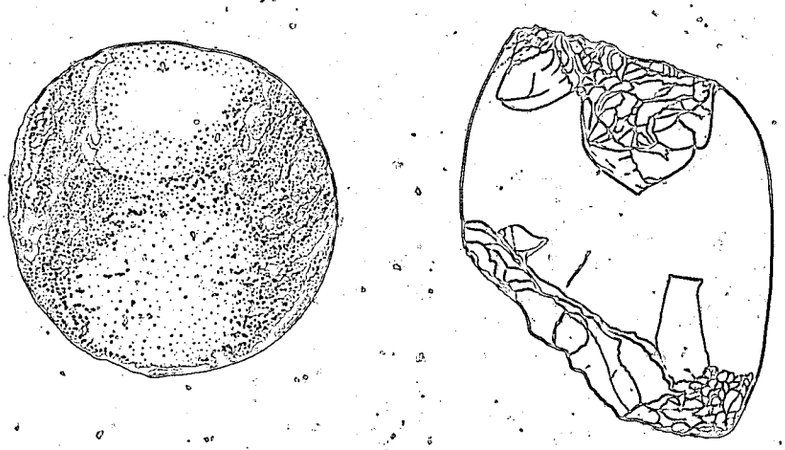
The men generally commented that the quartzite fragments I recorded had been smashed by djrilbung (flaking) and that they had been "hit", "knocked down" and "broken". For example, Djambidjin's brother, explained the function of two large pieces of quartzite as:

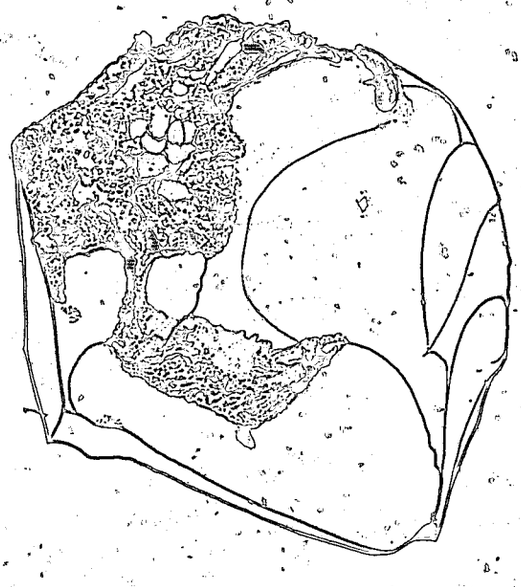
Figure 6.5a

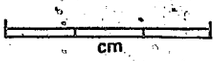
Percussion damaged quartzite hammer.

Figure 6.5b

Cobble of thermally shattered chalcedony.


a


b


cm

djrilbung (flaking), use him (quartzite) on that bulimarru (lit; rock black - ferecrete), knock him on that big bastard (horsehoof core).

Specifically the Aborigines made functional comments about 35 of the artefacts I recorded as hammers. Of these they felt 32 (91%) were fragments of hammerstones and one (3%) was part of a hand held seed grinding mill, another (3%) was rubbish and they were unsure of the function of another (3%) (Table 6.3).

Unretouched Flakes

During the course of this project I recorded 4478 unretouched flakes. These artefacts were characterized by the absence of any macroscopically visible edge damage. Many archaeologists would be quick to point out that stone flakes may be used without showing any distinct signs of use (Hayden 1977, 1979; White and O'Connell 1982:85; White 1967; Mason 1967; Strathern 1967; Gould et al. 1971, Gould 1980; Byrne 1980:113) and issue a cautionary warning accordingly. My own interpretation of these flakes was that they were simply the debitage produced in the process of stone tool manufacture, but obviously had I enjoyed the facility of a binocular microscope in the field then I may have found that some (many?) of these flakes did in fact display microscopic edge damage.

The Aborigines themselves referred to the multitude of small flakes produced in the production of stone tools a nyndurrba or nyndurr nyndurr (from nyndurrbungundadjanu - (nydurr [waste flake] bungu [hit] djanu [as a result]). They said these flakes were

produced when cores were knapped (djrilbung) or when primary flakes were retouched (gindilba). Retouch, "levelling" or "hitting along the edge" of a flake of stone produced flake scars the Aborigines called wabadu ngawu bungugindilmanu (flake scars, [wabuda], ngawu [rubbish], bungu [hit], gindilmanu [retouch]).

The term nynurrba is synonomous with the terms waste or unretouched flake - and the Aborigines generally indicated that such artefacts remained unused because they were either too small or too light to have been hafted or were too difficult to reduce, broken or lacked suitable cutting edges.

The Aborigines commented on all but 142 of the unretouched flakes I recorded and said that 98.9% of these were no more than the unwanted by-product of stone tool manufacture (Table 6.4). From the remaining 1.5% the Aborigines thought 17 artefacts (.4%) were sharp enough to have been used for butchering game, scarifying young men or cutting the cephalic veins of adults for ceremonial blood-letting. Flakes used for ceremonial incisions were characterized by one razor sharp convex margin and were just large enough so they could be held snugly between one's thumb and forefinger. These flakes were all made from white chalcedony whereas flakes that were thought suitable for cutting meat and butchering game were also made from inferior raw materials such as silcrete and ferecrete, were larger and had less regular cutting edges. The Aborigines felt 15 other unretouched flakes (.35%) resembled or may have been tulas (djimeri langgaru) and that two were like stone points (djimbula). They said that five (.1%) may have been suitable for delicate woodworking tasks such as carving

TABLE 6.4 Function of unretouched flakes

Function	Unretouched flakes n	Unretouched flakes %	Total %
Rubbish	4248	97.5)	
Make grinding slabs	24	.6)	98.85
Make handstone	5	.1)	
Hammer fragment	10	.2)	
Cut meat	3	.07)	
Scarification, blood-letting	14	.33)	.4
Curse	2	.05	.05
Woodworking	5	.1	.1
Make tula	15	.35	.35
Make stone point	2	.05	.05
Unsure	8	.2	.2
Total	4336	100	100

TABLE 6.5 Functions of utilized flakes, tula flakes, and burren adze flakes

Function	Utilized flakes n	Utilized flakes %	Tula flakes n	Tula flakes %	Burren adze flakes n	Burren adze flakes %
Rubbish	32	17	14	10.3	1	7
Unsure	33	17	3	2	–	–
No use	–	–	1	.7	–	–
Hafted woodworking	73	38	118	87	13	93
'Clean' wood	26	14	–	–	–	–
Make spear	13	7	–	–	–	–
Drill holes	1	1	–	–	–	–
Make tula	2	1	–	–	–	–
Core	3	1.5	–	–	–	–
Hafted knife	6	3	–	–	–	–
Spare one	1	5	–	–	–	–
Total	190	100	136	100	14	100

wood or gouging holes in the ends of spears and that 10 (.2%) were broken pieces of hammerstones. They also thought two flakes were suitable for ritual killings and were unsure of the function of another eight artefacts (.2%).

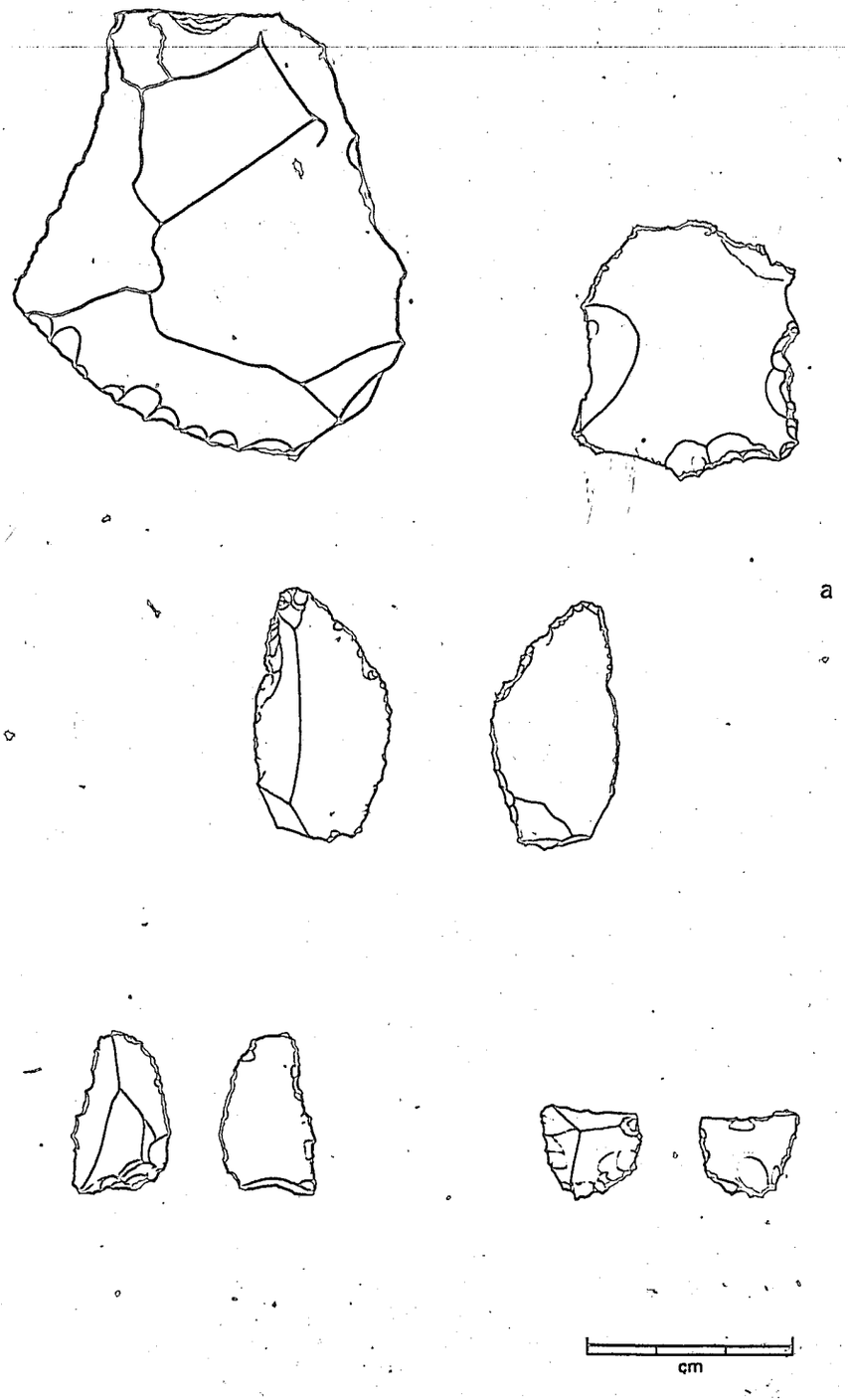
The miscellaneous uses of these apparently undamaged artefacts accounts for 49 of the total 4,336 artefacts for which functional information was recorded (Table 6.4). This result tends to de-emphasize the importance which some archaeologists argue for unretouched tools in the overall tool kit (Gould 1980; Hayden 1977; Byrne 1980:113; White 1967; Strahern 1967). The data presented here suggests that while Aborigines in the research area did occasionally use suitable unretouched flakes for a variety of tasks very few unretouched flakes located on sites investigated in this project appear likely to have been used. This may well be the case at other sites in Australia as well.

Utilized Flakes (Fig.6.6)

In addition to the great quantity of irregularly shaped unretouched flakes of stone I also recorded 281 randomly shaped flakes with edge damage (Fig.6.6). Archaeologists would identify these kinds of artefacts as either flake tools, utilized flakes or scrapers (Lorblanchet and Jones 1979; Mulvaney 1975; O'Connell 1977). These artefacts are generally described as either hafted or hand-held woodworking implements in the literature (Mountford 1941; Tindale 1965:138,147; Mulvaney 1975:77; White and O'Connell 1982:131; Basedow 1904:26; Hayden 1979; Stockton 1971).



Figure 6.6a Utilized flakes
Figure 6.6b Utilized flakes referred to as "gurdung".


a
b
cm

I recorded functional information for 190 of these artefacts (Table 6.5) and found woodworking was also the principal function (60%) given them by the Aborigines. The Aborigines thought 73 (38%) of these would have been hafted to spear throwers and called them spear thrower white chalcedony (djimeri langgarru) accordingly. They said that such flakes were used as general woodworking tools but that they had a rather impromptu value and that the edge damage indicated either minimal retouch, or short term use or rejections of the artefact.

Another 26 (14%) utilized flakes were thought to have been hand-held implements used for "cleaning up" or smoothing the final surface of wooden implements. These artefacts were called gurdung (literally fine scrapers) and would be recognized by archaeologists as small flakes which have been "nibbled" on one or more margins (Fig.6.6b).

Such gurdung seem very similar to what O'Connell (1977:273) called "micro-retouch scrapers" and sound very like the tools Horne and Aiston (1924:91) called pundunya. They describe these as 'casual' stones being

> Any that have a sharp edge. They are used for scraping. Directly they are blunt they are thrown away and another picked up. Sometimes they are chipped if the stone will keep its edge long enough but usually they are not kept. In finally smoothing a boomerang the workman would use 20 or 30 of these scrapers. They are called pundunya (literally scraper), which means any sharp-edged stone. They are not mounted in any way.

Another 13 utilized flakes (7%) were thought to have been used to scrape spear shafts. These were occasionally hafted to spear throwers and can be identified by the obvious notch in their margin. Aborigines identified these notched flakes by the material from which they were made and their association with the long scraping or planning technique used to smooth spear shafts (milbungama). Notched flakes are commonly associated with the task of spear manufacture in the literature (Basedow 1925:365; McCarthy 1976:34; Gould 1977:94; O'Connell 1977:273; Kaminga 1978:345; Hayden 1979:143).

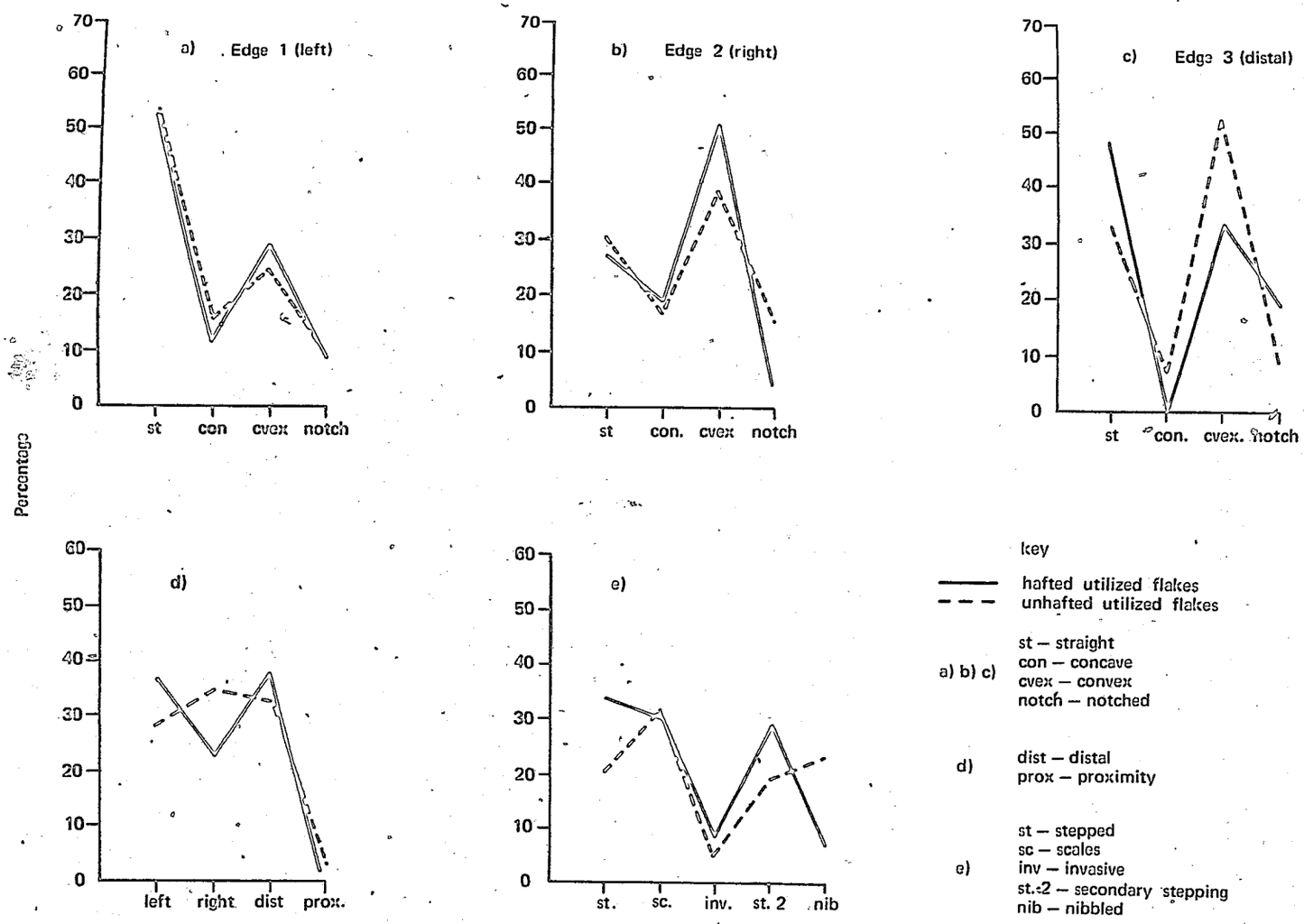
One of the problems of making functional interpretations from this rather amorphous - or randomly shaped class of tools is that each individual flake may have been used for several different functions (see Jones 1966; Lorblanchett and Jones 1979). This is something which is also illustrated by the functional interpretations given them by the Aborigines. For example they were unsure of the functions of 17% of the unutilized flakes and felt another 17% were rubbish. They also thought some of them were failed tulas (1%), cores (1.5%) or hafted knives (3%).

The diversity of functional interpretations given by the Aborigines for this class of tools makes it difficult to assume a particular function for them. This situation is not helped much by comparing the damaged edges of those artefacts the Aborigines thought were hafted with those thought not to be hafted. In Fig.6.7a-c the graphs indicate that the edge shapes of both supposedly hafted and unhafted flakes were virtually identical. Fig.6.7d illustrates that the location of edge damage was similar in both - although there is a



Figure 6.7

Edge shape, location and type of retouch on utilized flakes.


a) Edge 1 (left)
b) Edge 2 (right)
c) Edge 3 (distal)
Percentage
70
60
50
40
30
20
10
0
st
con
cvex
notch
con.
cvex.
d)
e)
left
right
dist
prox.
st.
sc.
inv.
st. 2
nib
key
hafted utilized flakes
unhafted utilized flakes
a) b) c)
st – straight
con – concave
cvex – convex
notch – notched
d)
dist – distal
prox – proximity
e)
st – stepped
sc – scales
inv – invasive
st.2 – secondary stepping
nib – nibbled

suggestion that hafted flakes were less often damaged on their right margin. Fig.6.7e suggests that hafted flakes were more often step fractured and that unhafted flakes more often had nibbled margins than hafted flakes. However this level of morphological comparison tends to demonstrate the similarities between the flakes the Aborigines thought were either hafted and unhafted rather than their differences and, in the absence of any data on respective edge angles, does not do anything to make specific functional interpretations from this class of tools any easier.

My only recourse therefore is to return to the ethnography and on the strength of these observations in addition to the major functions assigned them by the Aborigines, assume that the dominant function for randomly shaped stone artefacts displaying some kind of edge damage was indeed woodworking.

Adze Flakes (Fig.6.8)

During this project I recorded 161 tula adze slugs and flakes and 13 burren adze flakes. Tula adze flakes were originally defined as discoidal flakes, displaying unifacial secondary and tertiary step fracturing on their distal margins. I had anticipated these would be relatively distinct from remnant tula adze slugs, which are characterized by heavily step fractured, undercut, convex distal margins. In reality I found it difficult to differentiate between tula flakes and tula slugs. As a result I have identified both as tula adze flakes. Burren adzes are quite distinct morphologically and can be recognized as thick blade like flakes with step fractured lateral margins and with the striking platform perpendicular to the

Figure 6.8a1-3

Tula adze flakes in various stages of reduction.

Figure 6.8b1-2

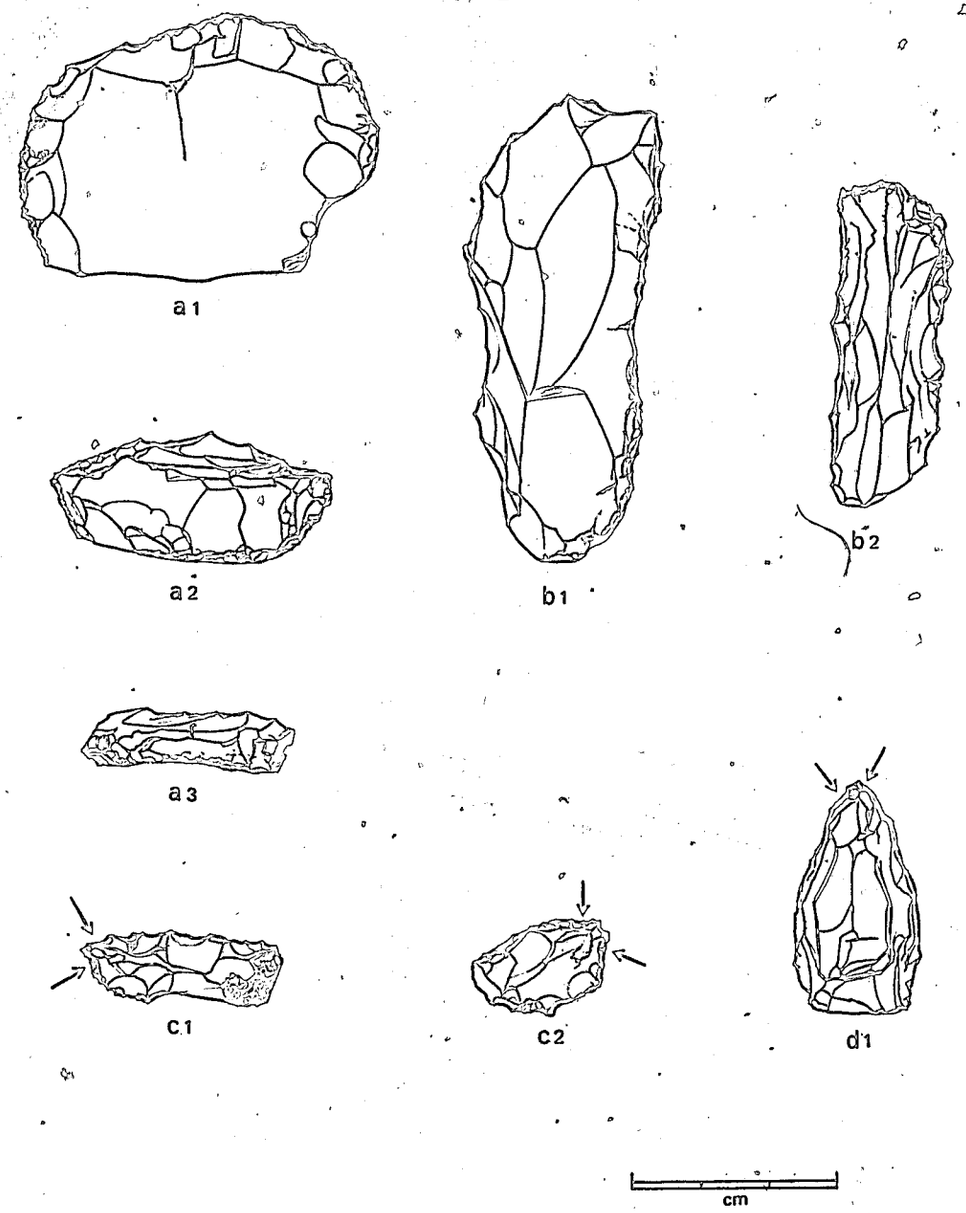
Burren adze flakes

Figure 6.8c1-2

Pointed adze slugs said to be used for engraving (arrow indicates edge damage).

Figure 6.8d

Pointed burren adze slug said to have been used for engraving (arrow indicates edge damage).


a1
a2
a3
b1
b2
c1
c2
d1
cm

long axis of the edge (O'Connell 1977).

The Aborigines I worked with did not call any of these artefacts by the term "tula" or any other specific term. They identified them by the material they were made of and their attachment to a spear thrower. Hence, they were called djimeri langgarru (white chalcedony, spear thrower) or simply referred to as langgarru. This term translates literally to mean "spear thrower" but was used by the Aborigines as a shorthand way of explaining that the artefact was used as a hafted woodworking tool (Plate 6.2b). Many artefacts were also simply referred to the material they were made of and hence were often simply referred to as djimeri (white chalcedony) (see Thomson 1964).

I recorded functional information for 136 tulas and of these the Aborigines thought 87% (Table 6.5) had been hafted to a spear thrower. Adze flakes hafted to spear throwers were the principal woodworking implement used by the Aborigines in this region and the desert in general. These tools were used to make digging sticks, boomerangs, shields, dishes, sacred boards, spears and other spear throwers (Stirling 1896:90; Spencer and Gillen 1899:583; Horne and Aiston 1924:102; Aiston 1928:127; McCarthy 1946, 1976; Davidson and McCarthy 1957; Tindale 1965:160; Gould 1970b:35; Stockton 1971; Mulvaney 1975:77; O'Connell 1977; Sheridan 1979; White and O'Connell 1982:131).

According to the people I worked with, large new tula flakes were used for roughing out and adzing smooth most implements, but the Aborigines said that as they got older, decreased in size and became lighter they could only be used for gently scraping or spokeshaving tasks (Fig.6.8a1-a3) (see also Spencer and Gillen 1899; Kaminga 1978).

As tulas were used, they were resharpened and rehafted until they became too small to be held in a haft. When this occurred they were discarded and another flake was inserted. As a result small remnant tulas are most commonly found on archaeological sites in the region. I was often told that the tulas I was recording were "no good" (10.3% -- Table 6.5) and on one occasion a frustrated Jimi Djambidjin left the grid we were working in and returned with a handful of decent sized remnant tulas in order to illustrate examples which were more like the "real ones" (see Tindale 1965:61 for a similar account).

Various people also drew my attention to the fact that tula flakes could be used "any side" and so explained the production of burren adzes (93% - Table 6.5, Fig.6.8b) and the presence of edge damage on the dorsal surface of the striking platform of some tula flakes (Fig.6.8a3). Similarly they drew my attention to several remnant adzes which had been reduced to a point (Fig.8c,d). These were apparently rehafted with the point exposed and used as engraving tools similar to the Pitjuru Pitjuru recorded by Gould (et al. 1971:153) and others (Spencer 1904; Davidson 1935:159; Tindale 1965:135; Stockton 1971:51; Mulvaney 1975:82).

Blades (Fig.6.9)

In this project we recorded 79 blades. These can be recognised as thin, long, parallel sided flakes displaying edge damage on their lateral and distal margins. This damage varied from macroscopic nibbling to extensive unifacial retouch. Many of these flakes were also broken.

Classic leilira blades of the kind described by Spencer and Gillen (1899) and McCarthy (1976) were quite rare at camp sites in the region. We did not record any in the samples we analyzed. The Aborigines called these large blades yulambi and said that only three of the 5,000 odd artefacts recorded were "like yulambi" (Plate 6.3a) but they were not "real ones". The men I worked with said "proper yulambi" were either used to cut initiation scars, and as weapons (Djilmadjanu, the owner of Estate Four in the study area was killed from multiple stabbings and lacerations inflicted with these knives) although their major function seems to have been to slash one's thighs and backs during mourning (gandjigundalba, see Vanderwal 1982; Plate 699). These functions are also assigned to large prismatic blades recorded in the literature (Stirling 1886:96; Carnegie 1898:348; Spencer and Gillen 1899, 1904; Basedow 1904:26; Horne and Aiston 1924:128; McCarthy 1946; Davidson and McCarthy 1957:19; Gould 1970:24, 1980:41; Mulvaney 1975:74). Spencer and Gillen (1904:74) suggest that cruder round nosed blades were used as scraping implements by women but the people I worked with appeared not to differentiate between men's and women's knives. O'Connell (1977) found the same thing in Central Australia. Sharp slender stone knives were highly prized by Aboriginal people in this region and this no

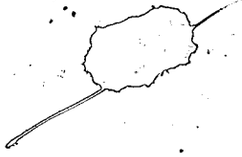


Figure 6.9a

Blades collected from quarries but rejected as they were too small or irregular in shape.

Figure 6.9b

Snapped blades thought to be used as woodworking tools.



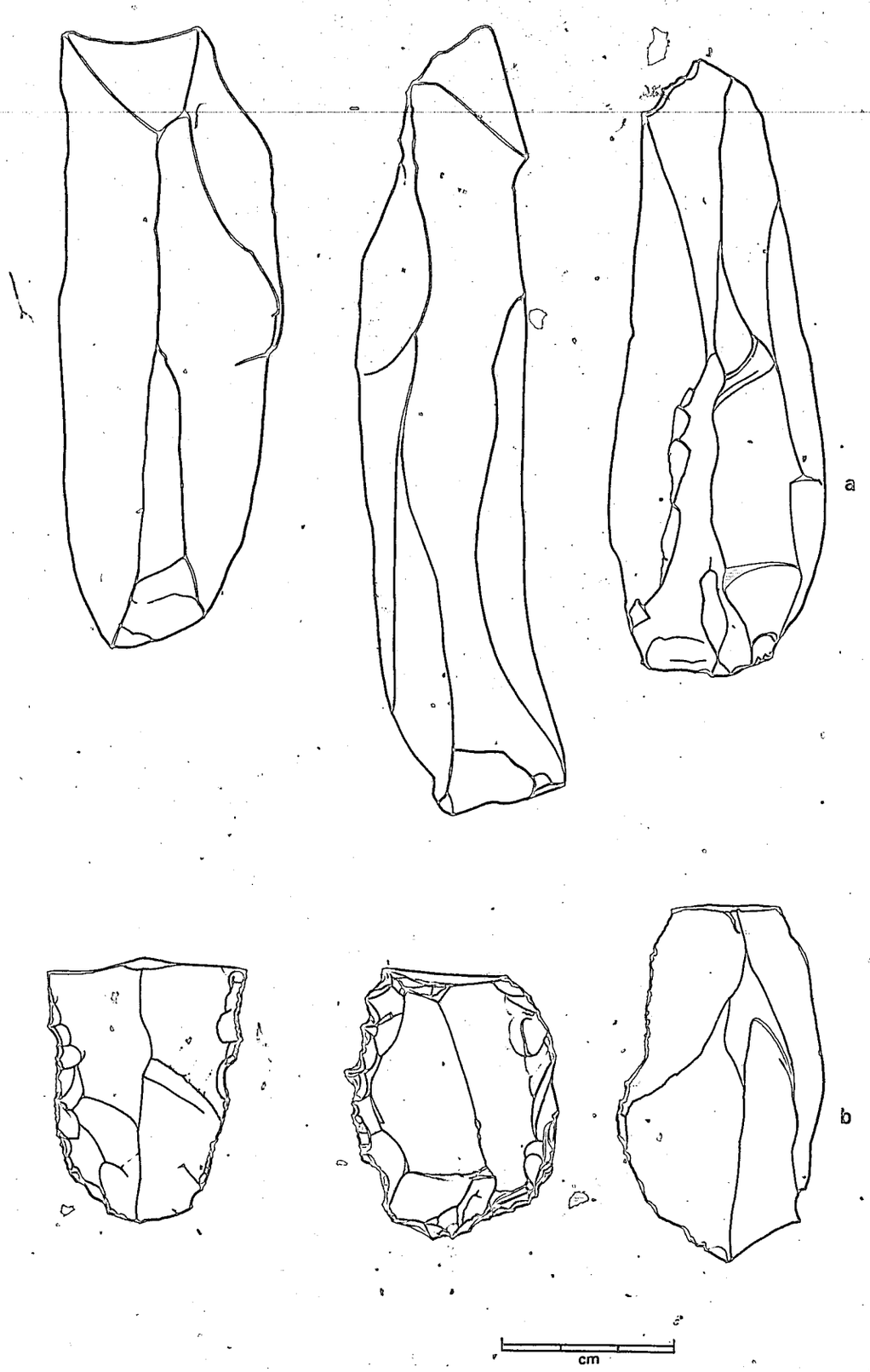

a
b
cm

Plate 6.3a

Building up a spinifex resin handle on a blade.

Plate 6.3b

Jimi Wirrrili retouching a stone point collected from the quarry near Lambanlamban (32).





doubt explains why good specimens are rarely found in archaeological sites. The only place good blades can be found in abundance is at quarry sites where they are still collected by local people (Fig.6.9a).

Most of the blades recorded in archaeological samples were either broken or were smaller and less regular in shape than leilira blades. I recorded functional information for 51 of these blades (Table 6.6) and this revealed that the Aborigines thought a large proportion (33%) were rubbish or were unsure what particular functions they may have been used for (10%). Some blades (4%) were thought to have been blanks for making stone points (djimbula) whereas others were thought likely to have been given small resin handles and used as knives for butchering game or initiating young men (14%). Invariably these blades were referred to as sharp (yiri) pieces of a particular type of rock and as the best cutting edges were obtained from white chalcedony many of these artefacts were simply referred to as djimeri (see Tindale 1965; Gould et al. 1971).

Most of the blades recorded archaeologically had been broken in half (Fig.6.9b) and were said to have been hafted and used as woodworking tools (35%). The Aborigines said these blades had been intentionally broken and were hafted transversely to a spear thrower with one sharp lateral margin exposed like a chisel. These were generally used like a spokeshave to smooth the final surface of wooden implements, and were specifically associated with the task of scraping spear shafts, maintaining the tip on hunting spears and making wooden dishes for women. Other authors refer to the use of the

TABLE 6.6 Functions of blades and stone points

Function	Stone Points		Blades	
	n	%	n	%
Hafted woodworking	8	33	18	35
Knives/scarification	–	–	7	14
Spear tips	4	17	2	4
Sorcery	3	12.5	–	–
Make stone point	1	4	2	4
Rubbish	3	12.5	17	33
Unsure	5	21	5	10
Total	24	100	51	100

TABLE 6.7 Technical terms commonly used by Aborigines

Aboriginal terms	English equivalent
Djrilbung	Direct percussion
Gindilmanu	Retouch
Wabuda	Flake scars
Wabuda ngawubungu-gindilmanu	Retouch scars
Ginyirrbungama	Pressure flaking
Yungiranu or Yibibungama	Flake grinding stones
Djarrga	Striking platform
Yabunda	Unretouched primary flake
Yiri	Sharp
Yiringu	To sharpen
Djinganma	Sharpen spears
Milbungama	Gentle wood scraping
Yunggunma	Grinding

hafted adze in the production of wooden dishes (Love 1942:216; Tindale 1972:246; Hayden 1977:115; Hamilton 1980:7) but the men I worked with said that they preferred to use the proximal end of a blade hafted to a spear thrower.

With continual use these blades would have reduced to slender burren like slugs but they were discarded as soon as they lost their sharp edge and never reached this stage. Archaeologists would recognize such tools as the broken proximal end of a blade displaying unilateral or bilateral edge damage (Fig.6.9b).

Woodworking is not a function commonly associated with blades but it was quite clearly the dominant function for the broken blades recorded in this project. These blades sound very similar to an artefact called kalarra described by Horne and Aiston (1924:90, 91; and Aiston 1928:126; Fig.19). They said these artefacts were used

> mostly in the making of Pirrhas (women's digging bowls)... but were also used in scraping up any wooden implements after it had been roughed out with the Tuhla (1924:90).

Points (Fig.6.10a-c)

We only recorded 31 stone points from the 5,000 plus artefacts examined in the project. The majority of these had been unifacially retouched and only two points had been bifacially trimmed. No Kimberley points were sampled although a few were seen at sites in the region.

Figure 6.10a

Unilaterally and bilaterally unifacially flaked stone points.

Figure 6.10b

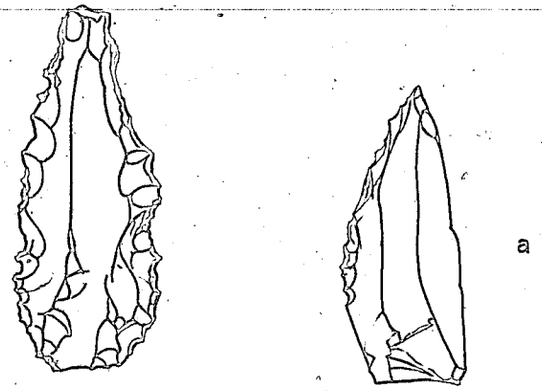
Pressure flaked bifacial point.

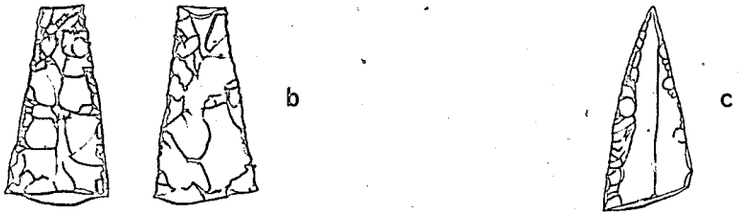
Figure 6.10c

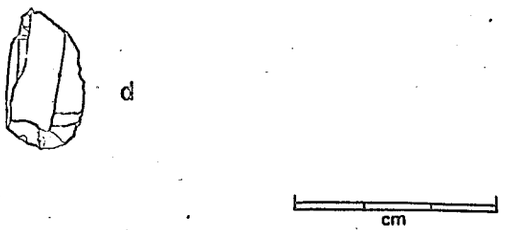
Attractively trimmed unifacial point. This was made of black chalcedony and thought to be used in sorcery.

Figure 6.10d

Burin thought to be used engraving.


a


b
c


d
cm

The Aborigines called all stone points djimbula but drew attention to the fact that some points were pressure flaked (ginyirrbungama; ginyirr [pressure] bunga [hit] ma [make]) whereas the others were simply retouched with gentle percussion (gindilba) (Plate 6.3b). People living near the study area could not pressure flake stone and said that the Ngardi and Djaru people immediately north could (see Love 1936; Elkin 1948; Akerman 1974,1979 for method of manufacture). The desert people I worked with appeared to have had no desire to acquire the skill and seemed quite happy to maintain the traditional exchange of hunting spears for them.

The Aborigines said bifacial points and Kimberley points were very prestigious items and were used as ceremonial tools and as objects of sorcery (see also Etheridge 1890:62; Basedow 1914:62; McCarthy 1946, 1976:19; Davidson and McCarthy 1957:445; Tindale 1965:154; Flood 1970:48; Ackerman 1979:149-50). Kimberley points were used as spear tips to the north (Carnegie 1898; Love 1936) but broke easily (Basedow 1925:370; Love 1936:75) and were much too valuable to have been used in this way in the desert (see also Davidson 1935:170).

Unifacially trimmed points were manufactured locally and were apparently used for a variety of functions. I recorded the functions for 24 artefacts and of these eight (33%) were said to have been used for woodworking, four (17%) were thought to have been used as spear tips, and three (12.5%) were said to have been used in sorcery. The Aborigines said another three (12.5%) were rubbish and were unsure of the function of another five (21%) (Table 6.6).

The Aborigines said that when unifacial points were used for woodworking they were occasionally "levelled" (unifacially retouched) on one margin and hafted with their lateral margins at right angles to the length of the spear thrower. These were used for fine scraping work, particularly when finishing hunting spears. More often though stone points were hafted with their tip exposed and used as engravers to carve wooden implements and incise designs on sacred boards (Fig.6.10). Woodworking was the principal function recorded for these artefacts in this project and is the most commonly recorded function in the literature (Horne and Aiston 1924:90; Aiston 1928:124; Davidson 1934:62; Flood 1970:50; Stockton 1971:53; White and O'Connell 1982:123).

The second most common function (17%) given to unifacially flaked points by the Aborigines was as spear tips for bamboo spears. This function is also commonly recorded in the literature (Horne and Aiston 1924; Aiston 1928:125; Davidson 1934; McCarthy 1957:14; Tindale 1957; Campbell 1960:520; Flood 1970:48; Kaminga 1978:333; Cundy 1980:41). Some of the unifacial points (12.5%) recorded archaeologically were also thought to have been used for acts of sorcery. These points were generally more attractively trimmed (Fig.6.10c) than those used in more profane tasks and were often made from exotic or beautifully coloured raw materials.

Burins (Fig.6.10d)

The function of burins found in Australia is unclear (Mulvaney 1975). Kaminga (1978:269) considers burins do not form a cohesive group and noted that only 6.5% of the examples he examined displayed

damage that would have resulted from the artefacts being used as an engraving tool. Hayden (1979:168) claims burins were used to "shave down wood in a scraping motion". He recorded one burin in an ethnographic situation which had apparently been made by an individual who "just thought about it and made it". This was the first and last burin this informant ever made and it was used to "rub" spears by using "the side, right angled edge of the burin scar as a plane held in the hand" (Hayden 1979:157).

The Aboriginal people I worked with gave a different functional interpretation for burins and clearly identified engraving as the function for which burins were used. We only recorded four burins in the region so I can document the comments made by individuals about these without overloading this section with unnecessary detail.

The first burin was described by Jimi Wirili (a Walmadjeri man from Christmas Creek) and Mick Djagamarra. They agreed the artefact probably was attached to a grip made of spinifex resin and used to engrave lines on a boomerang. The second burin was seen by Jambu and he pointed to the spall and said it was "like wire but use gandi" (white chalcedony) and said it would be used to carve designs on ceremonial boards. He said the tool would have been hand-held and demonstrated its use by mimicing an engraving technique with his thumb nail. The ends of pieces of wire are commonly used for engraving wooden artefacts today. The third burin was also seen by Djambu who thought this one was probably used to gouge out the throwing hole in the end of a hunting spear (gunarridingba). The fourth burin was described by Jimi Djambidjin as being used to drill

or gouge holes in wooden implements and he referred specifically to the construction of the throwing hole in a spear as well as to the hole cut (as well as burnt) through the end of some ceremonial boards.

The Aborigines do not have a specific term for burins but clearly identify them along with various pointed flakes, pointed tula slugs and unifacial points, and engraving or gouging tools.

Edge Ground Axes (Fig.6.11)

The principal chopping implement used by Aborigines in this region were edge ground axes (gurruwa or walgarru) (see also Carnegie 1898:342; Weston 1910:693; Davidson and McCarthy 1957:429). Traditionally they were highly valued and were obtained through trade with neighbouring linguistic units. They are still happily collected today if found at old camp sites.



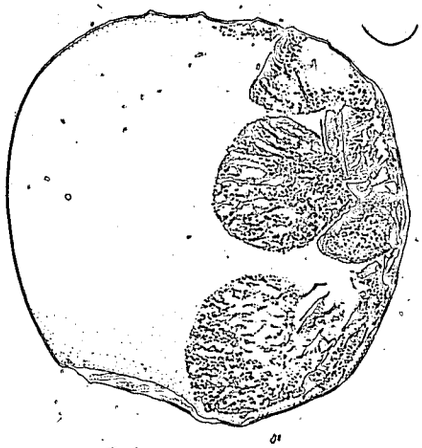
These axes were used to trim branches, cut down small trees and chop blocks of wood from which shields, clubs, spears, spear throwers, boomerangs, women's dishes were made (Spencer 1904:660; De Graff 1968:90; McCarthy 1976:19; Hayden 1979:109; Dickson 1981). Edge ground axes were apparently superior chopping implements to hand-held choppers (Dickson 1981:173) but dropped out of production soon after the introduction of steel hatchets (Spencer and Gillen 1899:575; Love 1936:67). Accordingly the art of manufacture was lost and I imagine this explains the observation of crudely flaked hand-held choppers used by Aborigines after 1940 (Mountford 1942; Thomson 1964; Tindale 1941,1965; Hayden 1979:109). As far as I can ascertain the last

Figure 6.11a

Ground edge axe

Figure 6.11b

Ground edge axe which has been reflaked to sharpen.



a



b

cm

nomadic Aborigine seen still using a ground edged axe was Arthur Djabanangga in 1957 (Thomson 1975:105).

Although now a lost art the manufacture of ground edge hatchets has been described quite frequently in the literature (Carnegie 1898:342; Spencer and Gillen 1899:590, 1904:657; Horne and Aiston 1924:105; Basedow 1925:363; Davidson and McCarthy 1957:426; De Graff 1968:90; Dickson 1981:6; McCarthy 1976; Hayden 1979:109).

Edge ground axe heads were rarely found in sites in the study area and none were recorded in any archaeological samples taken. Those found in the region were very small (average size 65mm x 64mm) and had an average weight of only 151g (Fig.6.11a). This is much smaller than most hatchet heads (see Dickson 1981; White and O'Connell 1982) and no doubt reflects the distance over which they were traded as well as the extent to which they were used before being discarded by local Aborigines. Dickson (ibid.) records that smaller hatchet heads were as effective as larger ones if given longer handles.

In some cases the original ground surface of axe heads found in this region had been resharpened by flaking (Fig.6.11b). I suspect this indicates that axe grinding was not a customary aspect of these peoples' technology. In one extreme example, a ground edge axe had been converted to a steep edged scraper

Ochre

Red ochre (brildji) was the most commonly used ochre in the region. It was traded to neighbouring linguistic units and was used locally as a medicinal and decorative substance. It was commonly used to decorate wooden artefacts and paint men when they were visiting people or were greeting visitors to their camps. It was also used extensively for ceremonial decorations and to paint rock shelters. When used medicinally it was either mixed with goanna fat or saliva and rubbed onto the infected area.

Red siltstone can be found abundantly throughout the region and suitably sized pieces can be collected from most creeks adjacent the hills. The Aborigines drew my attention to a fine deep red exposure of ochre at Nabalabanda (10) in the north of the study area which seemed to be the best source of the material in this region.

Three types of white pigment were used in the study area. These were most commonly used for ceremonial decoration but I have also seen small tablets of white pigment engraved with sacred designs (see Warburton 1875:159 and Carnegie 1898b). These had been carved with flakes of white chalcedony. The most commonly used white pigment was called bilalba and was used as a standard decorative material in most ceremonies. Another type, which I cannot differentiate from Bilalba, was called babaguna and was considered more sacred. It was reserved for decorating sacred boards and painting elderly men. The third type of white pigment was actually gypsum (mawundu). This was chipped from gypsum exposures in creekbeds and was heated in fires, mixed with saliva and painted on participants in ceremonies. To the best of my

knowledge this material, as well as the white down from fledgling wedgetail eagles was the most valued decorative material used in this region. White pigment could be collected from most creekbeds in the northern part of the Stansmore Range although the only exposure of gypsum was located at Mindirr (23).

Yellow pigment (gandawarra) was highly valued but does not seem to have been used as extensively as white or red ochre. I have seen small pieces of yellow pigment carved with simple sacred designs (the Walbiri traded these in the past) and have seen yellow pigment used in paintings in rockshelters. Pieces of yellow pigment can be found in most creekbeds in the area and there is an abundance of nicely shaped pieces of yellow pigment at Gandawarra (45) a waterhole just south of the study area.

Small pieces of ochre and pigment were kept by most men all the time and larger quantities were obtained when ceremonies were underway. Ochre was usually ground against a broken piece of a seed grinding slab or a convenient slab of stone and small fragments were often obtained by gouging a large block with a flaked piece of stone. For everyday use red ochre was simply ground and mixed with fat or water but for ceremonial decoration (madagurru) it was mixed with fluffy white flower heads collected from a small shrub which grows in the hills (Mollugo molluginea). This was stuck onto dancers with blood drained from their arms.

Manuports

The Aborigines used a range of miscellaneous pieces of rock for sacred and non-sacred activities. The most common non-sacred use was as hammerstones and heat retainers and these activities probably account for most of the characterless debris found on archaeological sites in the region. Heat retainers were occasionally placed inside the visceral cavity of large animals to help them cook and were frequently used to cook termites' larvae. Termites'larvae were collected after summer rains and were simply mixed amongst a pile of hot stones and eaten. Piles of such stones (gardang) are often seen at sites and provide evidence for the seasonal occupation of those sites.

The Aborigines used to collect and identify a range of stones they thought were beautifully banded, cracked or naturally sculptured. Many of these were similar to the designs Aborigines carved on ceremonial boards and were considered very sacred (daragu). Other naturally worn stones reminiscent of snakes' heads, dog's feet and other parts of animals were considered to be tangible evidence of dreamtime beings (dingari). Cracked pieces of stone were also collected because the cracks were thought to resemble scarification marks and were said to belong to "dreaming" (djugurrba or guruwari).

Medicine men (Marban) also used a characteristic variety of stones archaeologists would recognize as manuports. Those I have seen were either attractive small water rolled quartzite pebbles or small pieces of pisolithic ironstone. Such stones are rarely seen at sites and contemporary medicine men invariably scout over sites in search

of good specimens.

Another variety of manuports include various pieces of engraved stone. These included sacred stone tablets of the kind described by Warburton (1875:159) and Carnegie (1898b) which display various symmetrical religious designs. The few I have seen were carved into pieces of yellow and white siltstone. Another more common type of engraved stone is characterized by a seemingly random series of linear scratches, grooves and areas of polish. The Aborigines thought some of these "might be dreaming" but also claimed in many instances that someone had simply "made a mark", implying that they were no more than the result of idle doodling. Stones like these or the sacred slabs referred to above were engraved with pieces of flaked stone.

SUMMARY

This chapter describes the functions the Aborigines gave the different types of artefacts recorded in the project. It is quite apparent from the data presented in this chapter that the Aborigines in this part of the Western Desert retain a detailed and reliable memory of the stone tools traditionally used in the region. The men I worked with obviously possessed a detailed knowledge of stone tool form and function and this manifested itself through their detailed technical vocabulary of stone tool types and their individual morphological, technological and functional attributes. The technologically related terms most commonly used by these men are listed in Table 6.7-6.9.

TABLE 6.8 Aboriginal names and functions for artefact types

Artefact type	Aboriginal name	Dominant functions
Unretouched flakes	Nyndurrba	No function
Utilized flakes	Djimeri Langgarru	General wood working
	Gurdung	Hand held, fine scraping
Tula & Burren adze flakes	Djimeri Langgarru	General wood working
Unifacial points	Djimbula	Engraving, spear tips, sorcery
Kimberley points	Djimbula	Sorcery, ceremonial
Lelira blades	Yulamb	Mutilation, ceremonial, fighting
Snapped blades	Material/function	Carving women's dishes & spears
Burin	Material/Function	Engraving
All cores	Material type/flaked	Make stone tools
Hammers	Djrilga	Strike off flakes
Handstones	Djungari	Grind seeds
Grinding slabs	Yibiyanu	Grind seeds
Ground edge axe	Walgarru	Chop wood

TABLE 6.9 Raw materials identified by Aborigines

European name	Aboriginal name
White chalcedony	Djimeri, Gandi, Djula, Yelga
Quartzite	Djrilga, Marban Marban
Green silcrete	Bawarindji
Black ferecrete	Bulimarru
Grey silcrete	Balgarra
Red ochre	Brildji
Yellow pigment	Gandawarra
White pigment	Bilalba
Gypsum	Mawundu
Miscellaneous rocks	Buli

Another interesting feature emerging from this chapter was the extent to which the ethno-taxonomical and functional data recorded corresponds with the material recorded by other ethnographers. Of particular interest also is the close correlation between the Aboriginal taxonomy of stone tools and the formal stone tool typology used in this thesis, and by other archaeologists working in arid Australia. The extent of this correlation adds authenticity to the data presented here and confirms and deepens our understanding of the fuuctions of formally defined stone tool types. Gould (1970:42,1980:120) states quite emphatically that "no reliable or consistent relationship exists between the archaeologists' classification and the Aboriginal classification of stone tools in the Western Desert". In the light of the data presented in this chapter I would venture to say that this is not true.

Bearing this in mind however I think it is necessary to add that despite the extent of the correlation between the archaeological and Aboriginal taxonomies, the Aborigines did classify several types of tools, which were morphologically quite distinct, as more or less the same tools. This was particularly true for the variety of cores recorded and also true to a certain extent for some of the woodworking tools. These were generally referred to as merely flakes of stone hafted to spear throwers although the Aborigines did recognize classic tula adze flakes as superior woodworking tools. They also differentiated small unhafted scraping tools, calling these gurdung; or literally scrapers. In summary I think it would be accurate to state that the system of classification used by the Aborigines was based on a combination of the function of the stone

tools and the raw materials they were made of. They tended not to separate tools which were morphologically different within their classification if they had similar functions. Hayden (1977:87) records a similar thing in the technological projects he conducted in the Western Desert.

Essentially the Aborigines defined three areas in which stone tools were used. These included the use of stone tools in the manufacture of other stone tools; the use of stone tools in the manufacture of wooden implements and the use of stone tools in the preparation of seed foods.

The artefacts thought to be indicative of stone tool manufacture included horsehoof cores, multiplatform and single platform cores, hammers and unretouched flakes. The Aborigines interpreted these artefacts as the sources of raw material, the striking implements and the waste produced. All the cores were referred to collectively by the raw material from which they were made. The waste flakes and hammers were called nyndurrba and djrilga respectively.

The artefacts used in the production and maintenance of wooden implements included tula adze flakes, burren adze flakes, utilized flakes, blades, points and burins. The utilized flakes, tula and burren adze flakes were said to be used as general purpose woodworking tools and were used for the manufacture of all the wooden implements. These artefacts were all referred to as "spear thrower flakes" - i.e. as a particular type of raw material hafted to a spear thrower. However, small hand-held flakes used in woodworking were

referred to as gurdung and said to be used in "cleaning up" wooden implements. The main function of the blades recorded was to carve women's softwood dishes, sharpen spears and smooth the final surface of wooden implements. These were also referred to as flakes of particular raw materials hafted to a spear thrower. Large blades used as knives had quite a distinct function and were called yulambi.

Stone points were thought to be quite distinct from these implements and were generally thought to have been used to engrave wooden articles. These artefacts were called djimbula.

Two implements were used to grind seeds. These included the women's handstone and grinding slab. These were called djungari and yibiyanu respectively.

Several miscellaneous types of artefacts were recorded in the project. The few pieces of ochre and pigment recorded were thought to be used for various sacred and non-sacred decorations. A miscellaneous collection of other rocks were also recorded. The Aborigines thought many of these were simply hammerstones but said some had been collected because they were sacred. Some rocks were also engraved and were thought to indicate sacred symbols and/or the result of doodling by men with stone tools.

Chapter 7

ARCHAEOLOGICAL RECONNAISSANCE

The aim of the archaeological reconnaissance was to record as many artefacts at as many major camp sites in the region as possible in order to determine the extent and nature of any assemblage variability in the region. In this chapter I would like to present a concise outline of techniques used in the archaeological reconnaissance and describe the characteristics of the sites investigated. This is followed by a summary of the techniques used to record the artefacts examined in the project.

Sites Investigated

In the course of the project I attempted to sample the archaeological debris at all the major camp sites occupied by the Aborigines. With the exception of three camp sites this goal was achieved and 19 camp sites were investigated (Table 7.1;Fig.7.2-7.5). The three exceptions included Naligudjarra (5), Nawagudjarra (42) and Djawa Djawa (33). The latter of these sites was not investigated because it was a sacred place for women. The former sites were not investigated beause the exposures of artefacts at them were very poor.

TABLE 7.1 Characteristics of archaeological sites and samples examined

Site	Map reference	Topography	Artefact scatters	Location	SAMPLE EXAMINED Size sq	Exposure %	Artefact nos	Artefact density n²	Other archaeological material
1. Djulugan	Stanmore CB 6564	Large swamp	Margin of swamp	Southern margin	1050	50-70	555	.5	Recent hearths
2. Djarrga Djarrga	Stanmore CB 9443	Creek, rockhole	150m radius of rockhole	70m East and 40m west of rockhole	392	75	488	1	Spearthrower scars on mulga trees
3. Nganawalbinyu	Lucas 641 379	Large deep swamp	Margin of swamp	South East margin	84	100	374	5	-
4. Djungurr	Lucas 649 379	Sandplain, escarpment	Sand-dune to east	End of sand-dune	105	75	523	5	Rock shelters with wooden artefact and paintings
6. Ngandalarra	Lucas 636 386	Large swamp	Margin of swamp	Sand-dune and lunette adjacent swamp	31650	25	68	.002	Hearths, sacred board nearby, sandstone quarry
8. Guralba	Lucas 630 394	Claypan	Margin of claypan	NE Margin	65	100	64	1	-
10. Nabulabanda	Lucas 630 384	Creekline	300m radius of creek	150m south of creek	112	75	204	2	Rockshelters, stone arrangements, recent camps
17. Balgo Balgo	Lucas 675 375	Swamp, creek, floodplains	Margins of flood plain	1km north of swamp	80	100	385	5	-
18. Balabanda	Stanmore CB 8876	Claypan	Western margin of claypan	Foot of lunette	300	50	137	.5	Stone arrangements
19. Djulyurrulyurru	Stanmore CB 8570	Hills, creek, sandplain	Sand-dunes, plains, creekline	Sand-dune, plain and creekline	134	75-100	293	2	Scarred trees
22. Migiliri	Stanmore CB 8768	Rockhole, plains	700m radius from rockhole	Dune, south of rockhole	56	100	613	11	Hearths
23. Mindirr	Stanmore CB 8767	Rockhole, plains	100m radius from rockhole	55m east of rockhole	84	50-75	200	3	Sacred board, cache of animal bones, grinding grooves
25. Diedi	Stanmore CB 8844	Rockhole, escarpments, sandplain	Sandplains and creeklines	500m north along creek	50	90	117	2	Stone arrangement, sacred boards, stone windbreak, hunting pits, rockshelters, painting sites
26. Rundju Rundju	Stanmore CB 9714	Creek, sand-dune	On sand-dune	South side of dune	840	25	90	.11	-
27. Wilbarinyu	Stanmore CB 9658	Hills, flood plain	On flood plain adjacent hills	1km east of hills	192	75	88	.5	Large quarry
28. Dirbayga	Stanmore DB 0150	Creek, hills	500m east of hills, along creekline	400m east of hills	70	100	346	5	-
29. Gawayurru	Stanmore CB 9446	Creek, sandplain	Along creekline	West side of creek	140	100	220	15	-
30. Gundjingrra	Stanmore CB 7548	Escarpment, floodplain	On many claypans	Margin of claypan	48	100	144	3	-
31. Yurinubadu	Stanmore CB 6563	Creek, sandplain	East side of creek	50m east of creek	162	100	665	4	-

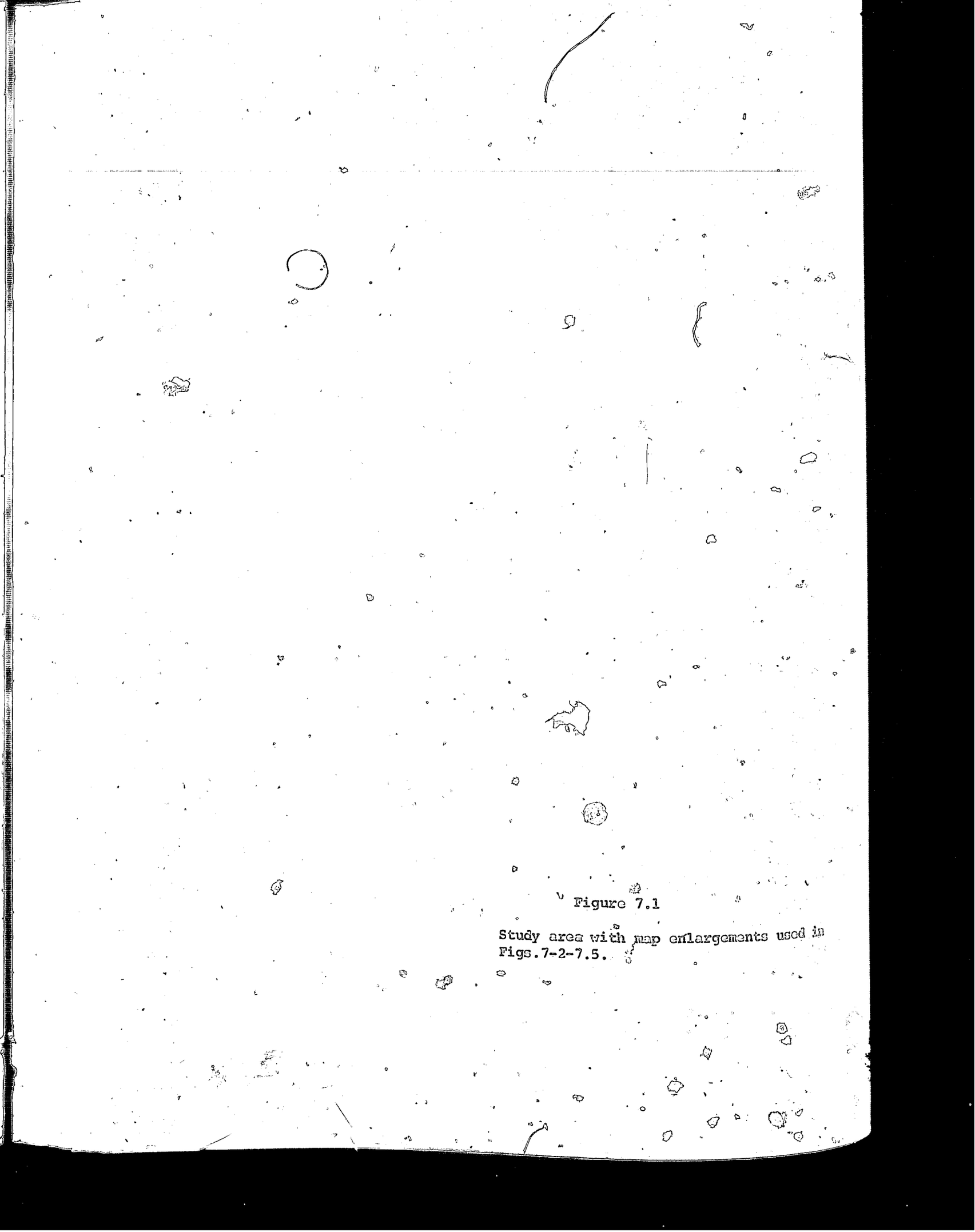


Figure 7.1

Study area with map enlargements used in Figs.7-2-7.5.

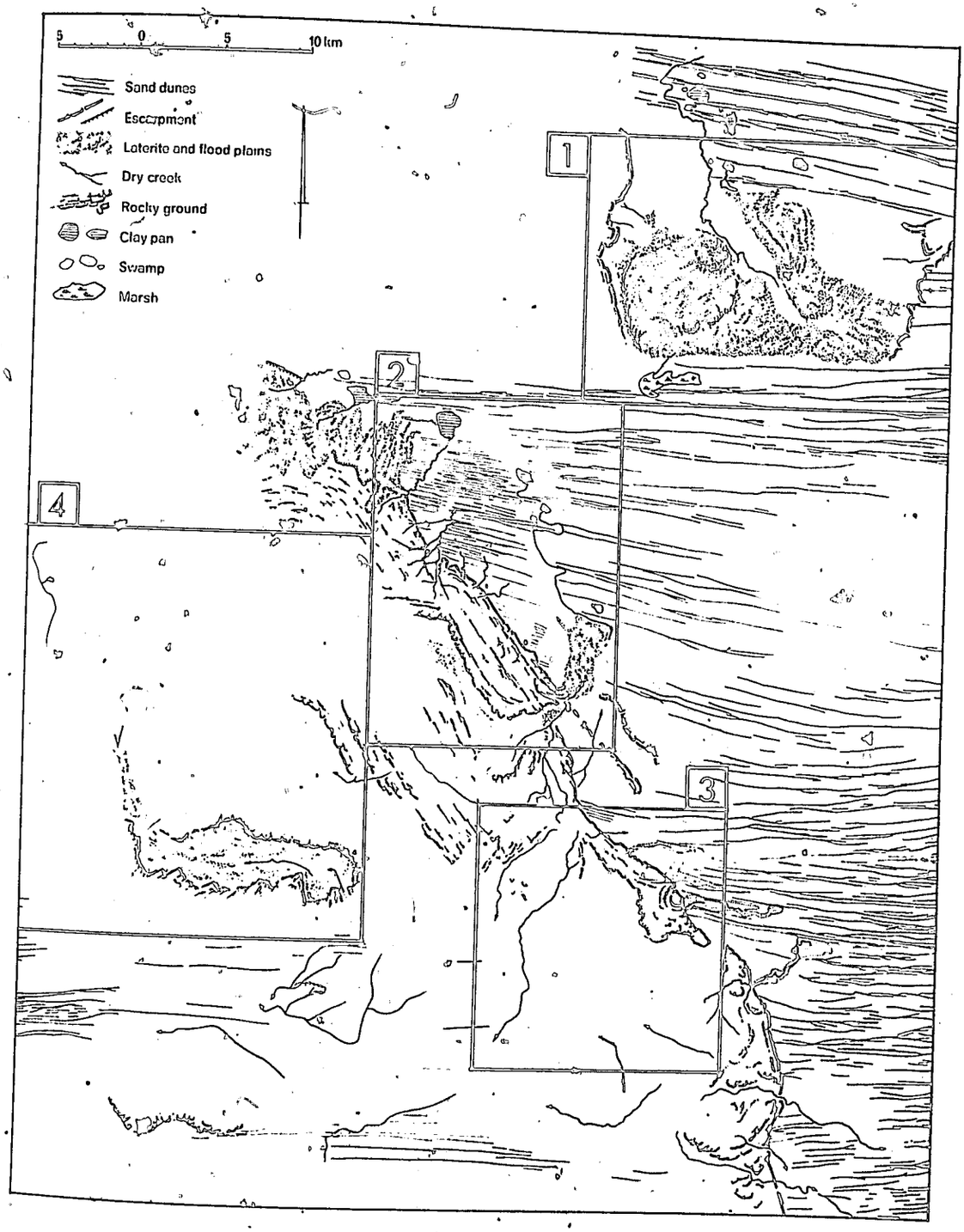

5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
1
2
3
4



Figure 7.2

Sites and location of samples taken in the north of the study area.

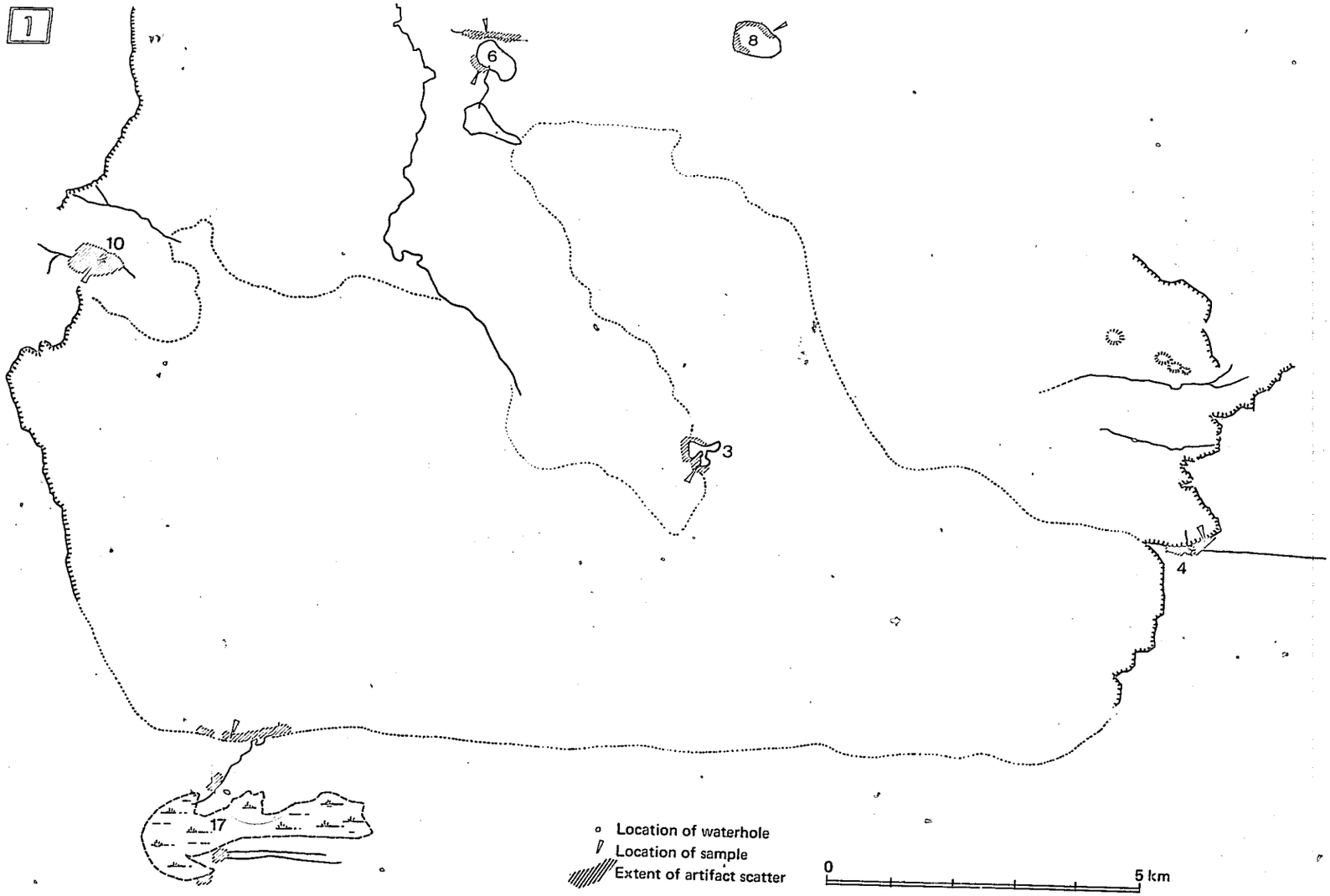

1
6
8
10
3
4
17
Location of waterhole
Location of sample
Extent of artifact scatter
0
5 km

Figure 7.3

Sites and location of samples taken in the centre of the study area.

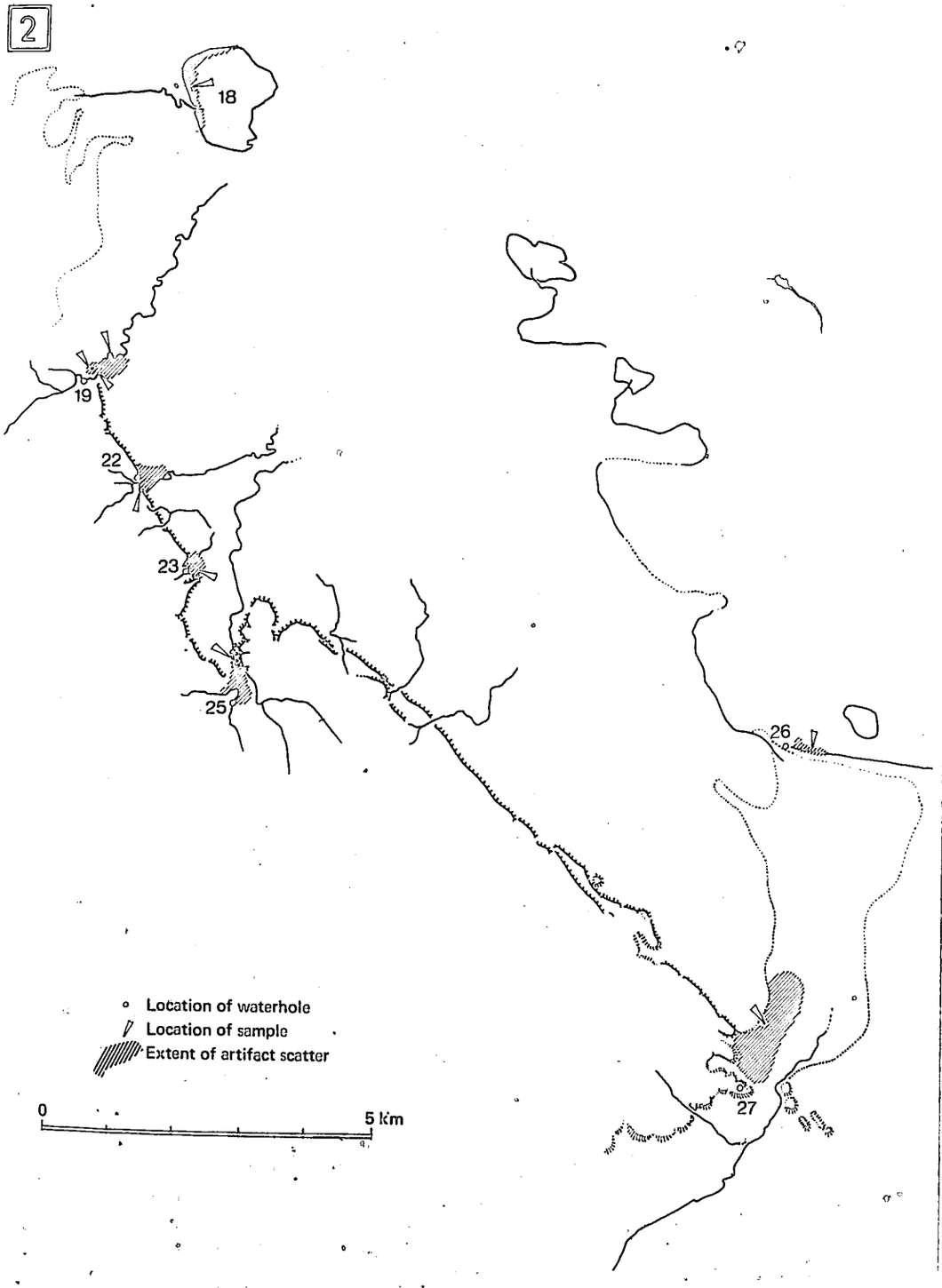

2
18
19
22
23
25
26
27
Location of waterhole
Location of sample
Extent of artifact scatter
0
5 km



Figure 7.4

Sites and locations of samples taken in the south of the study area.

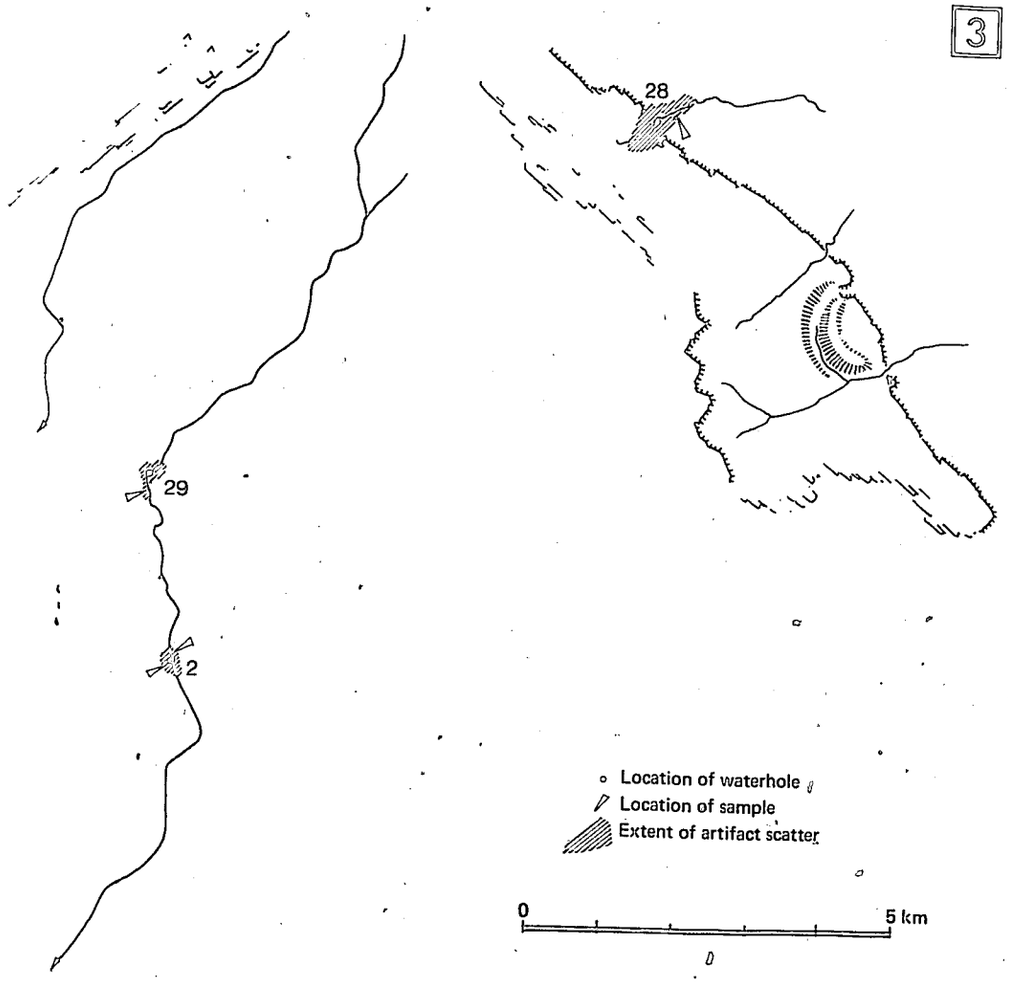

3
28
29
2
Location of waterhole
Location of sample
Extent of artifact scatter
0
5 km

Figure 7.5

Sites investigated in the west of the study area.


4
1
31
30
0
5 km

Sedimentation and vegetation cover was a problem at a lot of sites in the region and at many less important camp sites, there was often virtually no archaeological debris visible at all. At such sites huge areas had to be sampled to record very few artefacts. Archaeological investigation at Naligudjarra (5) gives some idea of the extent to which loose sand and regrowth covered the archaeological debris. Here I examined an area 500m x 200m (100,000 sq m) yet recorded only 22 artefacts. This is an artefact density of only one artefact per 5,000 sq m.

I generally attempted to sample sites with the greatest concentrations of artefacts but nevertheless had to sample some sites where the exposures were relatively poor and the density of artefacts was low. Ngandalarra (6) and Rundju Rundju (26) were such sites (see Plate 7.1a; Table 7.1). It would have been ideal to sample many of the smaller camp sites as well, but apart from the fact that exposures at many of these sites was poor I simply did not have enough field time.

At the conclusion of the field work we had sampled 19 major camp sites. These were spread evenly throughout the region and were located in a variety of different environmental zones. The sites investigated and sample locations are mapped in Fig.7.2-7.5. The locational characteristics of each site are described below and tabulated in Table 7.1.

Plate 7.1a

Thick vegetation cover and low artefact visibility at Nandalarra (6)

Plate 7.1b

Grid on margin of claypan at Guralba (8).





Site Numbers

Nineteen sites were examined during the course of the project. It will be noted in Table 7.1 that the site numbers for these sites runs inconsistently from 1 to 4, 6, 8, 10, 17 to 19, 22 to 23, 25 to 31. This sequence of numbers represents the order in which these sites were visited during the field work and are not intended to be unnecessarily confusing. I have stuck to these original numbers to avoid copying errors and unnecessary confusion when referring to field notes and obtaining information from the computer.

Map Reference

In Table 7.1 the location of each site is given using a grid reference to a particular map sheet. These map sheets are:

Stansmore SF52-6; Edition 2, Series R502 and Lucas SF52-2, Edition 1, Series R502.

The sites can also be located on the following air photos:

Stansmore F52-6; Run 1 No. 52, Run 2 No. 256, 264, Run 3 No. 73, 82; 1971

Stansmore F52-6; Run 3 No. 6654; 1977 and Lucas F52-6; Run 8 No. 79, 81, 85;1971

Topography

All of the archaeological sites examined in this project were located around different types of waterholes. These included seven rockholes, five soaks or large waterholes in creeks, three claypans and four swamps. The use of the term "swamp" in desert landscape may seem inappropriate but this term is in fact most accurate for the

wet, spongey, tree clad land characteristic of these internal drainage areas. The waterholes themselves are set against various forms of terrain. Six sites were located in the north of the study area, where the topography is largely dominated by escarpments, sandplains, flood plains and laterite plains. Seven other sites are located within the general vicinity of the Stansmore Range, itself a dominant feature in the landscape. A further five sites were located adjacent creeklines in the sandplains and one site is located on a flood plain underneath a large escarpment in the south of the study area.

Artefact Scatters

The archaeological debris at these sites consists almost entirely of artefact scatters. These are true open sites and represent the surviving habitation debris from the occupation of these sites as habitation base camps during the recent past. The principal characteristic of these artefact scatters is that they are diffuse - often spreading for hundreds of metres from the central water resource. At these sites artefacts were usually exposed in highly deflated erosion surfaces and contained no stratigraphy (Plate 7.1b,7.2a and b). With the exception of recently discarded objects and recently abandoned camp fires there are no organic remains and no discernible pattern in the distribution of artefacts at these sites.

In the absence of any stratigraphy and organic remains it was not possible to date these sites. On typological grounds alone the presence of many elements of the "small tool tradition" suggests they were occupied within the last 5,000 years. No coarse, heavy duty,

elements classically associated with the "core tool and scraper tradition" were seen at any sites (see Flood 1970; Bowler et al.1970; Mulvaney 1975; Dortch 1977; Gould 1977; White and O'Connell 1980 for relevant chronological details).

Sample Location

Because of the diffuse and deflated nature of open sites they are relatively difficult to sample adequately. This problem is not peculiar to open sites alone within archaeology but nevertheless it is a problem just the same. The two potential difficulties with open sites are that each site may display marked internal archaeological diversity and that differing levels of exposure may bias the appearance of the archaeological debris and therefore reduce the reliability of inter-assemblage comparisons.

There was very little I could do about these problems short of conducting large open area excavations; which the nature and timing of the project did not allow. Therefore the only way to reduce the impact of these potential problems was to sample as much of each site as possible and place samples over areas of maximum deflation; where the complete array of artefact types were visible and the possible biasing influence of sedimentation were likely to be least.

In the course of this project therefore, I recorded 24 samples at 19 sites. This included one sample at each site investigated and three samples at Djarrga Djarrga (2), two at Ngandalarra (6) and three at Djulyurrlyurru (19). These were generally placed on the

margin of waterholes, creek banks or across wind swales or erosion channels where the exposure of artefacts was greatest. The location of these samples is mapped in Fig. 7.2-7.5.

Sample Size

In accordance with O'Connell's recommendation (1977:277) when sampling open sites of this kind I always attempted to record at least 100 sq m of each site. As can be seen from Table 7.1 I generally recorded largersamples than this, but at eight sites this was not possible. There were several independent factors which influenced the extent to which sites could be sampled. One of the most obvious was that the amount of time we could spend at a site depended on the amount of water and petrol we were carrying. If we ran out of these essential supplies and had to leave I sometimes found the Aborigines were not keen to return to the same places again. This was particularly so at places such as Wilbarinyu (27), Guralba (8), Gundjimarra (30) where the hunting and foraging potential was poor. Hence the samples at these sites were relatively small. A second and overriding reason related to the amount of time the Aborigines were prepared to stay at certain camp sites and/or spend helping with the archaeological research. The constant irritation of flys, ants, wind, desert prickles, exposure to the scorching sun etc. made archaeological work on open sites very strenuous. Consequently if I ever felt the Aborigines were getting bored and uncomfortable I packed up and went hunting. Overall the Aborigines were remarkably helpful but I was very conscious of accidently "turning them off". Thirdly the artefact density at some sites was very high and at these sites the quantity of artefacts

meant it was too time consuming to sample an overly large area. Such a case occurred at Migiliri (22) where we recorded over 600 artefacts in only 56 sq m.

Because of the influence of these factors the samples taken at eight sites were less than 100 sq m. At the remaining 11 sites however the samples varied from 105 sq m to 31,000 sq m. The largest samples were generally taken at sites where the exposure of artefacts was poorest and large areas had to be sampled to record a sufficient number of artefacts.

Exposure

As indicated above I always tried to sample artefacts in areas of maximum deflation. Samples were usually placed over wind swales, erosion gutters, creek banks, claypan margins (Plate 7.1b,7.2a and b) and so on where the maximum amount of artefacts were deflated onto the residual ground surface. I usually sampled areas where I thought at least 75% of the artefacts were exposed. At two sites (Ngandalarra (6) and Rundju Rundju (26)) there were no areas of extreme deflation and at these sites the level of artefact exposure was relatively poor. At both sites I had to sample large areas to record widely scattered pockets of artefacts exposed in small wind swales between spinifex bushes.

Artefact Numbers

I generally tried to sample as many artefacts possible at each site; however at four sites the number of artefacts recorded was less than I would have liked. At Guralba (8) and Wilbarinyu (27) there was

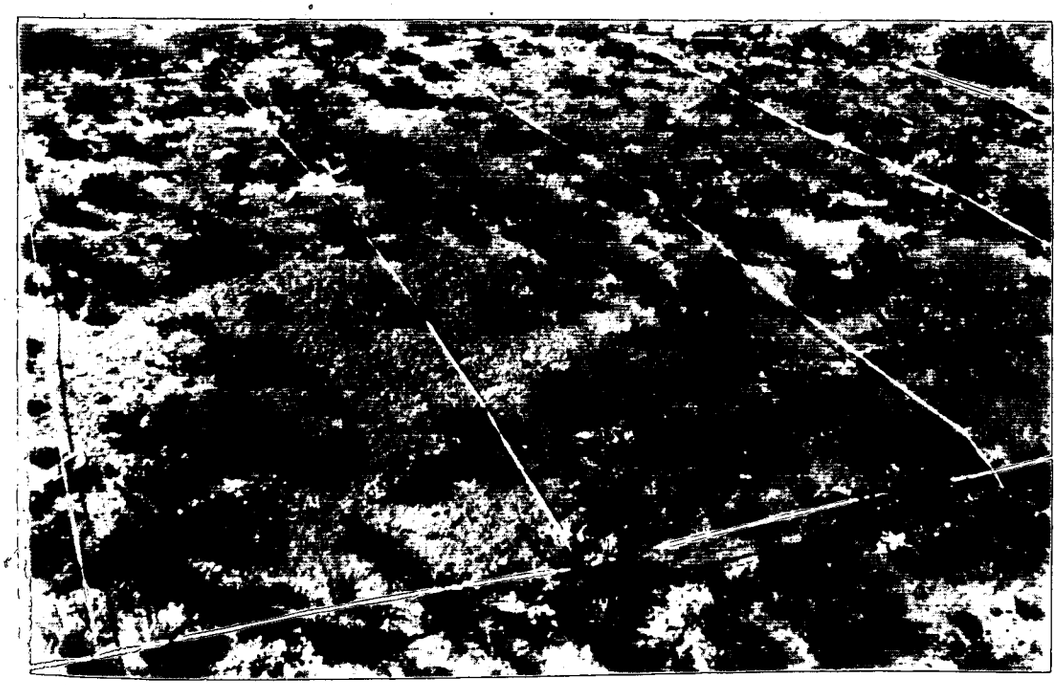
Plate 7.2a

Highly deflated scatter of artefacts sampled at Migiliri (22).

Plate 7.2b

Part of grid at Gawayurru (29).





no natural supply of water and we could not stay at these sites long. Therefore we only had time to examine 64 artefacts and 88 artefacts respectively. At another two sites Ngandalarra (6) and Rundju Rundju (26) the density of artefacts was very low and despite sampling large areas we only managed to record 68 artefacts and 90 artefacts respectively. At the other sites however decent sized samples of artefacts were recorded. The number of artefacts varied between 117 and 665.

Artefact Density

The density of artefacts per sq m is included in Table 7.1 to give the reader some idea of the distribution of artefacts in the samples recorded. It will be noticed that generally the greater the level of exposure the greater the concentration of artefacts.

Other Archaeological Material

Archaeological debris recorded at or in the vicinity of these sites sampled included scarred trees, rockshelters, organic remains, quarries, caches of sacred objects and stone arrangements. The principal objective and timing of this project did not allow a detailed consideration of these other forms of archaeological debris, so only a brief description is given below.

Organic Remains

The only bone remains found in any of the open sites examined in the project included the proximal end of a bandicoot femur and several fragmented reptile vertebrae wedged between two bone crushing

stones at Mindirr (23). Traditionally bones were either pulverized and eaten broken up to obtain marrow or consumed by scavengers such as crows and dingoes. The only plant remains found on the project included charcoal from recently abandoned hearths and fragments of broken boomerangs, spear throwers and digging sticks. A small piece of baler shell (Melo sp.) was found by K. Akerman at a site outside the study area. This must have been traded from the north west coast; over 1,000km away.

Scarred trees

Scarred trees were recorded at Djarrga Djarrga (2), Naligudjarra (5), Djulyurrulyurru (19), Diedi (25) and Yurinubadu (31). Those recorded were either the result of the removal of bark for dishes, or blanks for digging dishes and spear throwers.

Stone Arrangements

Stone arrangements were recorded in the vicinity of Dalabanda (18), Diedi (25), Nabulabanda (10) and Djungurr (4). Many standing stones were located between Guralba (8) and Yunggubalibanda (9). These related to the "bush potato" ceremony held in that region. Other stone arrangements recorded included individual stones, composite stone structures, circular and linear arrangements and other standing stones. Some other stone arrangements recorded were simply cleared areas of ground intended to reveal particularly unusual natural patterns in the bedrock, or to mark the location of particular feats achieved by medicine men.

Accurate plans and photographs of these structures have been made and the relevant mythological stories recorded. Unfortuntely the sacred nature of these features prevents them from being presented here.

Rock Shelters

Approximately 40 rockshelters were located in the vicinity of Diedi (25), Nabulabanda (10) and between Diringberri (11) and Yungubalibanda (9). Most of these contained shallow archaeological deposits and a variety of organic remains such as firewood, charcoal, broken spears, wood shavings and so on. Most shelters were usually occupied by family groups during heavy wet season rains; however quite a few shelters were also sacred places and contained caches of carved ceremonial boards, engraved stones, ochre, paintings, hand stencils and so on. These were only occupied by men.

Quarries

The stone quarries located in the study area have already been referred to in Chapter 6 (Fig.6.3). To recap briefly; the best quarries in the region were two white chalcedony quarries located near Lambanlamban (32) and Marl (37). The latter of these was very large - extending over 4km in an east west direction. Another white chalcedony quarry was located about 10km west of Migiliri (22). Two green silcrete quarries were located in the region; one near Wilbarinyu (27) and the other near Mirrilmirril (44). Once again these were very large quarries extending over half a kilometre in any direction. Exposures of black ferecrete were quarried in the hills near Djungurr (4) and Birbayga (28) and a poor quality grey silcrete

was quarried on the escarpment adjacent Mindirr (23).

Artefactual Recording Techniques

The original intention of the field work was to record as many artefacts as possible while actually in the field. The only artefacts that were returned to the laboratory were those that required drawing or further consideration. I chose this approach for two reasons. The first and overriding reason was the Aborigines I worked with had never seen an archaeologist before and knew nothing of the archaeological procedures. I therefore felt it best to record everything in front of them and return each artefact to the place I collected it from. In this way very little disturbance was caused to their old camp sites and no suspicion was aroused. The second reason was that it was quicker to record each artefact as I collected it rather than bag, label, pack, unpack, relabel, analyse, rebag and repack each artefact returned to the laboratory. The technique of recording artefacts in the field turned out to be most efficient and we recorded a total of 5,714 artefacts during the course of the field work.

I had some previous experience of the archaeologicial debris in this region, before commencing this project and was able to design a recording form for the project which was quite adequate for the salient characteristics of the artefacts found in the area. This form is reproduced in Fig.7.6 and the main features of it are described below.

Figure 7.6

Artefact recording sheet used in project.

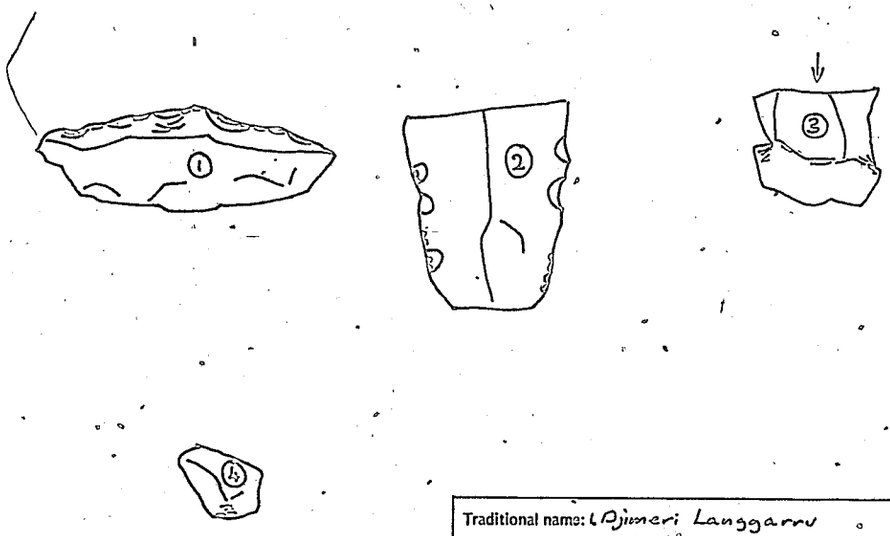
Site Diedi (35) Area/ Feature Square 1/1 Date 25.6.83

Material 1-3 chalcedony, 4-silcrete Colour 1-3 white, 4 - green

Cortex NONE Heat treatment NONE

4 Unut. fl.	Point	2 Horse hf.cr.	Hammer
Ut. fl.	2 Blade	Single plt. core	Handstone
Tula adze fl.	Burin	Mult. plt. core	Grinding slab
1 Tula adze sl.	Core scrapers		Ochre
Burrên adze			Manuport

Distal



		Left	Right	Proximal Prox.	(Bulb) Dist.
	Dorsal	2	2		1
	Ventral				
Sec.	Stepped	2	2		1
Sec.	Scalar				
Sec.	Invasive				
Tertiary	Stepped	2	2		1
Tertiary	Nibbled				
Tertiary	Crushed				
Tertiary	Broken				2
Tertiary	Pecked				
Tertiary	Percussion				
Tertiary	Ground				
Tertiary	Polish.				

Traditional name: 1. Djimeri Langgarru
2. Djimeri
3. Djimeri
4. Ngyndurrba

Implement:
1+2. Djuna (resin) - langgarru (spear thrower)

Function:
1. Wood working
2. Carve woman's bowls
3 Djïlbung (knock him down)
4 nothing

Worked edges:
1. Sharpen: leave him
2. Use him

Miscellaneous:
1. big one
2. Good Djimeri

Site

The number and name of the particular site under investigation which was recorded on each form.

Area/Feature

The number of the particular square we were working on within each grid sample was also recorded on the form.

Material

The material type from which each artefact was made was recorded.

Colour

The colour of each artefact was also recorded. This provided supplementary information to the type of raw materials used for each artefact.

Cortex

The presence of cortex was recorded for each artefact whenever it occurred.

Heat Treatment

No heat treated artefacts were recorded in the artefacts sampled.

Artefact Types

The form catered for 17 different types of artefacts. This list was based on previous knowledge of the types of artefacts found in the region and was quite satisfactory. The only unexpected feature was that no choppers were recorded and one backed blade was found at Djulugan (1). The terms used here for each artefact type have been taken from Mulvaney (1975); Gould et al. (1977) and O'Connell (1977). The morphological characteristics of these artefact types have been described in Chapter 6.

As can be seen on the dummy form presented in Fig.7.6 each artefact recorded was traced and given a number. This number was plotted on an attached plan of the grid under investigation and was used to identify each artefact with its particular type; raw material, colour and so on. This artefact number was also used as an identity code to locate and recognize each artefact in site notes and in the computer. For example, the first artefact in Fig.7.6 was recorded in grid square 1/1, at Diedi (25) and can thus be recognized as artefact 25,11,1.

Artefact Tracing

Plans were traced around each artefact recorded, thus allowing the documentation of any distinctive morphological characteristics such as burin spalls, unusual edge shapes or edge damage and provided an approximate guide to the size of each artefact.

Artefact Size

The size of each artefact was recorded from this plan by measuring the length and width from the tracing. The length of each flake was recorded at right angles from the striking platform to the furthest point on the distal margin. Width was measured at the widest point at right angles to the length measurement.

In the case of cores, length was measured along the perpendicular from the striking platform but in the case of multiplatform cores, was measured parallel to the direction from which the majority of flakes had been struck. Width was again recorded at right angles to these length measurements. The length of artefacts without striking platforms was recorded between the greatest distance in a straight line between two points and width was again recorded at right angles to this.

Retouch Characteristics

A table at the bottom of each form was designed to record the location and type of retouch on each artefact recorded on the form. This was done by placing the number of each artefact in the appropriate squares. The dummy examples given in Fig. 7.6 indicate how this worked. For example artefact No. 1 had secondary and tertiary step flaking on the dorsal surface of its distal margin. Artefact No. 2 had scalar retouch and nibbling on the dorsal surface of its right and left margins. The term used to define the types of edge damage have been adopted from Gould et al. 1971 and Hayden 1979.

Traditional Information

Traditional information for each artefact was recorded in the space at the bottom of the form. The information usually recorded included the traditional name and particular function of each artefact. Where relevant, I also tried to record information regarding the type of wooden implements to which the artefacts may have been hafted and any comments the Aborigines had to make regarding the edge damage on each artefact. Miscellaneous comments made by the Aborigines were also recorded. The techniques used to record this information were described in Chapter 6.

Coding and Computing

All the data recorded on this form was given numerical codes, recorded on another sheet (Fig.7.7) and transferred to the DEC-10 computer system for analysis. The bulk of the analysis was done using simple crosstabulations and frequency routines available in the Statistical Package for Social Scientists (Nie et al. 1975). These routines were fast and flexible and could provide data to answer questions such as the number of artefacts at each site, the size of the cores recorded, the functions the Aborigines gave the artefacts recorded and so on. A more sophisticated multivariate statistical technique, was required to analyse the nature of the proportional distribution of the artefacts in the region and this is described in detail in the following chapter.

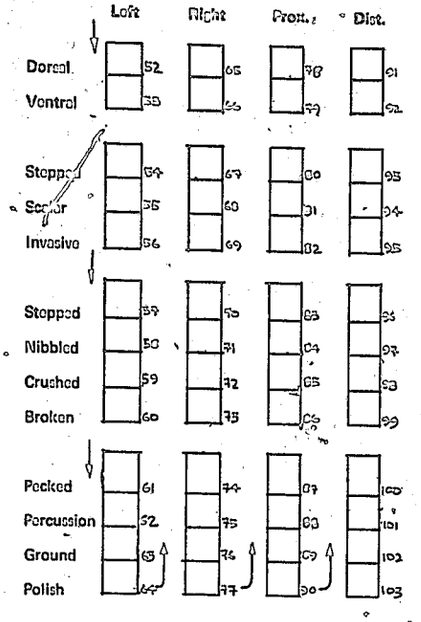
Figure 7.7

Coding form used in project.

CODING FORM

Page

Variable	
1	Site number
2	Square number
3	Artefact number
4	X coordinate
5	Y coordinate
6	Material
7	Colour
8	Cortex
9	Artefact type
10	Length
11	Width
12	Total length retouch
13	Shape of edge 1
14	Shape of edge 2
15	Shape of edge 3
16	Nature of groove
17	Traditional name
18	Implement
19	Function
20	Worked edge(s)
21	Miscellaneous



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CHAPTER 8

ETHNOGRAPHIC AND ARCHAEOLOGICAL COMPARISONS

Before the nature of the correlation between the artefactual composition of open sites and the activities of the Aborigines inhabiting them can be discussed it is necessary to demonstrate that variation in the representation of artefacts at major sites in the region under examination is sufficient to be recognized archaeologically. To date the only archaeological investigation into open sites in the Western Desert has revealed there is no significant inter-assemblage variation. Hayden (1976, 1979) concluded:

> if pronounced differences between tool proportions in assemblages do occur in the Western Desert ... it seems that they occur under very exceptional circumstances and are very rare (1979:169).

O'Connell (1977:267) on the other hand thought there were "significant intersite differences in the composition of stone tool assemblages in Central Australia" but Isaac (1977:10) felt that any variation apparent in O'Connell's material was "rather subtle".

I find it difficult to believe that in an area as large as the Western Desert there is little variation in the composition of stone tool assemblages. It seems inconceivable that the Aborigines conducted more or less the same activities, used and discarded the same stone tools in much the same frequencies at all the sites they

camped at. Over the last four years that I have worked in the Western Desert I have recorded approximately 90 open sites in a region of about 7,500 sq km in and around the study area. If this density of sites holds true for the entire Western Desert then we are led to believe that there are approximately 92 million archaeological sites in this part of Australia which are more or less the same!

This chapter therefore begins with an examination of the nature and magnitude of the variation in the proportional representation of stone tools at major camp sites in the region. Having demonstrated the extent of this variation it then goes on to address the question of how effectively the proportional varition apparent in the distribution of stone tools reflects variation in human behaviour.

Variation in proportions of artefact types

In this project we recorded 5,714 artefacts represented by 16 different types of artefacts at 19 sites. The frequencies and percentages of each artefact type at these sites are presented in Table 8.1. From this total it is apparent that unretouched flakes constituted approximately three quarters of the archaeological debris and many artefact types such as stone points, burins, core scrapers and horsehoof cores were represented in very low numbers. One backed blade was recorded at Djulugan (1) but this has not been entered on the table. Other artefact types were relatively well represented and it is within these groups that obvious variations in the archaeological record can be detected.

TABLE 8.1 Quantity of artefacts at each site

SITES		ARTEFACT TYPES: Unretouched flakes	Utilized flakes	Tula adze flakes	Burren adze flakes	Points	Blades	Burins	Core scrapers	Horsehoof cores	Single platform cores	Multiplatform cores	Hammers	Handstones	Grinding slabs	Ochres & Pigments	Manuports	Total
1. Djulugán	n	442	33	27	4	2	20	0	0	1	2	5	3	7	7	1	1	555
	%	79.6	5.9	4.9	0.7	0.4	3.6	0.0	0.0	0.2	0.4	0.9	0.5	1.3	1.3	0.2	0.2	
2. Djarrga Djarrga	n	345	8	30	1	2	7	0	1	0	0	0	6	31	53	0	4	488
	%	70.7	1.6	6.1	0.2	0.4	1.4	0.0	0.2	0.0	0.0	0.0	1.2	6.4	10.9	0.0	0.8	
3. Nganawalbinyu	n	252	45	18	2	3	3	0	0	0	5	9	7	3	15	2	10	374
	%	67.4	12.0	4.8	0.5	0.8	0.8	0.0	0.0	0.0	1.3	2.4	1.9	0.8	4.0	0.5	2.7	
4. Djungurr	n	405	30	15	1	3	7	0	0	3	0	7	18	5	17	5	7	523
	%	77.4	5.7	2.9	0.2	0.6	1.3	0.0	0.0	0.6	0.0	1.3	3.4	1.0	3.3	1.0	1.3	
6. Ngandalarra	n	41	3	4	0	1	0	0	0	0	1	1	0	6	6	4	1	68
	%	60.3	4.4	5.9	0.0	1.5	0.0	0.0	0.0	0.0	1.5	1.5	0.0	8.8	8.8	5.9	1.5	
8. Guralba	n	37	5	4	0	1	0	0	0	3	1	1	1	4	6	0	1	64
	%	57.8	7.8	6.3	0.0	1.6	0.0	0.0	0.0	4.7	1.6	1.6	1.6	6.3	9.4	0.0	1.6	
10. Nabulabanda	n	141	16	4	2	1	3	0	0	0	1	9	0	1	15	9	2	204
	%	69.1	7.8	2.0	1.0	0.5	1.5	0.0	0.0	0.0	0.5	4.4	0.0	0.5	7.4	4.4	1.0	
17. Balgo Balgo	n	261	62	10	2	2	19	1	1	0	2	8	2	3	11	1	0	385
	%	67.8	16.1	2.6	0.5	0.5	4.9	0.3	0.3	0.0	0.5	2.1	0.5	0.8	2.9	0.3	0.0	
18. Dalabanda	n	91	13	0	0	1	7	1	0	0	0	0	0	6	17	1	0	137
	%	66.4	9.5	0.0	0.0	0.7	5.1	0.7	0.0	0.0	0.0	0.0	0.0	4.4	12.4	0.7	0.0	

TABLE 8.1 (continued)

SITES		ARTEFACT TYPES: Unretouched flakes	Utilized flakes	Tula adze flakes	Burren adze flakes	Points	Blades	Burins	Core scrapers	Horsehoof cores	Single platform cores	Multiplatform cores	Hammers	Handstones	Grinding slabs	Ochres & Pigments	Manuports	Total
19. Djulyurrulyurru	n	226	6	4	1	1	3	0	1	2	0	6	3	1	26	4	9	293
	%	77.1	2.0	1.4	0.3	0.3	1.0	0.0	0.3	0.7	0.0	2.0	1.0	0.3	8.9	1.4	3.1	
22. Migiliri	n	540	3	10	0	4	0	1	0	2	2	5	0	3	32	6	5	613
	%	88.1	0.5	1.6	0.0	0.7	0.0	0.2	0.0	0.3	0.3	0.8	0.0	0.5	5.2	1.0	0.8	
23. Mindirr	n	263	3	1	0	0	1	0	0	0	3	0	1	1	7	0	0	280
	%	93.9	1.1	0.4	0.0	0.0	0.4	0.0	0.0	0.0	1.1	0.0	0.4	0.4	2.5	0.0	0.0	
25. Diedi	n	147	4	8	1	3	3	0	0	0	1	1	0	0	9	0	0	177
	%	83.1	2.3	4.5	0.6	1.7	1.7	0.0	0.0	0.0	0.6	0.6	0.0	0.0	5.1	0.0	0.0	
26. Rundju Rundju	n	44	5	0	1	1	1	0	0	0	0	3	1	3	21	0	10	90
	%	48.9	5.6	0.0	1.1	1.1	1.1	0.0	0.0	0.0	0.0	3.3	1.1	3.3	23.3	0.0	11.1	
27. Wilbarinyu	n	28	13	0	0	1	1	0	0	0	0	7	6	3	1	1	27	88
	%	31.8	14.8	0.0	0.0	1.1	1.1	0.0	0.0	0.0	0.0	8.0	6.8	3.4	1.1	1.1	30.7	
28. Birbayga	n	286	10	10	0	3	1	0	0	2	1	11	0	3	17	1	1	346
	%	82.7	2.9	2.9	0.0	0.9	0.3	0.0	0.0	0.6	0.3	3.2	0.0	0.9	4.9	0.3	0.3	
29. Gawayurru	n	171	5	4	0	1	1	0	0	0	0	0	1	9	26	0	2	220
	%	77.7	2.3	1.8	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	4.1	11.8	0.0	0.9	
30. Gundjimarra	n	133	3	0	0	0	0	0	0	0	0	5	3	0	0	0	0	144
	%	92.4	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	2.1	0.0	0.0	0.0	0.0	
31. Yurinubadu	n	625	14	12	1	1	2	1	0	0	3	4	1	0	1	0	0	665
	%	94.0	2.1	1.8	0.2	0.2	0.3	0.2	0.0	0.0	0.5	0.6	0.2	0.0	0.2	0.0	0.0	
Total nos		4478	281	161	16	31	79	4	3	13	22	82	53	89	287	35	80	5714
Total %		78.4	4.9	2.8	0.3	0.5	1.4	0.1	0.1	0.2	0.4	1.4	0.9	1.6	5.0	0.6	1.4	

The proportion of unretouched flakes for example varies from as low as 31.8% at Wilbarinyu (27) to 94% of the assemblage of artefacts at Yurinubadu (31). The proportion of utilized flakes varies from as low as 0.5% at Migiliri (22) to over 16% at Balgo Balgo (17). The proportion of tula adze flakes varied from a total absence at Rindju Rundju (26) to over 6% at Guralba (8). Similarly blades were totally absent at some sites but constituted approximately 5% of the assemblages at Balgo Balgo (17) and Dalabanda (18). Handstones and grindstones were also absent at some sites but constituted as much as 8.8% and 12.4% respectively of the assemblages at Ngandalarra (6) and Dalabanda (18).

The presence of this inter-assemblage variation raises two questions which will be discussed in the remainder of this chapter. The first is, how significant is this variation in the proportion of artefacts at each site? The second, is there a pattern to this variation and how does it conform to the pattern of economic activity conducted by the Aborigines at these sites?

Statistical significance of the variations

Before any assessment of the actual significance of the variations apparent in the proportional representations of artefacts at sites can be made, the archaeological debris needs to be re-examined with a view to emphasising the functional aspects of the data. This has the advantage of revealing obvious patterns in the artefactual compostion of sites and increasing the frequency of artefacts per category sufficiently to allow statistical analysis of

their distribution. It also has the advantage of absorbing artefact types such as burins, horsehoof cores, core scrapers and burren adzes, which are present in such low numbers they are of little use in discriminating between sites. In other words it makes it easier to determine and interpret the functional variability apparent between sites and compare this with the subsistence activities practised at those sites.

In Chapter 6 I defined the functions of the artefact types recorded in the project and drew attention to the fact that the Aborigines did not differentiate between artefact types on morphological grounds if they had similar functions. Because of this, artefacts with similar functions can be combined into broad functional categories, thus highlighting the functional aspects of the archaeological data without distorting the archaeological picture. For example handstones and grinding slabs can be grouped into a functional category of seed grinding tools; utilized flakes, tulas, burren adzes and core scrapers can be classed into a functional category of scrapers; points and burins can be classed together as engraving tools; horsehoof cores, multiplatform cores and single platform cores can be grouped together as cores.

This condenses the 16 different types of artefacts into nine artefact categories. The new categories are unretouched flakes, scrapers, engravers, blades, cores, hammers, grindstones, ochres and manuports.

The proportions of these redefined categories are presented in Table 8.2. It is immediately apparent that, with the exception of the frequencies of ochre and engravers, the numbers of artefacts in each category are significantly increased and thus the major functional components of the entire assemblage are better defined. This makes it possible to examine the extent of the proportional variation apparent within these artefact categories from a statistical point of view. The results of a chi-square analysis of the proportional variation in each of these artefact categories is presented in Appendix 2. It can be seen from these tables that there is indeed "significant intersite differences in the composition of stone tool assemblages" (O'Connell 1977:269).

The magnitude of this statistical variation is most apparent when examining the proportional extremes within each artefact category. For example the variation in the proportional representation of unretouched flakes between Wilbarinyu (27) (31.8%) and Yurinubadu (31) (94.0%) is highly significant ($P<0.001$). Similarly the variation in the proportion of scrapers between Balgo Balgo (17) (19.2%) and Mindirr (23) (1.4%) is also highly significant ($P<0.001$). So the pattern is repeated for the variation apparent between the proportions of blades at Birbayga (28) (0.3%) and Dalabanda (18), (5.1%); cores at Guralba (8) (7.8%) and Djarrga Djarrga (2) (0.2%), hammers at Djungurr (4) (3.4%) and Yurinubadu (31) (.2%); grindstones at Ngandalarra (6) (17.6%) and Yurinubadu (31) (.2%); manuports at Wilbarinyu (27) (30.7%) and Djulugan (1) (0.2%); all being highly significant statistically ($P<0.001$, Appendixes A2.1-2.9).

TABLE 8.2 Quantity of redefined artefact categories per site

SITES		ARTEFACT CATEGORIES										
		Unretouched flakes	Scrapers	Engravers	Blades	Cores	Hammers	Grindstones	Ochred & pigments	Manuports	Total
1. Djulugan	n	442	64	2	20	8	3	14	1	1	555
	%	79.6	11.5	0.4	3.6	1.4	0.5	2.5	0.2	0.2	
2. Djarrga Djarrga	n	345	39	2	7	1	6	84	0	4	488
	%	70.7	8.0	0.4	1.4	0.2	1.2	17.2	0.0	0.8	
3. Nganawalbinyu	n	252	65	3	3	14	7	18	2	10	374
	%	67.4	17.4	0.8	0.8	3.7	1.9	4.8	0.5	2.7	
4. Djungurr	n	405	46	3	7	10	18	22	5	7	523
	%	77.4	8.8	0.6	1.3	1.9	3.4	4.2	1.0	1.3	
6. Ngandalarra	n	41	7	1	0	2	0	12	4	1	68
	%	60.3	10.3	1.5	0.0	2.9	0.0	17.6	5.9	1.5	
8. Guralba	n	37	9	1	0	5	1	10	0	1	64
	%	57.8	14.1	1.6	0.0	7.8	1.6	15.6	0.0	1.6	
10. Nabulabanda	n	141	22	1	3	10	0	16	9	2	204
	%	69.1	10.8	0.5	1.5	4.9	0.0	7.8	4.4	1.0	
17. Balgo Balgo	n	261	74	3	19	11	2	14	1	0	385
	%	67.8	19.2	0.8	4.9	2.9	0.5	3.6	0.3	0.0	
18. Dalabanda	n	91	13	2	7	0	0	23	1	0	137
	%	66.4	9.5	1.5	5.1	0.0	0.0	16.8	0.7	0.0	
19. Djulyurrulyurru	n	226	12	1	3	8	3	27	4	9	293
	%	77.1	4.1	0.3	1.0	2.7	1.0	9.2	1.4	3.1	

TABLE 8.2 (continued)

SITES		ARTEFACT CATEGORIES										
		Unretouched flakes	Scrapers	Engravers	Blades	Cores	Hammers	Grindstones	Ochres & pigments	Manuports	Total
22. Migiffiri	n	540	13	5	0	9	0	35	6	5	613
	%	88.1	2.1	0.8	0.0	1.5	0.0	5.7	1.0	0.8	
23. Mindirr	n	263	4	0	1	3	1	8	0	0	280
	%	93.9	1.4	0.0	0.4	1.1	0.4	2.9	0.0	0.0	
25. Diedi	n	147	13	3	3	2	0	9	0	0	177
	%	83.1	7.3	1.7	1.7	1.1	0.0	5.1	0.0	0.0	
26. Rundju Rundju	n	44	6	1	1	3	1	24	0	10	90
	%	48.9	6.7	1.1	1.1	3.3	1.1	26.7	0.0	11.1	
27. Wilbarinyu	n	28	13	1	1	7	6	4	1	27	88
	%	31.8	14.8	1.1	1.1	8.0	6.8	4.5	1.1	30.7	
28. Birbayga	n	286	20	3	1	14	0	20	1	1	346
	%	82.7	5.8	0.9	0.3	4.0	0.0	5.8	0.3	0.3	
29. Gawayurru	n	171	9	1	1	0	1	35	0	2	220
	%	77.7	4.1	0.5	0.5	0.0	0.5	15.9	0.0	0.9	
30. Gundjimarra	n	133	3	0	0	5	3	0	0	0	144
	%	92.4	2.1	0.0	0.0	3.5	2.1	0.0	0.0	0.0	
31. Yurinubadu	n	625	27	2	2	7	1	1	0	0	665
	%	94.0	4.1	0.3	0.3	1.1	0.2	0.2	0.0	0.0	
Total nos		4478	459	35	79	119	53	376	35	80	5714
Total %		78.4	8.0	0.6	1.4	2.1	0.9	6.6	0.6	1.4	

The appearance of such significant variation in the proportional distribution of artefacts in the region is very interesting and encouraging. It implies that artefacts were indeed being used and discarded in different frequencies at respective sites in the region. The question which now needs to be asked is whether this assemblage variability is patterned and, if so, does this patterning resemble the expected pattern derived from Aboriginal testimony of site use.

ETHNOGRAPHIC EXPECTATIONS

The following predictions concentrate on the three areas where the archaeological debris may be expected to relate to the traditional behaviour of the Aborigines in the region; the preparation of seed foods, the manufacture of wooden implements and the manufacture of stone tools.

Seed Grinding

Seed grinding is probably the most straightforward aspect of traditional economic behaviour from which to make predictions about the archaeological record. Seed grinding artefacts are directly related to the production of food from seeds so it is therefore reasonable to expect the proportions of seed grinding artefacts found in sites to be closely related to the quantity of seeds consumed at individual sites. Thus seed grinding sites should be identifiable archaeologically because of the high proportion of seed grinding artefacts contained in them.

In Chapters 4 and 5 it was reported that seeds were an important resource at Djarrga Djarrga (2), Gawayurru (29), Dalabanda (18) and Djulyurrulurru (19). It is therefore logical to expect that these sites will contain the highest proportion of seed grinding implements in the region.

On the other end of the scale are sites such as Mindirr (23), Djulugan (1), Yurinubadu (31), Gundjimarra (30), Balgo Balgo (17), Rundju Rundju (20) and Wilbarinyu (27). These sites were occupied during the "hot season", "wet time" or early "green grass time" before new supplies of seeds had ripened. Therefore seed foods were not an important part of the diet of the inhabitants of these sites. These sites should thus contain the lowest proportions of seed grinding artefacts in the region.

There was also a group of sites at which seeds were a moderately important part of the diet. These sites were occupied during the cold season or "goanna get up time" and included Migiliri (22), Birbayga (28), Diedi (25), Guralba (8), Ngandalarra (6), Nabulabanda (10), Nganawalbinyu (3) and Djungurr (4). It is difficult to anticipate what the proportion of seed grinding artefacts should be in this latter group of sites, but the obvious prediction would be that it would be greater than at the sites where seeds were unimportant and smaller than at the sites where seeds were an important resource.

Woodworking Artefacts

Unfortunately there is virtually no data available which gives some idea of the actual quantity of artefacts likely to have been used up in the production of wooden implements. The timetable of this project did not allow for an analysis of this aspect of Aboriginal technology. Nevertheless, what data there is does indicate that the greatest proportion of woodworking tools were likely to be used up and discarded at sites where wooden implements were most frequently made. Hayden (1977:182) and Gould (1977:165) suggest that between 11 and 22 woodworking tools (which I would define as scrapers) were required to make the annual inventory of spear throwers, spears, boomerangs, clubs, digging sticks and women's bowls by one man; thus providing some insight into the relative quantity of woodworking artefacts likely to have been discarded at major woodworking sites. Gould (ibid.) goes on to suggest that an individual adze had an average scraping life of over 3,000 "useful strokes". These figures provide some insight into the disproportionate amount of stone tools likely to have been discarded at important woodworking locations compared to sites at which the only woodworking activities were related to the maintenance of wooden implements. The most important woodworking sites in the region were Nganawalbinyu (3) and Balgo Balgo (17) and it is therefore reasonable to postulate that these sites will contain the greatest proportions of woodworking tools. Other sites where wooden tools were made from local supplies of hardwoods included Diedi (25) and Djarrga Djarrga (2) and these sites should also contain high proportions of woodworking implements. To the best of my knowledge no other sites in the region were important

woodworking sites.

Stone Tool Manufacture

Stone tool manufacture is also a reasonably straightforward functional category from which to examine the relationship between human behaviour and archaeolgical debris. This is particularly the case with unretouched flakes which were not transported or used once detached from cores. The proportion of waste flakes in sites must therefore provide a direct (if not particularly accurate) indication of the amount of stone tool production at individual sites. One can make the crude assumption that the more stone tool manufacture conducted at sites the greater the quantity of waste flakes produced. Further, the Aborigines indicated that more artefacts were made at sites nearer quarries and thus one would expect that the highest proportion of unretouched flakes to be found at sites such as Mindirr (23), Djulugan (1), Yurinubadu (31), Gundjimarra (30), Rundju Rundju (26), Wilbarinyu (27), Migiliri (22), Birbayga (28), Diedi (25), Djulyurrulyurru (19) and Djungurr (4) which were closest to quarries. Conversely the proportion of unretouched flakes should decrease at the remaining sites in the region as the availability of stone decreased. The proportions of unretouched flakes should therefore show a gradual decline at Dalabanda (18), Gawayurru (29) and Djarrga Djarrga (2) which were a moderate distance from quarries. Guralba (8), Ngandalarra (6), Nganawalbinyu (3), Balgo Balgo (17) and Nabulabanda (10) were the greatest distance from supplies of good quality stone and these sites should contain the lowest proportion of unretouched flakes in the region.

The same pattern should also be apparent in the distribution of hammerstones in the study area. It seems logical to expect the number of hammerstones which were likely to have been used and broken to decrease as the amount of stone tool manufacture decreased. Therefore one would also expect to find the greatest proportion of hammers fragments at sites where the greatest amount of stone tool manufacture took place. This proportion should also decrease, consistently paralleling that of unretouched flakes, as the relative availability of good quality stone decreased.

The proximity of sites to quarries should also effect the proportions and size of cores in sites. As indicated in Chapter 6 the Aborigines transported stone in the form of cores (as well as primary flakes) from quarries to different sites. Similar behaviour has been noted by Thomson (1964:405), Hayden (1977:180), Basedow (1925:364) and Carnegie (1898:391, 1898b:21). Consequently it would seem logical to expect the greatest quantity of exhausted cores to be found at sites where supplies of raw materials were not readily available; thus indicating their transportation, continual use and eventual discard at the most distant sites. If this pattern of behaviour is reflected in the archaeological record then the distribution of cores in the region should be inversely proportional to the distribution of waste flakes. In this case the proportion of cores discarded should be the lowest at sites closest to quarries (Mindirr (23), Djulugan (1), Yurinubadu (31), Gundjimarra (30), Rundju Rundju (26), Wilbarinyu (27), Migiliri (22), Diedi (25), Birbayga (28), Djungurr (4)), increase at sites which were a moderate distance from quarries (Djulyurrulyurru (19), Gawayurru (29), Djarrga Djarrga (2) and

Dalabanda (18)) and be the greatest at sites where the availability of stone was relatively poor (Guralba (8), Ngandalarra (6), Nabulabanda (10), Balgo Balgo (17) and Nganawalbinyu (3)).

A Predictive Ethnographic Model

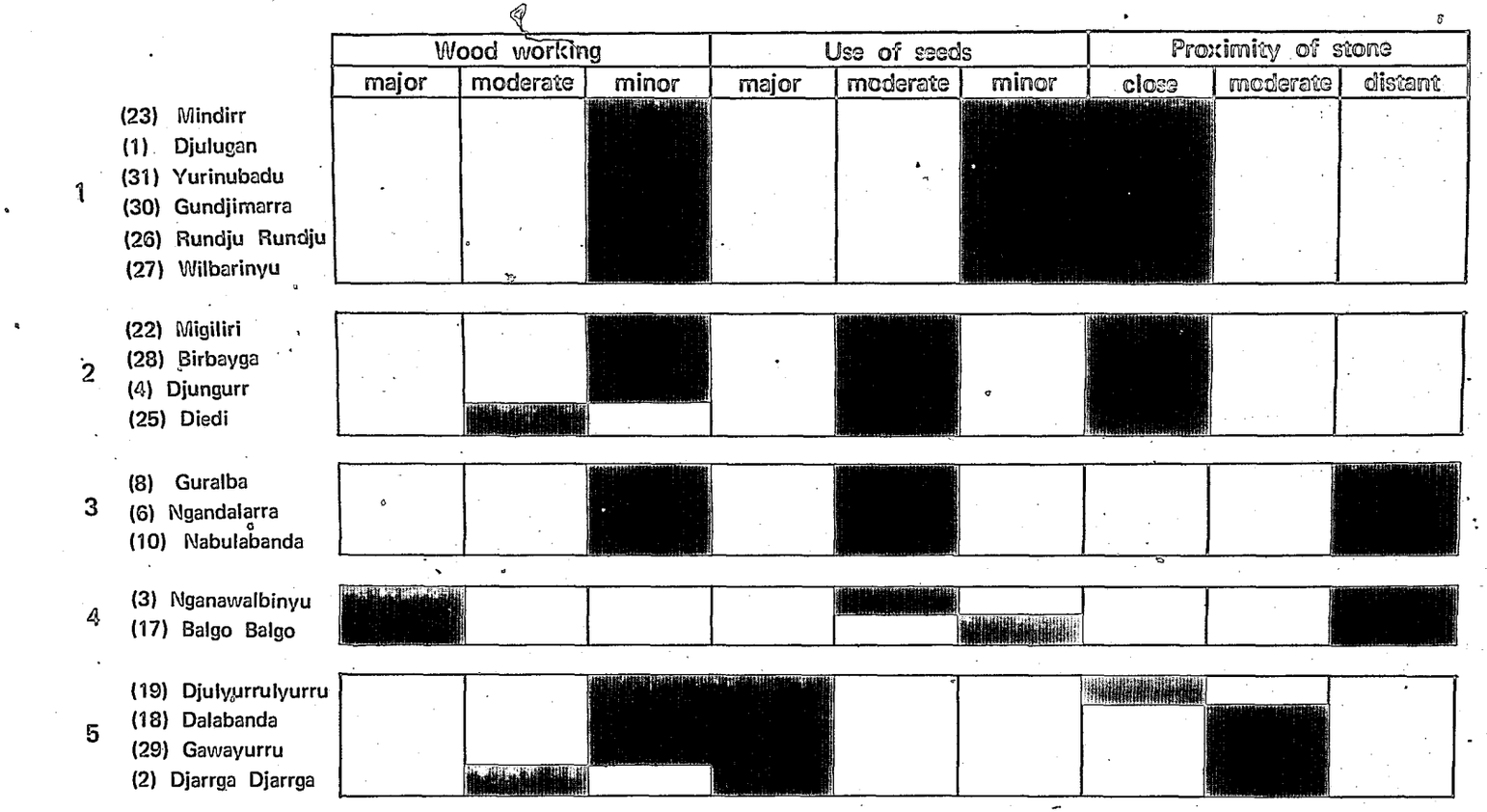
So far this section has drawn attention to the patterns I would expect to see in the distribution of stone tools in the region given the importance of woodworking activities at individual sites, the importance of seeds in the economy of inhabitants of each site and the proximity of quarries to individual sites.

As it stands however this discussion presents something of a complicated series of interacting variables and the pattern in the way these variables interrelate at each site requires classification. I thus need to define which combination resources were available to the inhabitants of particular sites and define a regional ethnographic model against which any patterns in the distribution of stone tools can be compared.

Figure 8.1 represents the pattern which emerges from an examination of the relationship between the location of individual sites and the relative importance of seed, wood and stone resources. From this figure it is apparent that five groups of sites can be defined from which access to different combinations of these resources was more or less the same. These groups are called Subsistence Groups 1, 2, 3, 4, and 5 and the salient characters of each group are discussed below.

Figure 8.1

Resources available at sites in Subsistence Group 1,2,3,4,5.


Wood working
Use of seeds
Proximity of stone
major
moderate
minor
major
moderate
minor
close
moderate
distant
1
(23) Mindirr
(1) Djulugan
(31) Yurinubadu
(30) Gundjimarra
(26) Rundju Rundju
(27) Wilbarinyu
2
(22) Migiliri
(28) Birbayga
(4) Djungurr
(25) Diedi
3
(8) Guralba
(6) Ngandalarra
(10) Nabulabanda
4
(3) Nganawalbinyu
(17) Balgo Balgo
5
(19) Djulyurrulyurru
(18) Dalabanda
(29) Gawayurru
(2) Djarrga Djarrga

Subsistence Group 1

Essential characteristics: minor woodwork, minor use of seed, close to quarries.

Sites in Subsistence Group 1 include Mindirr (23), Djulugan (1), Yurinubadu (31), Gundjimarra (30), Rundju Rundju (26) and Wilbarinyu (27). With the exception of Mindirr (23) all these sites were occupied during the wet season but, like Mindirr (23), were occupied during a time of stress when the pursuit of food was the dominant activity people were involved in. The essential characteristics which these sites have in common were that all six sites were close to stone quarries and that supplies of seeds were scarce and the manufacture of wooden implements was minimal.

Subsistence Group 2

Essential characteristics: minor woodworking, moderate use of seeds, close to quarries.

Sites in Subsistence Group 2 include Migiliri (22), Birbayga (28), Diedi (25) and Djungurr (4). These four sites were also close to supplies of stone, but unlike sites in Subsistence Group 1 were occupied at a time of year when resources were more abundant and seeds were more readily available. Diedi (25) was the only one of these sites where woodworking was a relatively important activity.

Subsistence Group 3

Essential characteristics: minor woodworking, moderate use of seeds, a long way from quarries.

Sites in Subsistence Group 3 included Guralba (8), Ngandalarra (6) and Nabulabanda (10). The defining characteristics of sites in this group was that they were all a long way from good quality supplies of flakable stone. Seeds were a moderately important resource to inhabitants of these sites but woodworking was not an important activity.

Subsistence Group 4

Essential characteristics: major woodworking sites, moderate and minor use of seed, a long way from quarries.

Sites in Subsistence Group 4 included Balgo Balgo (17) and Nganawalbinyu (3). Both these sites were important woodworking sites and both were a long way from good supplies of stone. Seeds were of moderate importance at Nganawalbinyu (3) but Balgo Balgo (17) was occupied early in the year, before seeds had ripened.

Subsistence Group 5

Essential characteristics: minor woodworking sites, major use of seeds, moderate distance from quarries.

Sites in Subsistence Group 5 included Djulyurrulyurru (19), Dalabanda (18), Djarrga Djarrga (2) and Gawayurru (29). The defining characteristics of these sites was that seeds were an important facet of the local economy. With the exception of Djuryurrulyurru (19) these sites were a moderate distance (15km) from quarries. Djarrga Djarrga (2) was the only one of these sites where woodworking was an important activity.

Ethnographic and Archaeological Comparisons.

So far I have defined five groups of sites which had access to differing combinations of resources in the region. I have also made some initial predictions about the expected distribution of artefacts in the region given the relative access of sites to those resources. Having done this I am now in a position to determine the nature of the archaeological variability and examine the extent to which the proportional variation in the distribution of stone tools correlates with the ethnographic predictions.

Before determining the degree to which the archaeology matches the ethnographic predictions, it is worth summarizing the patterns one would expect to see in the archaeological debris in view of the ethnographic model outlined above. Obviously one would expect the sites which are alike in this model to be the same sites as those which are most similar archaeologically. It is logical to expect the sites which had access to to the same resources to contain the same assemblages of artefacts. Therefore, with few exceptions, one would expect all the sites which are

(a) Archaeological correlates of Subsistence Group 1 to contain low proportions of woodworking tools, seed grinding implements, cores and a high proportion of unretouched flakes and hammers.

(b) Archaeological correlates of Subsistence Group 2 to contain low proportions of woodworking tools, low proportions of cores, moderate proportions of seed grinding implements and high proportions of unretouched flakes and hammers.

(c) Archaeological correlate of Subsistence Group 3 to contain

low proportions of woodworking tools, unretouched flakes and hammers, a high proportion of cores and a moderate proportion of seed grinding implements.

(d) Archaeological correlates of Subsistence Group 4 to contain a high proportion of woodworking tools and cores, a moderate proportion of seed grinding implements and a low proportion of unretouched flakes and hammers.

(e) Archaeological correlates of Subsistence Group 5 to contain a low proportion of woodworking implements, a high proportion of seed grinding implements and a moderate proportion of cores, utilized flakes and hammers.

The remainder of this chapter examines the extent to which these predictions are met in the archaeological record. The following section classifies the sites examined archaeologically into groups and compares the sites in these groups to the sites previously grouped ethnographically. This is followed by an examination of the artefactual content of these sites in view of the predictions outlined above. The following chapter examines the anomalous characteristics of the archaeological debris and discusses other possible interpretations of the data.

Taxonomy of Archaeological Sites

The taxonomy of archaeological sites presented here is defined using the nine redefined categories of artefacts described previously in this chapter (Table 8.2). It uses these functionally based categories to determine which sites contained similar assemblages of

artefacts and therefore which sites provide evidence of similar activities.

This analysis could be done in two ways. The similarity between sites could be estimated visually, by examining the percentage of each artefact category per site or mathematically using the same data. In this thesis I have chosen to classify the sites recorded using a mathematical technique (described below) as this was both a convenient way of organizing the data and, more importantly, avoided the subjective and possibly biased placement of sites in groups which I already knew to be alike ethnographically. It should be stressed however, that I have used this technique for its convenience and impartiality and not as indisputable evidence of the nature of the archaeological variability in the landscape. Quite clearly the difference between what is mathematically significant and what an archaeologist may deem to be significant in sites needs to be taken into consideration and this calls for a visual or archaeological assessment of the result derived mathematically.

Clustering Technique

The technique used to determine which sites were most alike was an average linkage cluster analysis. The similarity between sites was measured using the squared Euclidean distance computed on the percentage of each type of artefact per site. This was calculated by the formula:

$$dij^2 = \frac{1}{p}\left\{\sum_{k=1}^{p}(xik - xjk)^2\right\}$$

where i and j are assemblages of artefacts at different sites and Xik is the percentage of artefact type k at Site i. The program used was from the Clustan User Manual, third edition, edited by D. Wishart (1978) and advise and direction was provided by Y. Pittelkow at the Australian National University.

The principal advantage of this technique was that it did not require any transformation of the data other than converting the raw frequencies of artefacts per category at each site into percentages. In this instance I was interested in determining which sites were most alike according to the absolute differences between the proportions of the dominant artefacts at each site. Other techniques and measures of similarity such as single linkage, Gower metric (Hartigan 1976) and Euclidian distance computed on the square root of the proportional data (Hodson 1969) were tried and gave satisfactory results but the technique described above seemed the most appropriate.

Squared Euclidean distance was chosen as an acceptable means of showing similarity because it is commonly available and its properties are known (Wishart 1978). Average linkage was chosen as a suitable clustering technique as this avoided the problem of "chaining". Average linkage determines the similarity between groups of sites according to the average distance between all pairs of similar sites in comparative groups. "Chaining" is a process in which similar sites are added individually to the group of sites which cluster first. This obviously makes it difficult to recognize similar groups of sites from the dendrogram produced (Hodson 1969, 1970;

Everitt 1974).

Results

The results of this analysis are illustrated in Fig.8.2. The most obvious characteristic of the dendrogram is the division of the archaeological sites in the landscape into two main groups. These groups have been defined on the relative proportion of unretouched flakes in each site. One group contains 10 sites with high proportions of unretouched flakes (between 77.1% and 94%: Table 8.2). The other group contains seven sites with lower proportions of unretouched flakes (between 70.7% and 57.8%). Two sites do not fit into either group.

Within these two main groups six other groups of sites have been defined on the basis of other dominant artefacts contained within them. These six groups are the basis for discussion here. Graphs and tables of the proportions and frequencies of each artefact category in these groups are presented in Figs.8.3-8.8 and Table 8.2. The results of chi-square analysis of the inter-site comparisons between artefact categories are given in Appendix 2.

Group 1 (Fig.8.3)

Group 1 contains Mindirr (23), Yurinubadu (31) and Gundjimarra (30). These sites are characterized by a dominant component of unretouched flakes and low proportions of the remaining eight artefact categories. Site 30 contained significantly more cores ($P < 0.05$) and hammers ($P < 0.01$) than Site 31.

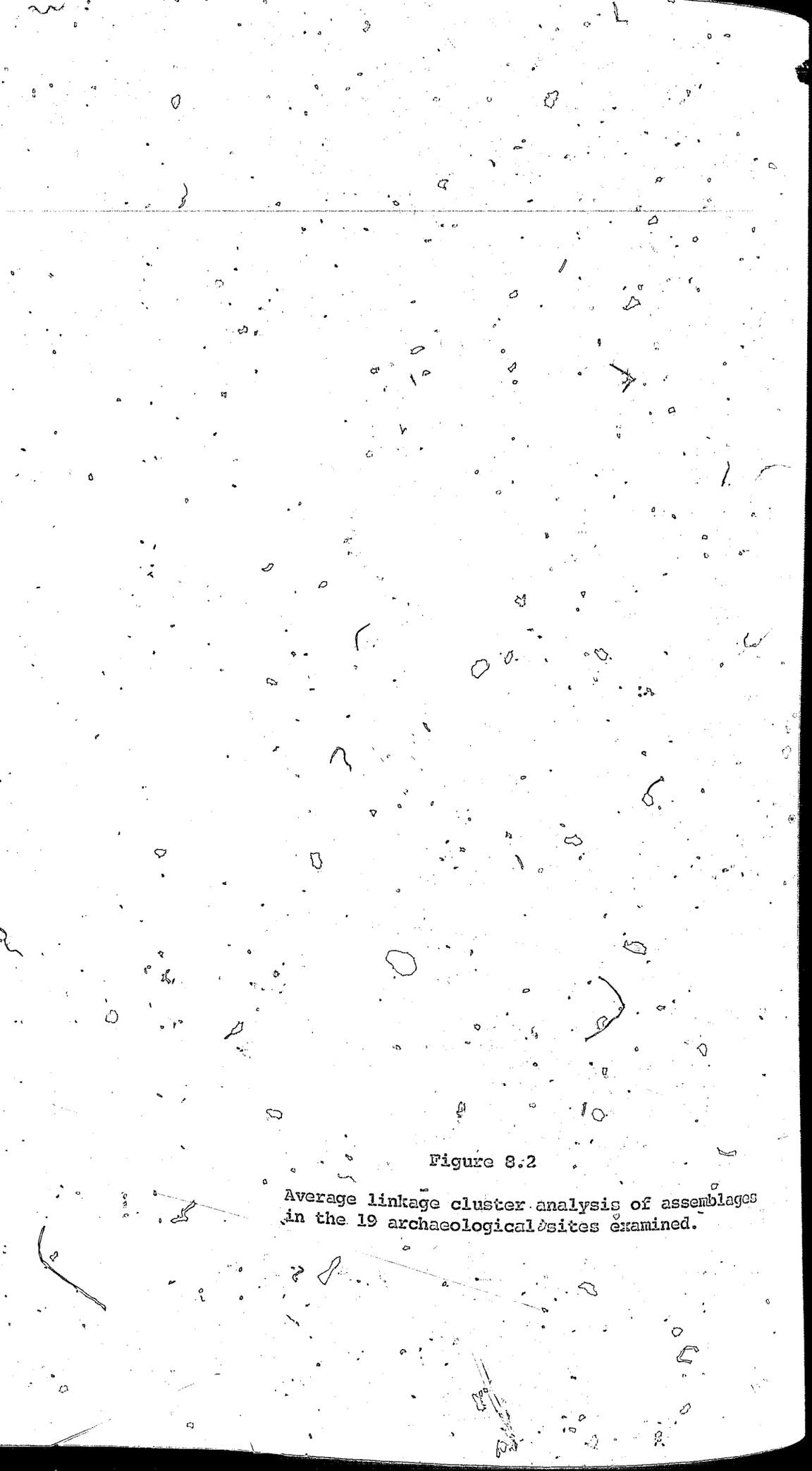


Figure 8.2

Average linkage cluster analysis of assemblages in the 19 archaeological sites examined.

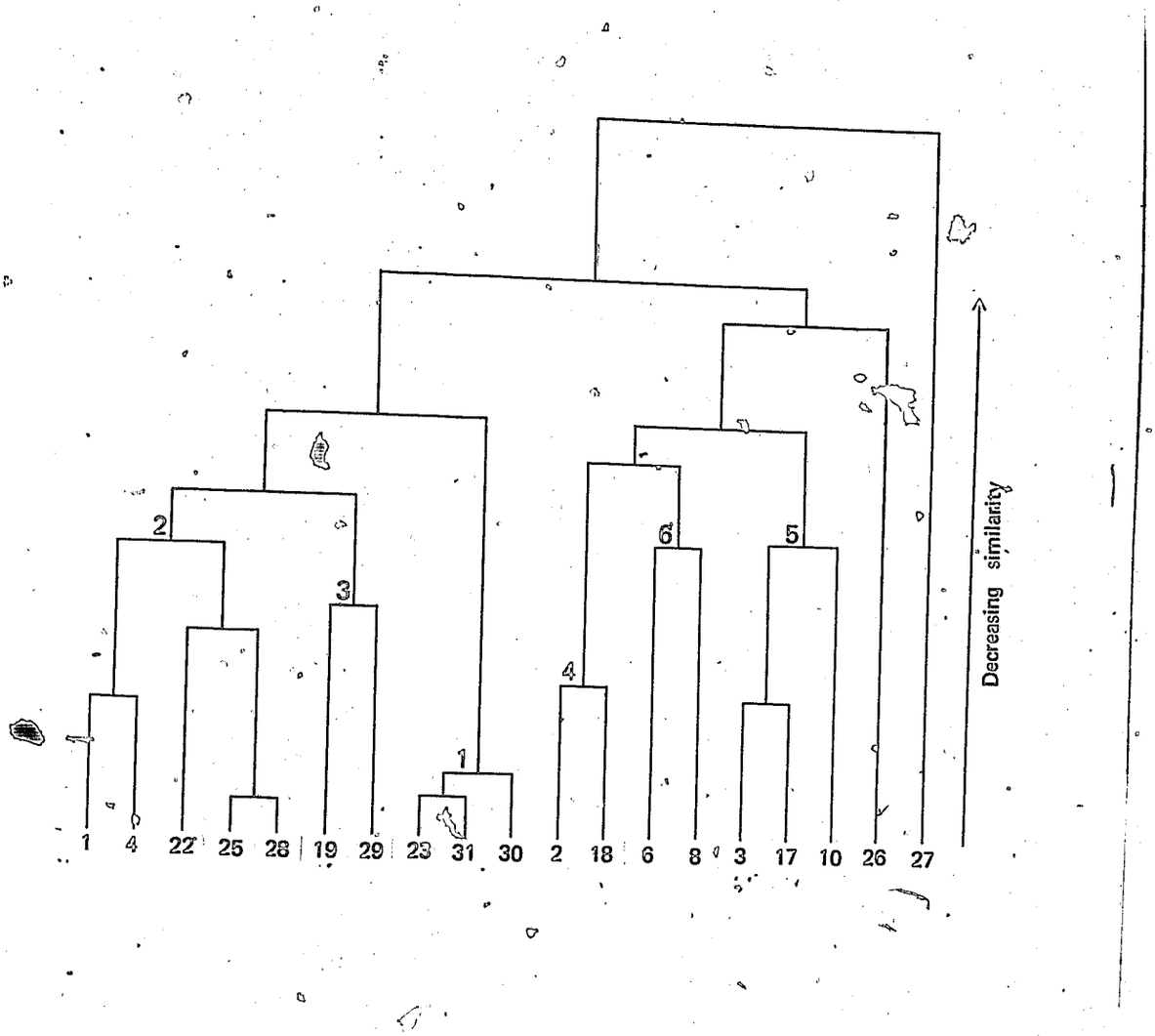

Decreasing similarity
1
2
3
4
5
6
1 4 22 25 28 19 29 23 31 30 2 18 6 8 3 17 10 26 27

Figure 8.3

Assemblage of artefacts in each site linked together in Group 1.



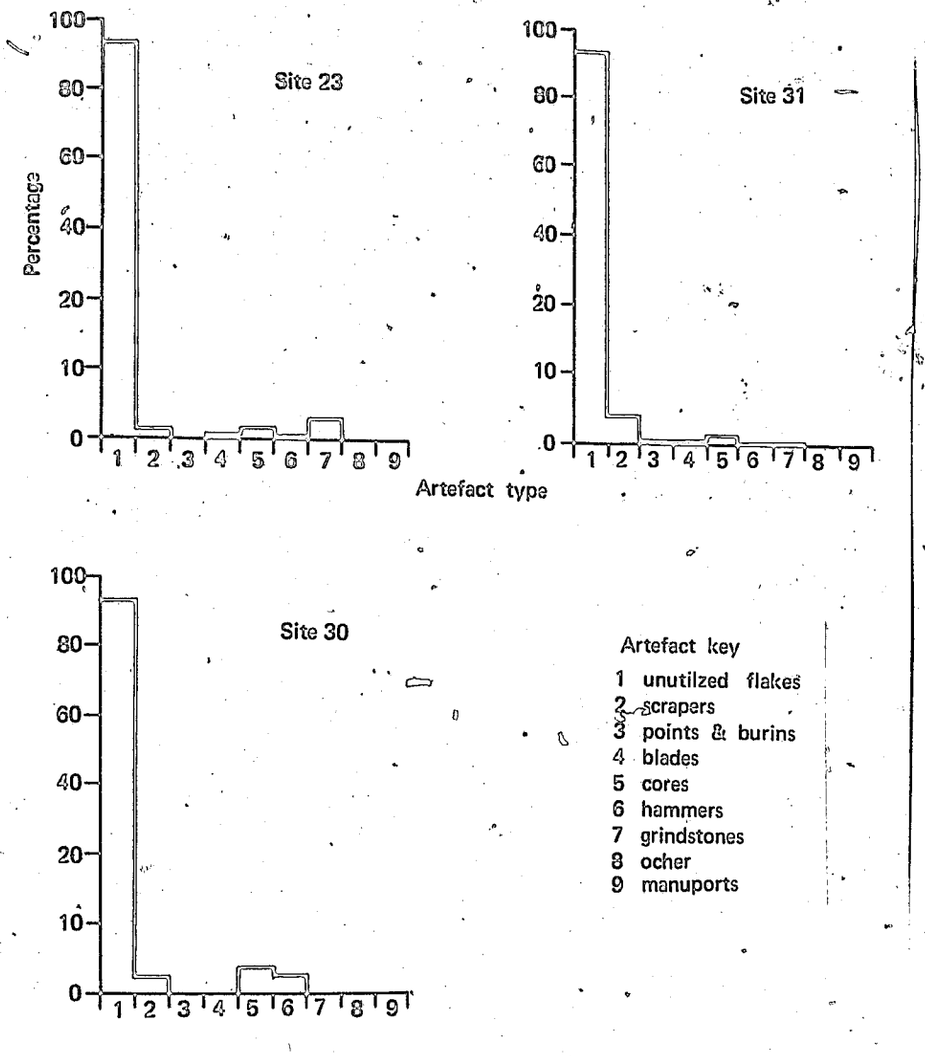
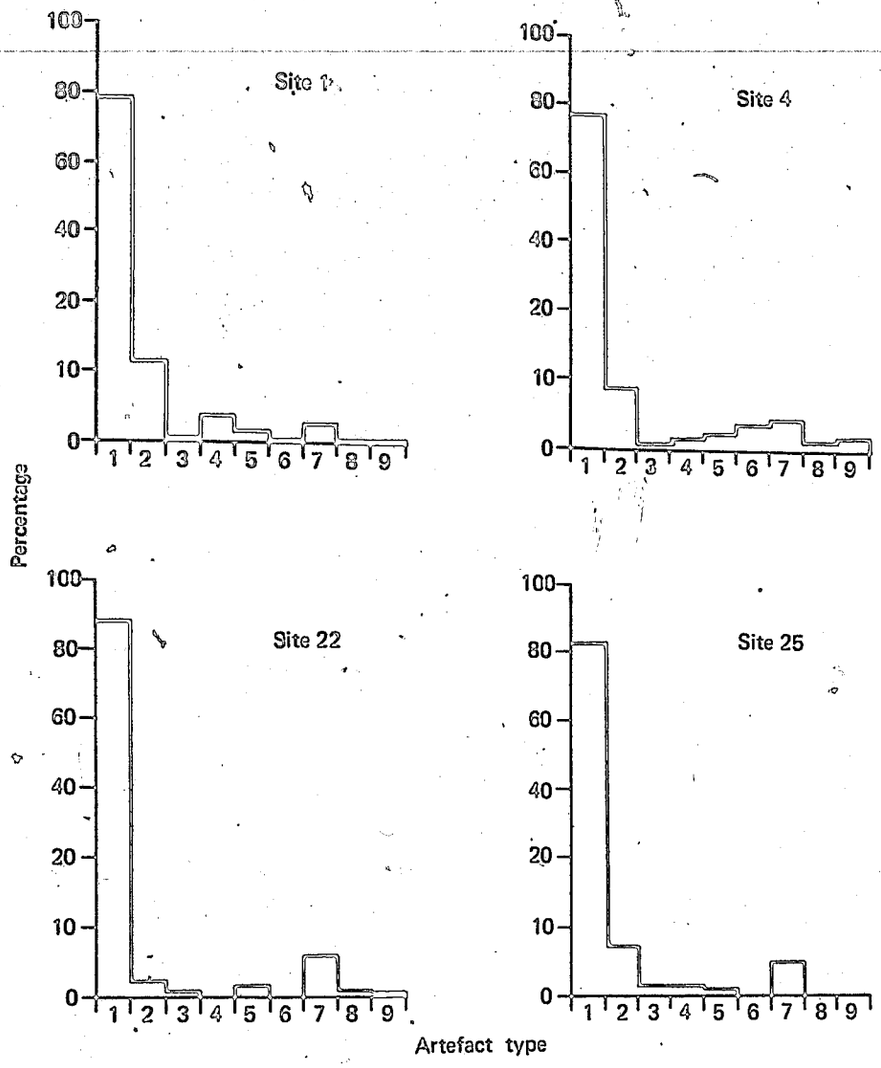

Site 23
Site 31
Site 30
Percentage
100
80
60
40
20
10
0
1 2 3 4 5 6 7 8 9
Artefact type
Artefact key
1 unutilzed flakes
2 scrapers
3 points & burins
4 blades
5 cores
6 hammers
7 grindstones
8 ocher
9 manuports

Figure 8.4

Assemblage of artefacts in each site linked together in Group 2.

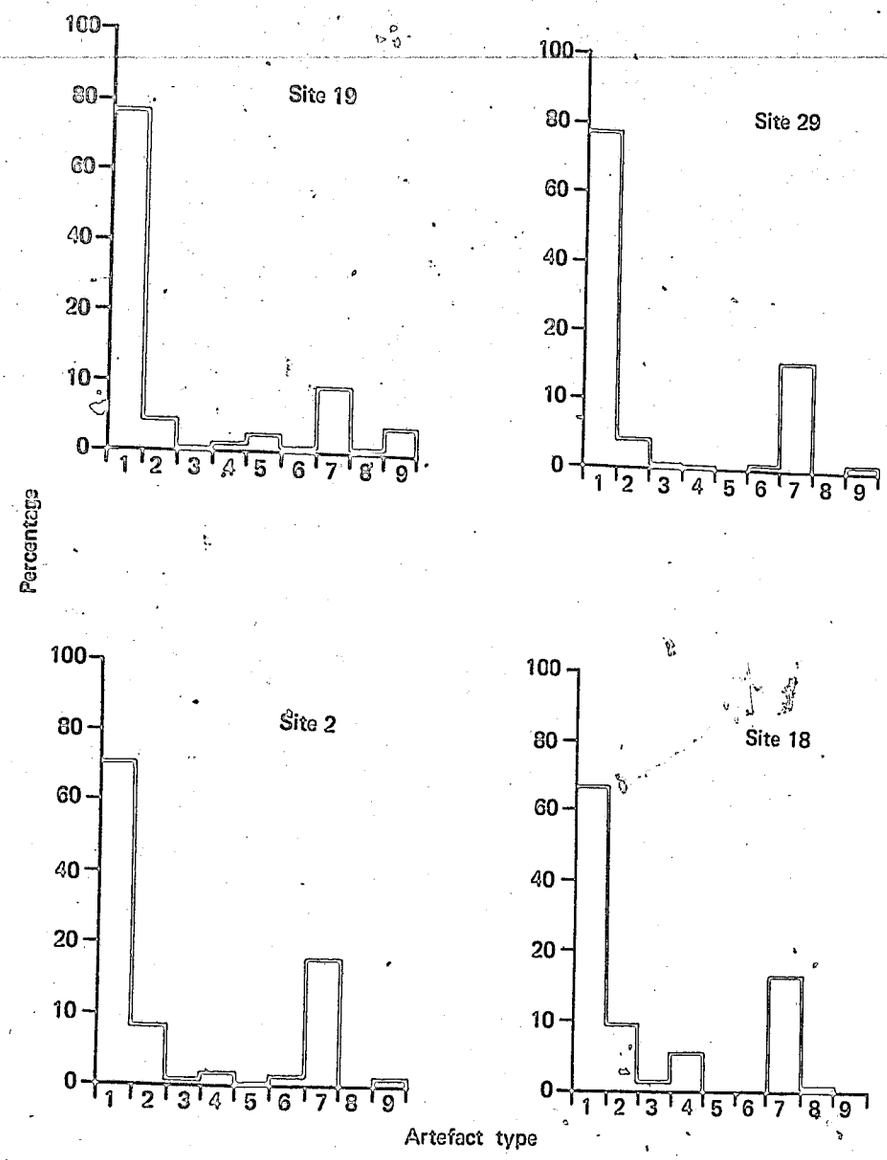


Artefact key

1 unutilzed flakes
2 scrapers
3 points & burins
4 blades
5 cores
6 hammers
7 grindstones
8 ocher
9 manuports

Figure 8.5

Assemblage of artefacts in each site linked together in Group 3 (Sites 19 and 29) and Group 4 (Sites 2 and 18). The four sites from these groups form Archaeological Group 3.

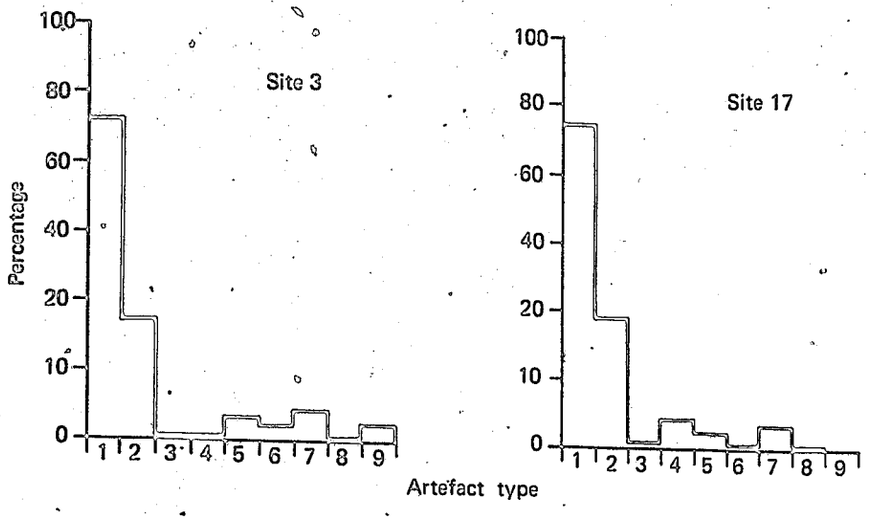


Artefact key

1 unutilzed flakes
2 scrapers
3 points & burins
4 blades
5 cores
6 hammers
7 grindstones
8 ocher
9 manuports

Figure 8.6

Assemblage of artefacts in each site linked together in Group 5. The sites form Archaeological Group 4.

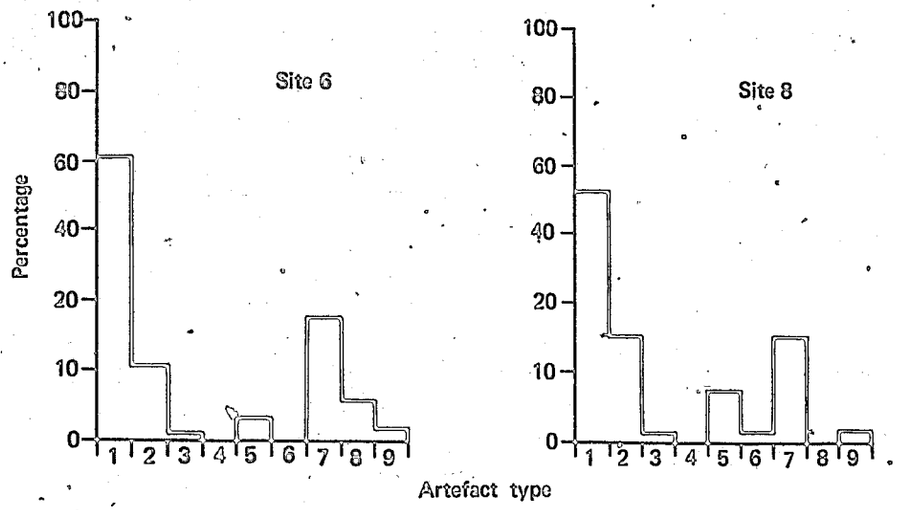


Artefact key

1 unutilzed flakes
2 scrapers
3 points & burins
4 blades
5 cores
6 hammers
7 grindstones
8 ocher
9 manuports

Figure 8.7

Assemblage of artefacts in each site linked together in Group 6. These sites form Archaeological Group 5.



Artefact key

1 unutilzed flakes
2 scrapers
3 points & burins
4 blades
5 cores
6 hammers
7 grindstones
8 ocher
9 manuports

Group 2 (Fig.8.4)

Sites within this group fall into two subgroups. Those in subgroup 2a include Djulugan (1) and Djungurr (2). These sites contain similar proportions of unretouched flakes and scrapers. Subgroup 2b contained Migiliri (22), Diedi (25) and Birbayga (28). Diedi (25) and Biribayga (28) are most alike in this group. Migiliri (22) contains a higher proportion of unretouched flakes than Diedi (25) ($P<0.10$) and Biribayga (28) ($P<0.02$) and a lower proportion of scrapers than either of these sites ($P < 0.001$ and $P < 0.01$ respectively).

Group 3 (Fig.8.5)

This group contains Djulyurrulyurru (19) and Gawayurru (29). These sites contain equivalent proportions of unretouched flakes and scrapers and equally high proportions of seed grinding implements. There are significantly more seed grinding artefacts at Gawayurru (29) than at Djulyurrulyurru (19) ($P < 0.05$). There were no cores and no ochre at Gawayurru (29).

Group 4 (Fig.8.5)

This group includes Djarrga Djarrga (2) and Dalabanda (18). Both contain equivalent proportions of unretouched flakes, high proportion of scrapers and seed grinding implements. There were significantly more blades recorded at Dalabanda (18) ($P < 0.02$) than at other sites in this group.

Group 5 (Fig.8.6)

This group contains Ngandalarra (6) and Guralba (8). These sites contained low proportions of unretouched flakes, and high proportions of scrapers, seed grinding implements and cores. There was a high percentange of ochre at Ngandalarra (6) but no ochre recorded at Guralba (8).

Group 6 (Fig.8.7)

This group contains Nganawalbinyu (3), Balgo Balgo (17) and Nabulabanda (10). These sites were characterized by a low proportion of unretouched flakes. Balgo Balgo (17) and Nganawalbinyu (3) are most alike in this group and contain a high proportion of scrapers. Nabulabanda (10) contained more seed grinding tools than Balgo Balgo (17) ($P < 0.05$) and more ochre than either site ($P < 0.01$ and $P<0.001$ respectively).

Ungrouped Sites

Two sites (Wilbarinyu (27) and Rundju Rundju (26)) were unlike any other sites in the region. Rundju Rundju (26) contained a very low proportion of unretouched flakes (48.4%) and an exceptionally high proportion of seed grinding implements (26.4%) and manuports (10%). Wilbarinyu (27) contained even fewer unretouched flakes (31.8%), a high proportion of scrapers (14.8%) and an even greater proportion of manuports (30.7%).

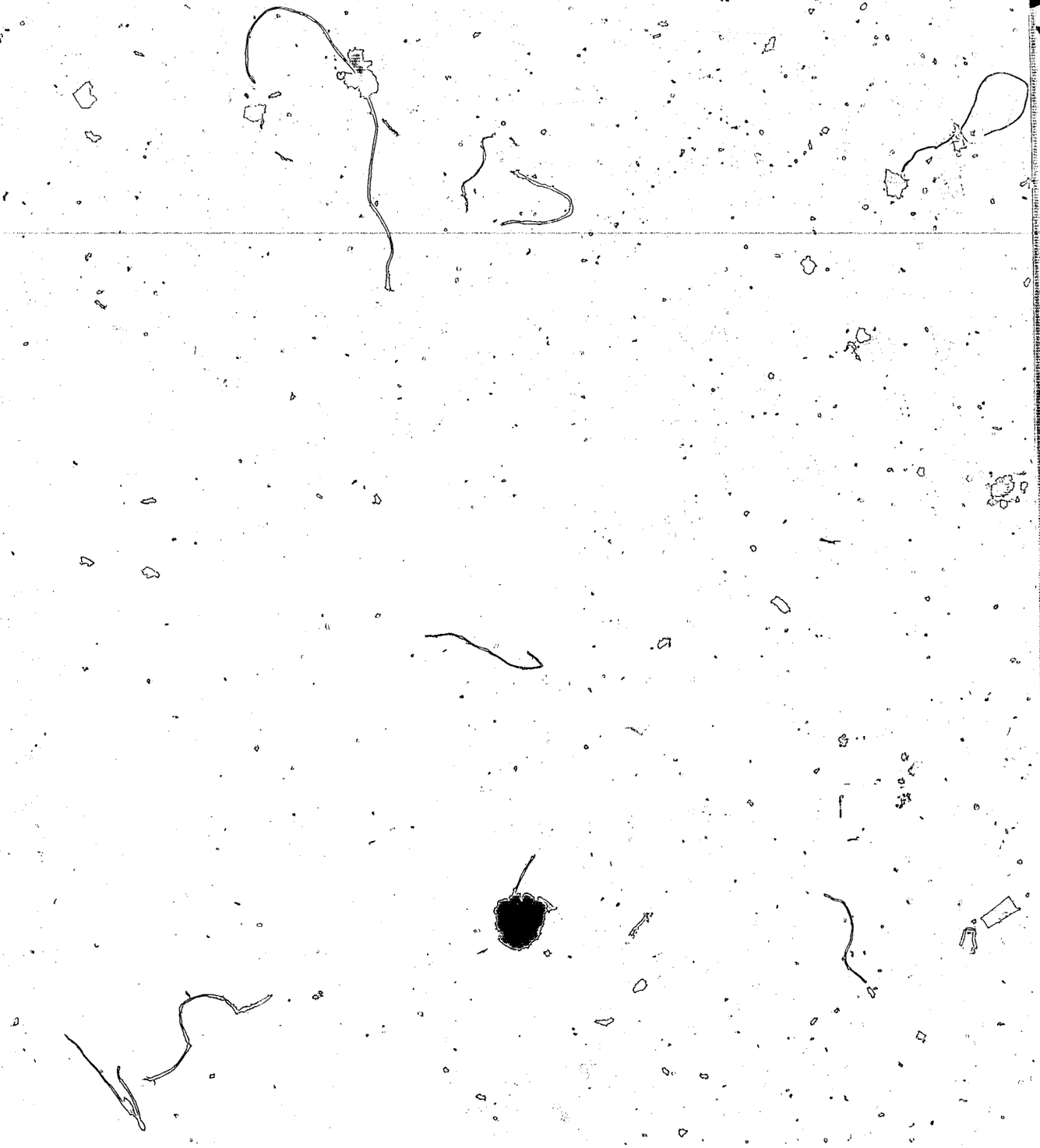
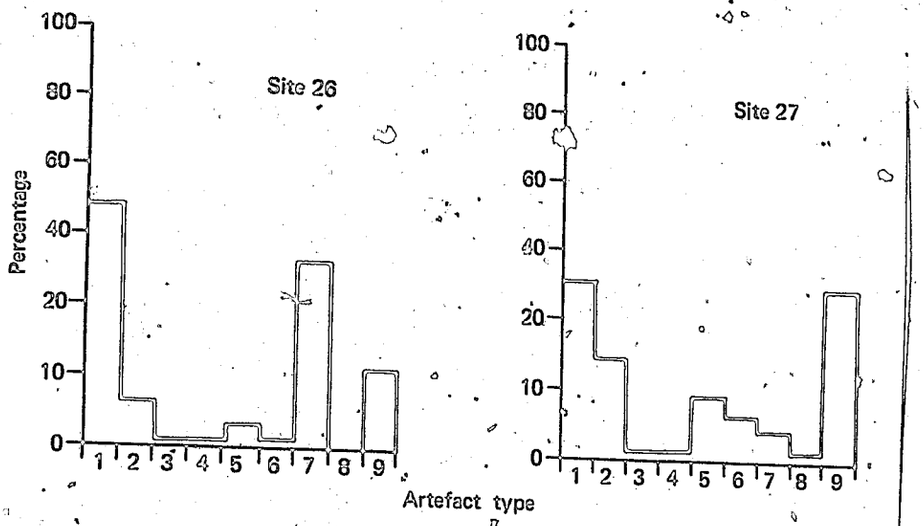


Figure 8.8

Assemblage of artefacts in each of the ungrouped sites.



Artefact key

1 unutilzed flakes
2 scrapers
3 points & burins
4 blades
5 cores
6 hammers
7 grindstones
8 ocher
9 manuports

Archaeological Review of these Groups

A visual review of the data given in Figs.8.3-8.8 reveals the existence of alternative clusters of sites to those determined by this technique.

The most striking example of this is the way the cluster analysis separates Djarrga Djarrga (2) and Gawayurru (29) and gives the impression that Group 3 and 4 are very different (Fig.8.5). A visual interpretation of these sites suggests that Djarrga Djarrga (2) and Gawayurru (29) are almost identical and that Gawayurru (29) (Group 3) is definitely more like Djarrga Djarrga (2) (Group 4) than it is like Djulyurrulyurru (19) (Group 3).

This interpretation is based on a visual assessment of the similarity between the proportions of the less well represented artefacts (engravers, blades, hammers, manuports) and seed grinding implements in these sites. The cluster analysis has made an early separation of Djarrga Djarrga (2) and Gawayurru (29) because of the different proportions of unretouched flakes (Table 8.2) and in doing so has ignored the marked similarity in these other variables.

Because of the functional importance of these less well represented artefact categories it would seem more appropriate from an archaeological point of view to have linked Djarrga Djarrga (2) and Gawayurru (29) together and Dalabanda (18) and Djulyurrulyurru (19) to th

Hodson (1970:307) points out that one of the problems with average linkage is that it is "very easy for sites to become trapped in clusters at an early stage of the analysis, from which they cannot escape later". Two similar sites may therefore be widely separated by the clustering technique - and this seems to have occurred here. Hodson says that while average linkage may present the most reasonable archaeological taxonomy of any technique this overly arbitrary framework is a deficiency in the method.

As a result I think the obvious separation of Djarrga Djarrga (2) and Gawayurru (29) by this method is misleading and would suggest the arrangement of these sites be reconsidered in the light of the visual similarity between them.

Several other sites could also be regrouped visually but in this case the mathematical taxonomy is probably the most appropriate. In these cases a visual review of the graphs presented in Fig.8.4,8.6 and 8.7 suggest that Djulugan (1) (Group 2) is similar to Balgo Balgo (17) (Group 6); Djungurr (4) (Group 2) is similar to Nganawalbinyu (3) (Group 6) and Ngandalarra (6) (Group 5) is similar to Nabulabanda (10) (Group 6). In these instances however the similarity between the less well represented variables is not as close as was the case between Djarrga Djarrga (2) and Gawayurru (29) and consequently does not outweigh the high correlation in the most dominant variables in each site (Table 8.2).

Given this visual review of the data it seems most appropriate to define five groups of sites which contain similar proportions of stone tools. These groups include;

1. Archaeological Group 1: which contains Mindirr (23), Yurinubadu (31) and Gundjimarra (30) (Fig.8.3).

2. Archaeological Group 2: which contains Djulugan (1), Djungurr (4), Migiliri (22), Diedi (25) and Birbayga (28) (Fig.8.4).

3. Archaeological Group 3: which contains Djarrga Djarrga (2), Gawayurru (29), Dalabanda (18) and Djulyurrulyurru (19) (Fig.8.5).

4. Archaeological Group 4: which contains Ngandalarra (6) and Guralba (8) (Fig.8.6).

5. Archaeological Group 5: which contains Nabulabanda (10), Balgo Balgo (17) and Nganawalbinyu (3) (Fig.8.7).

Taxonomic Correlations

A comparison between this archaeological taxonomy and the ethnographic model proposed earlier reveals that with a few exceptions there is quite a strong correlation between the ethnographic and archaeological taxonomies. Possibly the weakest relationship between these taxonomies is the extent of the correlation between Subsistence Group 1 and Archaeological Group 1. Here only Mindirr (23), Yurinubadu (31) and Gundjimarra (30) are alike from both an ethographic and archaeological point of view. The three other sites from Subsistence Group 1 (Rundju Rundju (26), Wilbarinyu (27) and Djulugan (1)) do not conform to the expected archaeological pattern at all. These sites are discussed in detail

below, but briefly two of them (Rundju Rundju (26) and Wilbarinyu (27)) were totally unlike any other sites in the region and the other (Djulugan (1)) has been placed within Archaeolgical Group 2 rather than with sites in Archaeological Group 1 as expected.

Another weakness was the correlation in the way Nabulabanda (10) linked with Nganawalbinyu (3) and Balgo Balgo (17) (Subsistence Group 4) rather than with Guralba (8) and Ngandalarra (6) (Subsistence Group 3) as expected given their mutual similarity in the ethnographic model.

Apart from these four sites however the remaining 15 sites do conform to the sort of archaeological pattern which would be expected given their arrangement in the ethnographic model. As already indicated Mindirr (23), Yurinubadu (31) and Gundjimarra (30) were all alike ethnographically and archaeologically. Migiliri (22), Birbayga (28), Diedi (25) and Djungurr (4) also fall into the same archaeological and ethnographic groups. Guralba (8) and Ngandalarra (6) were also alike ethnographically and archaeologically. Nganawalbinyu (3) and Balgo Balgo (17) from Subsistence Group 4 were also linked together archaeologically, falling into Archaeological Group 5. Djulyurrulyurru (19), Djarrga Djarrga (2), Dalabanda (18) and Gawayurru (29), from Subsistence Group 5 were also alike archaeologically, forming Archaeological Group 3.

Therefore, despite minor inconsistencies, the overlap between the archaeological taxonomy and ethnographic model is convincingly strong and indicates that the archaeological debris does indeed

provide a reliable reflection of the various aspects of Aboriginal behaviour related to the procurement and use of basic resources such as seeds, stone and wood.

Sites Stone Tools and Aboriginal Behaviour

This section examines the extent to which the particular predictions relating to the proportional distribution of artefacts in sites are fulfilled and draws attention to any inconsistencies in the pattern for later discussion. It also examines the extent to which the archaeological content of each site reflects the procurement and use of the local resources at those sites.

Archaeological Group 1 (Fig.8.3;Table 8.2)

This group contained Mindirr (23), Yurinubadu (31) and Gundjimarra (30). These sites were close to stone quarries but otherwise had a limited resource base with no hardwoods and few edible seeds or tubers available. People living at these sites had to work hard for a living and there was very little time for relaxation and leisure. Men were heavily involved in subsistence activities.

Given these conditions one could expect these sites to display the least internal archaeological diversity of any sites in the region. The proximity of quarries compared to other sites in the region should be reflected by a relative abundance of unretouched flakes, and a low proportion of cores. The absence of hardwoods and relative unimportance of seeds in the economy should be reflected by relatively low proportions of seed grinding and woodworking

implements in the archaeological debris.

Looking at the graphical representation of the proportions of the artefacts in these sites it is apparent that unretouched flakes dominated the assemblage at each site and the proportions of woodworking and seed grinding implements were indeed low. The only inconsistency in the pattern displayed by the archaeological debris at these sites was the high proportion of cores at Gundjimarra (30). This is higher than expected given the proximity of this site to a quarry and will be discussed further in Chapter 9.

Archaeological Group 2 (Fig.8.4;Table 8.2)

This group contains Migiliri (22), Birbayga (28), Diedi (25) and Djungurr (4). To a certain extent the subsistence characteristics of the inhabitants at these sites were similar to those in Group 1. However, these sites were not quite as close to supplies of good quality stone for making stone tools and were set in richer and more diverse ecological surroundings. Grass seeds were of greater importance to the inhabitants of these sites although, with the exception of Diedi (25), hardwoods were not available and woodworking was not a particularly important activity. p; Therefore the archaeological debris at these sites should still contain a high proportion of debitage resulting from stone tool manufacture (although this proportion should be less than at sites in Group 1) and, with the exception of Diedi (25), should contain approximately the same proportions of woodworking tools and slightly higher proportions of seed grinding artefacts. Diedi (25) was a moderately important woodworking site and should therefore contain a higher

proportion of woodworking tools.

The archaeological content of these sites does show a general correlation with these expectations. For example these sites contain slightly smaller proportions of unretouched flakes (between 77.4% and 88.1%; Table 8.2), and a higher percentage of seed grinding implements (4.2% - 5.8%) than sites in Archaeological Group 1. Diedi (25) does contain a higher proportion of woodworking tools as expected (7.8%) although this was not significantly different from the proportion of woodworking tools at Birabayga (28) ($P<0.50$).

Another unexpected feature of the archaeology in this group was the high proportion of scrapers at Djungurr (4) (8.8%) where there were no supplies of hardwood of any note. This anomaly will be discussed in the next chapter.

Archaeological Group 3 (Fig.8.5;Table 8.2).

This group contains Dalabanda (18), Gawayurru (29), Djarrga Djarrga (2) and Djulyurrulyurru (19). These sites were occupied during the same season as most of the sites in Archaeological Group 2 but grass seeds were an important facet of the economy. Other differences included the presence of a small, good quality stand of mulga (A. aneura) at Djarrga Djarrga (2). This site, Gawayurru (29) and Dalabanda (18) were a relatively long way from the nearest quarry (15km).

If the archaeological debris at these sites provides a reasonable indication of the economic characteristics then one would expect the distance these three sites were from quarries to be reflected by a decrease in the proportion of waste flakes and an increase in the proportion of cores. Djulyurrulyurru (19) was closer to a quarry than these sites and should therefore contain similar proportions of debitage and cores as sites in Archaeological Group 2. Otherwise these sites should contain a higher proportion of seed grinding artefacts than any other sites in the region and Djarrga Djarrga (2) should contain more woodworking tools than other sites in this group.

The archaeological content of sites in this group provides a reasonably accurate reflection of the economic activities which the Aborigines said occurred there. The importance of edible seeds is firmly reflected in the high proportion of ground sandstone fragments at all sites (between 9.2% and 17.2%). The availability of hardwoods at Djarrga Djarrga (2) is reflected in the high proportion of scraping tools at that site (8.0%) although this proportion is not significantly different to the percentage of woodworking tools recorded at Gawayurru (29) or Djulyurrulyurru (19) ($P < 0.10$) and was not significantly different than the proportion of woodworking tools recorded at Dalabanda (18) (Appendix 2.2).

To the best of my knowledge Dalabanda (18) was not an important woodworking site, yet it contained a high proportion of both scrapers (9.5%) and blades (5.1%). Another unexpected characteristic of the archaeological content at sites in this group was the near or total

absence of cores at Dalabanda (18), Gawayurru (29) and Djarrga Djarrga (2). The percentage of unretouched flakes at these sites showed a general decline (77.1% to 66.4%) as expected. The anomalous characteristics of sites in this group will be discussed in the following chapter.

Archaeological Group 4 (Fig.8.6;Table 8.2)

The sites in this group, included Balgo Balgo (17), Nganawalbinyu (3) and Nabulabanda (10). All these sites were a long way from good quality supplies of stone. Seeds were of no more importance in the economy of their inhabitants than at sites in Archaeological Group 2. Balgo Balgo (17) and Nganawalbinyu (3) were near the best supplies of hardwood and were the most important woodworking sites in the region.

These economic conditions should be reflected archaeologically by a decrease in the proportion of waste flakes and an increase in the proportions of cores at all three sites. Wood scraping tools should constitute a dominant part of the assemblage at Nganawalbinyu (3) and Balgo Balgo (17). The proportion of seed grinding artefacts at these sites should be similar to the proportion of seed grinding artefacts at sites in Archaeological Group 2.

Once again the archaeological debris provides a reasonable reflection of the activities at these sites. Nganawalbinyu (3) and Balgo Balgo (17) contain a very high proportion of wood scraping tools as expected (17.4% and 19.2% respectively) and all three sites contained low proportions of unretouched flakes, moderate proportions

of seed grinding implements and high proportions of cores. Unexpected features of the archaeological debris included a high proportion of blades at Balgo Balgo (17) (4.9%) and a high proportion of ochre (4.4%) and scrapers (10.8%) at Nabulabanda (10). These anomalies are discussed further in the next chapter.

Archaeological Group 5 (Fig.8.7;Table 8.2)

This group contains Ngandalarra (6) and Guralba (8). These sites are similar in many economic respects to sites in Archaeological Group 2. They were a long way from supplies of good quality stone, and seeds were of moderate importance in the diet. However unlike Nganawalbinyu (3) and Balgo Balgo (17) these were not important woodworking sites.

Given these economic characteristics the archaeological content of these sites should be characterized by a relatively low proportion of unretouched flakes and scrapers, high proportion of cores and moderate proportion of seed grinding implements.

The archaeological expression of these activities is the poorest in the entire region and the only consistencies within the expected pattern were the low proportions of waste flakes and the relatively high proportions of cores at both sites. Otherwise sites in the group contained unexpectedly high proportions of scraping tools (10.3% and 14.1%) and very high proportions of seed grinding implements (17.6% and 15.6%). There was also an unexpectedly high proportion of ochre at Ngandalarra (6). These anomalies are discussed in the next chapter.

Ungrouped and Misplaced Sites (Fig.8.8;Table 8.2)

Rundju Rundju (26) and Wilbarinyu (27) were unlike any other sites recorded in the project and Djulugan (1) did not fall into the group it was expected to ethnographically. There is no completely satisfactory answer to the peculiar assemblage of artefacts at these sites, but the following points may help explain parts of their unusual character.

The assemblage of artefacts at Wilbarinyu (27) contained an unusually low percentage of unretouched flakes (31.*%) and high percentage of scrapers (14.8%), cores (8.0%), hammers (6.8%) and manuports (30.7%). This site is located within 200m of a large quarry of green silcrete and this explains most of the unusual characteristics of the archaeological debris. From an ethnographic point of view Wilbarinyu (27) was really a camp site on a quarry - hence the large proportion of hammers and cores. All the manuports recorded were made of thermally shattered cobbles of green silcrete and according to the Aborigines had been collected for but not used as hammerstones and left at the site. It was only used for a short time during the wet season but was also visited by people travelling along the Stansmore Range later in the year as well. The low proportion of waste flakes at the site indicates that flaked stone was being manufactured and taken from it by people passing through the region. As indicated in Chapter 6 flakes of stone were taken from quarries to proper camp sites for making stone tools. This is what was happening at Wilbarinyu (27). The unusual archaeological debris here is therefore consistent with a habitation site adjacent a quarry. The only inexplicable feature of the archaeological debris is

the high proportion of scrapers.

There seems to be virtually no correlation between the archaeological debris at Rundju Rundju (26) and the subsistence behaviour recorded there. The most unusual feature of this site was the low proportion of unretouched flakes (48.9%) and high proportions of seed grinding implements (26.7%) and manuports (11.1%). To the best of my knowledge there is no economic reason for this unusual assemblage of artefacts. This site was occupied fleetingly during the wet season and was definitely not an important seed processing site location. The Aborigines thought the high proportion of manually transported pieces of rubble at the site had probably been used as heat retainers to cook termites' larvae - and this was a wet season food. The only other explanation for the archaeological appearance of Rundju Rundju (26) is the poor visibility of archaeological debris there. Most of the site was covered by loose sand and vegetation I imagine this has led to more large artefacts (such as manuports and seed grinding implements) being recognized than small artefacts (such as unretouched flakes). Therefore the proportional representation of different types of artefacts at Rundju Rundju (26), is likely to be unrepresentative of the economic activities which occurred there.

Ethnographically Djulugan (1) was identical to Yurinubadu (31) and therefore should have contained archaeological debris which was similar to this and other sites in Archaeological Group 1. However this site contained fewer unretouched flakes (79.6%) and more scrapers (11.5%) and blades (3.6%) than any of the sites in this group. There is no known ethnographic explanation for this anomalous

assemblage of artefacts and I am inclined to think the debris at this site was sampled inaccurately. Djulugan (1) was the first site examined in the project and was very difficult to record. Both the Aborigines and I were unsure of what each of us was doing, and as a result I left some artefacts unrecorded for fear of appearing overly pedantic. Added to this is the possibility that I simply missed many of the tiny pieces of debitage in the early stages of the sample. As a result I think there is a good case for querying the true representativeness of this sample.

Because of the anomalous character of the artefactual assemblage of all three sites I have excluded them from most of the discussion in the following chapter. Wilbarinyu (27) and Rundju Rundju (6) however, have been included in the section dealing with the distribution of raw materials because they were near an important quarry and the presence of various materials at these sites is of relevance and interest.

Chapter 9

ANOMALIES AND OTHER INTERPRETATIONS

Despite general agreement between the archaeological debris and the subsistence activities conducted at sites there have also been some obvious inconsistencies. For example the variation in the proportion of cores across the landscape was inconsistent and some sites contained no cores at all. There were also sites which contained high proportions of seed grinding implements even though seeds were not a particularly important resource and there were sites with high proportions of woodworking tools but, to the best of my knowledge were not important woodworking locations. Similarly throughout the preceding text it was apparent there were anomalies in the proportions of ochre and blades at sites and so far I made virtually no references to the distribution of manuports or engraving tools in the region.

In this chapter I would like to examine these anomalies more extensively and investigate other interpretations of the data in order to make a complete and exhaustive assessment of the capacity of stone tools to reflect Aboriginal behaviour.

WOODWORKING TOOLS

Scrapers

The most obvious anomaly in the distribution of scrapers across the landscape was the high proportion of these artefacts at Djungurr (4), Ngandlarra (6), Guralba (8), Nabulabanda (10) and Dalabanda (18) (between 8.8% and 14.1%: Table 8.2).

Access To Hardwood

I have no direct evidence from the Aborigines that woodworking was a major activity at these sites, but given the fact that four of these sites were located near suitable stands of different woods (Fig.4.5;chapter 4) it seems reasonable to assume that my ethnographic data is incomplete and that these sites were in fact reasonably important woodworking sites. Nabulabanda (10) had access to supplies of two species of hardwoods (Acacia aneura and A. pachycarpa) from nearby flood plains; Ngandalarra (6) and Guralba (8) had access to A. pachycarpa from the flood plains to the south and Dalabanda (8) had access to the best supply of softwoods (Erythina vespetilio) in the region. This seems to be quite a sensible explanation for the high proportion of scrapers at these sites; but

before this explanation is accepted. I think several other possibilities should be explored.

Collection of tubers

One explanation for the relatively high proportion of scrapers at Ngandalarra (6), Djungurr (4), Guralba (8) and Nabulabanda (10) may be that scrapers were used rather extensively at these sites to sharpen digging sticks dulled through the collection of Ipomoea tubers at these locations. These tubers were generally collected from quite deep underground and I think it is reasonable to assume that the constant collection of these tubers at these sites may well have necessitated the constant resharpening of women's digging sticks and hence the use and discard of relatively high proportions of wood scraping tools. If this explanation is feasible then the proportion of woodworking tools at these sites may provide indirect evidence for the collection of underground food.

Two techniques were used to sharpen digging sticks. If sharpened by men they were usually adzed smooth with a hafted woodworking tool (see Hayden 1979:111 and Hamilton 1980:18). However if sharpened by women they were generally ground on blocks of sandstone (Helms 1896; White 1910:728; Horne and Aiston 1924:56; Love 1936:67; Thomson 1964:407; Tindale 1972:446). I did not record this latter technique for sharpening digging sticks and the only piece of sandstone I saw which was thought to have been used to sharpen anything was said to have been used to sharpen a steel hatchet. The few women I spoke to about this said men sharpened their digging sticks with stone tools.

Nevertheless given the strength of the ethnographic data to the contrary I do not consider the high proportion of scrapers at these sites an entirely reliable indication of the manufacture of digging sticks and hence evidence for the collection of underground tubers at these sites.

Manufacture of Wooden Implements

Another possible explanation for the high proportion of scrapers may well be that these sites were occupied during the cold season - when men had sufficient time to be able to make wooden implements. The importance of time in this regard is apparent if we examine how time consuming wooden artefacts were to produce. Ethnographic observations (Mountford 1941; Gould 1970; Hayden 1979) reveal it took between three and nine hours to make a spear thrower and Thomson (1964), in a detailed account, records two men taking six days to construct a small spear thrower. Hayden (1979) suggests that hardwood "punishment" spears required a great deal of work and Tindale (1972:246) records that the construction of large, hardwood dishes was one of the most difficult manufacturing tasks men had to perform. Mountford (1941) records these took between three and four days to construct and Love (1942) records four women spending one and a half days making these dishes. Large hardwood dishes were not used in this region but these figures nevertheless give some idea of the kind of investment necessary to make wooden implements from hardwoods.

With this in mind, it is quite apparent from the subsistence system defined in Chapter 5 that the only time of year when men had these quantities of time available to them was during the cold time, when the abundance of vegetable tubers collected by women freed them from the task of food collection and allowed them to devote time to manufacturing of wooden implements.

Therefore one would expect to find the highest proportions of scrapers at sites which were occupied during the cold season. In this instance Ngandalarra (6), Guralba (8), Djungurr (4) and Nabulabanda (10) were occupied at this time of year and this seasonal factor may explain the unexpectedly high proportion of scrapers at these sites. Unfortunately this does not explain the high proportion of scrapers at Dalabanda (18) as this site was not occupied or foraged over during the cold season.

Curation

A fourth factor likely to influence the proportion of scrapers at these sites (and other sites in general) is the extent to which these artefacts were transported before being discarded. The view is expressed that highly curated artefacts may be repeatedly removed from their context of use and as a result there may be "little correlation between what is done and the artefacts remaining" (Binford 1973:242). Not surprisingly therefore, influences of curation on the relative abundance of various tool types in assemblages has been the subject of some discussion in the literature (see Ammerman and Feldman 1974; Munday and Lincon 1979; Bettinger

1979).

So far in this thesis I have worked on the general assumption that greatest numbers of scrapers were discarded at the locations where they were most frequently and intensely used. This is likely to be true for utilized flakes which the Aborigines say were used and discarded spontaneously when and where they were needed but is perhaps less likely to be true for tula and burren adze flakes. These artefacts were more highly curated (see O'Connell 1977; Gould 1980) and were transported from place to place and reused until they became too small to be held in a haft.

It may be therefore that the proportion of adze flakes (and hence scrapers in general) in sites relates solely to the distance each site was from its nearest supply of raw material and not to the extent which they were used as woodworking tools at particular sites. If true, the reason there was a high proportion of scrapers at Guralba (8), Ngandalarra (6) and Nabulabanda (10) may simply be that these sites were a long way from suitable supplies of raw materials and that more woodworking tools were discarded at these sites because the tools had been exhausted through use at other sites along the way.

However I would tend to be skeptical of this explanation for the proportional representation of scrapers in these sites. There are several reasons for this. One of the most obvious is that (as already indicated) a disproportionate amount of woodworking tools seemed to be used up in the production of wooden implements and it is therefore likely that the greater proportion of these would accumulate at the major woodworking locations in the region. A second reason for skepticism is that the Aborigines transported cores and flakes of stone for use at sites in stone poor regions. Therefore there is no reason to assume more artefacts may have been discarded at Guralba (8), Ngandalarra (10) and Nabulabanda (10) because they had been used up at other sites occupied beforehand. This is particularly true for Guralba (8) and Ngandalarra (10) because these sites were occupied quite early in the traditional seasonal round. In any case the transportation, use and eventual discard of woodworking tools would not explain the unexpectedly high proportions of woodworking tools at Djungurr (4) and Dalabanda (18), as these sites were relatively close to quarries. Lastly Hayden's technological research in the Western Desert revealed that curation should

> not in fact substantially affect the differential patterning of tool types at sites; tools are predominantly discarded where they have been used, not elsewhere (1976:456).

It therefore seems unlikely that curation is responsible for the high proportions of scrapers at these five anomalous sites (or any other sites in the region for that matter). This can be further demonstrated by looking at the proportional distribution of scrapers in view of what might be expected if curation was an important factor influencing the proportional distribution of scrapers at different sites in the region. If, for example, curation was an important influencing factor, one of the first things I would expect to see in the archaeological debris would be a consistent increase in the proportion of exhausted scrapers at sites as the distance between sites and the major supply of raw material (Table 9.1) used at those sites increased. Similarly one would expect that as supplies of stone suitable for hafting decreased, the Aborigines would have made more intense use of the artefacts they already had. Therefore the size of scrapers at the most distant sites should be noticeably smaller than at sites closer to quarries. In relation to this, one would expect that as the Aborigines ran out of suitable tulas and burren adze flakes they would have offset this by making increased use of randomly shaped pieces of stone (utilized flakes) collected from camp sites or knapped off cores as substitutes.

Table 9.1 Raw materials used at each site

SITE		RAW MATERIAL TYPE								
		Miscellaneous	White chalcedony	Green silcrete	Black ferecrete	Grey silcrete	Quartzite	Sandstone	Siltstone	Total
1. Djulugan	n	4	527	0	0	0	3	2	0	536
	%	0.7	98.3	0.0	0.0	0.0	0.6	0.4	0.0	
2. Djarrga Djarrga	n	13	374	3	0	0	1	3	0	394
	%	3.3	94.9	0.8	0.0	0.0	0.3	0.8	0.0	
3. Nganawalbinyu	n	24	288	6	10	0	7	2	0	337
	%	7.1	85.5	1.8	3.0	0.0	2.1	0.6	0.0	
4. Djungurr	n	62	158	3	205	0	40	0	3	471
	%	13.2	33.5	0.6	43.5	0.0	8.5	0.0	0.6	
6. Ngandalarra	n	1	40	1	0	1	0	8	0	51
	%	2.0	78.4	2.0	0.0	2.0	0.0	15.7	0.0	
8. Guralba	n	4	44	0	0	0	4	0	0	52
	%	7.7	84.6	0.0	0.0	0.0	7.7	0.0	0.0	
10. Nabulabanda	n	4	144	3	22	1	2	0	1	177
	%	2.3	81.4	1.7	12.4	0.6	1.1	0.0	0.6	
17. Balgo Balgo	n	29	312	18	5	0	4	0	0	368
	%	7.9	84.8	4.9	1.4	0.0	1.1	0.0	0.0	
18. Dalabanda	n	1	111	0	0	1	0	0	0	113
	%	0.9	98.2	0.0	0.0	0.9	0.0	0.0	0.0	
19. Djulyurrulyurru	n	2	217	11	7	2	3	8	0	250
	%	0.8	86.8	4.4	2.8	0.8	1.2	3.2	0.0	

TABLE 9.1 (continued)

SITE		RAW MATERIAL TYPE: Miscellaneous	White chalcedony	Green silcrete	Black ferecrete	Grey silcrete	Quartzite	Sandstone	Siltstone	Total
22. Migiliri	n	1	563	1	0	0	0	2	0	567
	%	0.2	99.3	0.2	0.0	0.0	0.0	0.4	0.0	
23. Mindirr	n	0	158	2	0	106	2	3	0	271
	%	0.0	58.3	0.7	0.0	39.1	0.7	1.1	0.0	
25. Diedi	n	2	158	4	0	4	0	0	0	168
	%	1.2	94.0	2.4	0.0	2.4	0.0	0.0	0.0	
26. Rundju Rundju	n	4	26	10	0	13	1	1	0	55
	%	7.3	47.3	18.2	0.0	23.6	1.8	1.8	0.0	
27. Wilbarinyu	n	0	2	48	0	0	0	0	0	50
	%	0.0	4.0	96.0	0.0	0.0	0.0	0.0	0.0	
28. Birbayga	n	22	151	18	126	2	4	1	0	324
	%	6.8	46.6	5.6	38.9	0.6	1.2	0.3	0.0	
29. Gawayurru	n	0	173	2	1	0	0	6	0	182
	%	0.0	95.1	1.1	0.5	0.0	0.0	3.3	0.0	
30. Gundjimarra	n	3	137	0	1	0	0	0	0	141
	%	2.1	97.2	0.0	0.7	0.0	0.0	0.0	0.0	
31. Yurnubadu	n	1	660	1	0	0	1	0	0	663
	%	0.2	99.5	0.2	0.0	0.0	0.2	0.0	0.0	
Total nos		177	4243	131	377	130	72	36	4	5170*
Total %		3.4	82.1	2.5	7.3	2.5	1.4	0.7	0.1	

*Missing data for 544 artefacts.

Therefore, if curation had some influence on the distribution of scrapers at sites in the region one would expect this to be expressed archaeologically through:

(a) a general increase in the proportion of scrapers in the assemblage of artefacts at each site;

(b) a gradual increase in the relative proportion of utilized flakes compared to adze flakes; (c) a reduction in the size of scraping tools as the distance between sites and their nearest major supply of raw materials increased.

Figure 9.1 presents the results of these expectations. In Fig.9.1a it can be seen there is no consistent increase in the proportion of scrapers at sites as the distance from the nearest major quarry increases. Sites which are the furthest from quarries (Ngandalarra (6) and Guralba (8)) do not contain the highest proportions of woodworking tools in the region and four sites (Djungurr (4), Diedi (25), Djarrga Djarrga (2) and Dalabanda (18)) within the first 20km from quarries contain relatively high proportions of woodworking tools. One of these (Djungurr (4)) is only 1km from the nearest major supply of raw material.

Figure 9.1a

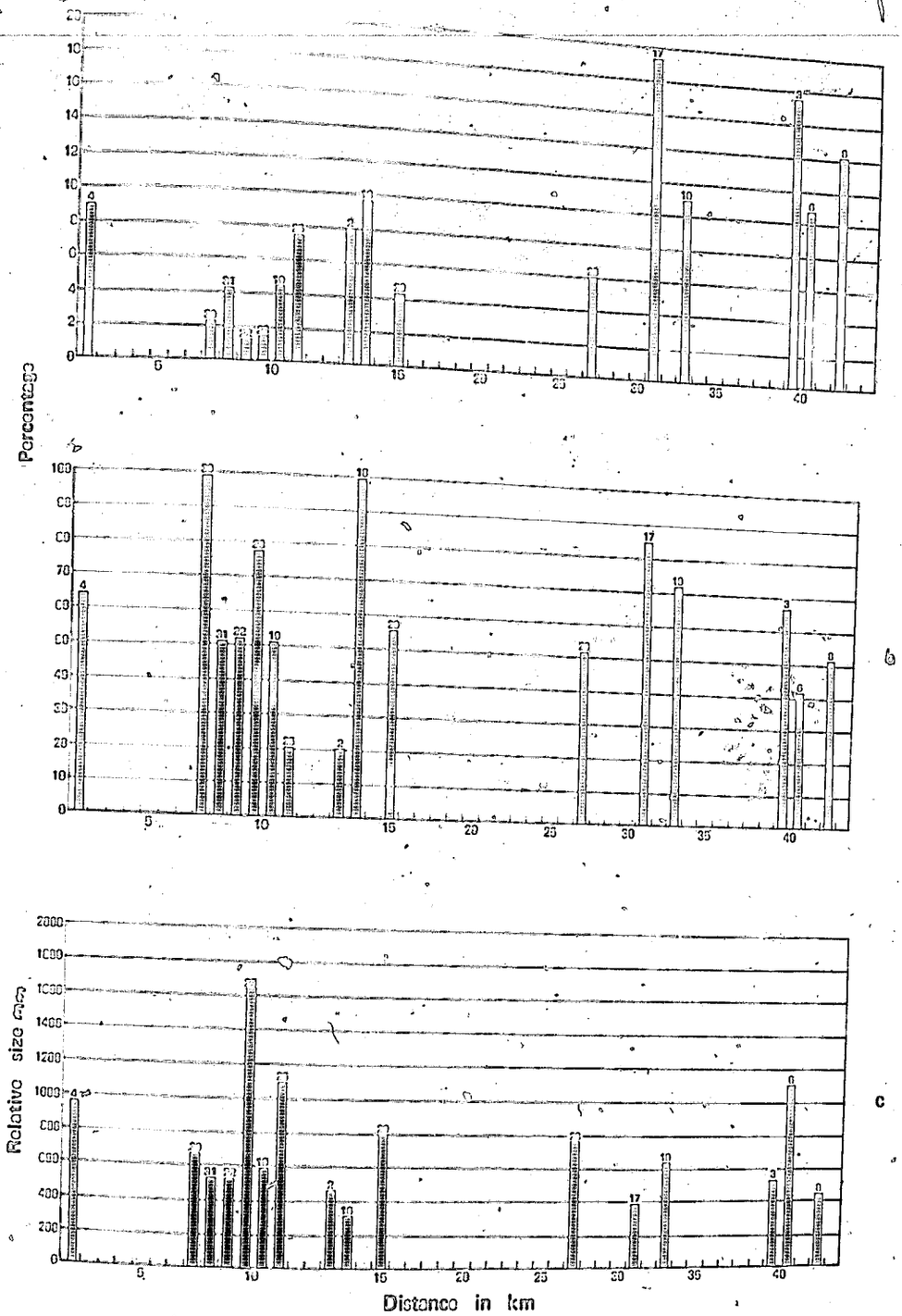
Proportion of scrapers in each site compared to the distance each site was from the nearest major supply of stone.

Figure 9.1b

Percentage of utilized flakes in the category of "scrapers" at each site compared to the distance each site was from the nearest major supply of stone.

Figure 9.1c

Relative size of artefacts in the scraper category as the distance between sites and the nearest major supply of stone increased.


Percentage
a
b
c
Relative size
Distance in km

Also the relative proportions of utilized flakes compared to adze flakes at each site does not increase as one gets further away from quarries Fig.9.1b). In fact there is no difference in the average proportional representation of utilized flakes throughout the region at all. Specifically 60.5% of all the scrapers recorded at sites within the first 20km of quarries consisted of utilized flakes and 60.8% of all the scrapers at the sites within the next 20km from quarries were also composed of utilized flakes. The only sites where no adze flakes were recorded were Gundjimarra (30) and Dalabanda (18) and both these sites are less than 15km from the nearest quarry. Lastly, Fig.9.1c indicates there is no consistent reduction in the approximate size of artefacts as the distance between sites and quarries increases. In this case the smallest scrapers were not found in the most distant sites. In the light of these results I am inclined to think curation does not provide a satisfactory explanation for the high percentage of scrapers at Ngandalarra (6), Nabulabanda (10) and Guralba (8).

Consequently the best explanation for the unexpectedly high proportion of scrapers at Djungurr (4), Guralba (8), Ngandalarra (6) and Nabulabanda (10) is likely to be the combined influence of the general availability of wood at these sites and their occupation during the cold season, when men had the time to manufacture wooden implements.

This explanation does not explain the high proportion of scrapers at Dalabanda (18) as this site was not occupied during the cold season. I think the most likely explanation for the scrapers at this site is that they were used in the construction of softwood dishes made from the unusually abundant supply of softwood nearby. This interpretation is supported by the high proportion of blades at Dalabanda (5.1%) but I have no ethnographic evidence that this activity did take place at this site in the past.

Summary: Scrapers and Aboriginal Behaviour

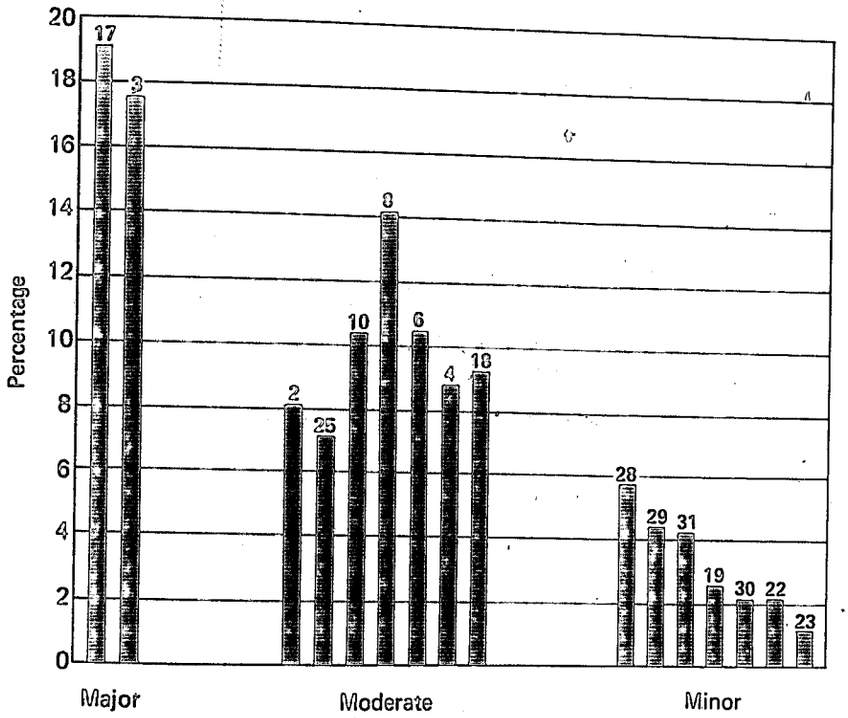
In summary therefore there are reasonable grounds to support a view that the wood scraping component of the archaeological debris provides an accurate indication of the amount of woodworking peformed at individual sites in the region. Fig.9.2 illustrates the relative proportion of woodworking tools in sites and the relative importance of woodworking actually conducted at those sites.

Here the proportional representation of scrapers at Balgo Balgo (17) and Nganawalbinyu (3) provides clear evidence of the importance of these sites as woodworking centres. At the other end of the spectrum are sites which were not located next to important supplies of wood and/or were occupied at a time of year when men were busily engaged in food collection and did not have time to make wooden implements. These sites include Birbayga (28), Gawayurru (29), Yurinubadu (31), Djulyurrulyurru (19), Gundjimarra (30), Mindirr (23) and Migiliri (22) and contain the lowest proportion of scrapers in



Figure 9.2

The proportion of scrapers in sites compared to the relative importance of each site as a woodworking location.


Percentage
20
18
16
14
12
10
8
6
4
2
0
17
3
2
25
10
8
6
4
18
28
29
31
19
30
22
23
Major
Moderate
Minor

the region. The statistical significance between the proportion of scrapers at these seven sites and Balgo Balgo (17) and Nganawalbinyu (3) is very high ($P<0.001$).

Between these two extremes are sites such as Diedi (25) and Djarrga Djarrga (2) which were moderately important woodworking sites and sites such as Ngandalarra (6), Guralba (8), Nabulabanda (10) and Djungurr (4) which were occupied during the cold season; where it is assumed woodworking was a moderately important activity. These sites fall into a rather grey area statistically and are less easy to define archaeologically. Nevertheless if we take the average proportions of scrapers in these three groups each group is quite easy to define. For example the average proportion of scrapers varies from 18.3% at the major woodworking sites; to 8.9% at sites where woodworking was of moderate importance; to 3.4% at sites where woodworking was not an important activity.

Blades

The proportion of blades recorded in this project, compared to the rest of the archaeological debris was relatively small (79 artefacts; 1.4% of the entire assemblage). Because of this the percentage of blades at most sites was small and there was little variation of statistical significance in their proportional distribution. However this was not the case at Dalabanda (18) and Balgo Balgo (17) where blades constituted 5.1% and 4.9% of the assemblages. This percentage was significantly different than all

other sites in the region ($P<0.05$; Appendix 2.4) except Diedi (25) and therefore invites some explanation.

The main function of the blades recorded ethnographically in this project was woodworking. As such, their primary function was the construction of women's softwood dishes, but they were also used to sharpen hunting spears and to smooth the final surface of wooden implements in general.

No doubt these functions explains the high proportions of these artefacts at Dalabanda (18) and Balgo Balgo (17). I have already suggested (above) that the high proportion of blades at Dalabanda (18) may have resulted from their use in the construction of women's winnowing dishes from the unusually abundant supply of softwood (Erythrina vespertilio) west of that site although I have no ethnographic data that indicates this activity took place there.

There is more evidence for their use as woodworking tools at Balgo Balgo (17). This site was used as a repair stop for "cleaning" digging sticks by people on their way north to the "bush potato country" and I think it is resonable to interpret the high proportion of blades at this site as archaeological evidence for the "cleaning" or maintenance of digging sticks here.

Engravers

The number of stone points and burins recorded in the project was very small (35 artefacts:.6% of the entire assemblage) and there is little pronounced variation in the proportion of these artefacts across the landscape (Appendix 2:3). The greatest proportion of engravers varied from 1.5% to 1.7% of the assemblage of artefacts at Ngandalarra (6), Guralba (8), Dalabanda (18) and Diedi (25). It is possibly unwise to make too much of this subtle variation in the distribution of engravers but nevertheless the following comments are relevant.

The primary function of these engraving tools was in the construction of sacred hardwood ceremonial boards. These were always engraved at sacred locations and hidden at special spots in the landscape. It is therefore interesting that the highest proportion of engraving tools should be recorded at these particular four sites. Ngandalarra (6) and Dalabanda (18) were the two most sacred habitation sites in the region and I know these sacred objects were made and used there. I do not know if this activity took place at Diedi (25) or Guralba (8) but I do know that both sites are very close to the only two locations where sacred boards are hidden. It is tempting therefore, despite the absence of statistical support, to view the presence of engraving tools at these four sites as archaeological evidence for a tradition of ceremonial board manufacture at these sites.

SEED GRINDING ARTEFACTS

The only major anomalies in the distribution of seed grinding artefacts in the region were the unexpectedly high proportions of these artefacts at Ngandalarra (6) and Guralba (8). To the best of my knowledge seeds were not of major economic importance at these sites but the proportion of seed grinding artefacts was as high (17.6% and 15.6% respectively) as at sites such as Djarrga Djarrga (2) and Gawayurru (29) where seeds were an important resource.

The most likely factor contributing to the proportion of grindstone fragments at Ngandalarra (6) is the location of a small sandstone rise next to the site. Sandstone from here was used to make seed grinding artefacts and this is indicated archaeologically both by the high proportion of sandstone flakes (15.7%;Table 9.2) and the fragments of ground sandstone at that site. Therefore the high proportion of seed grinding artefacts at Ngandalarra (6) probably reflects the manufacture of seed grinding implements rather than the consumption of great quantities of seed foods. Another factor may also contribute to the unexpectedly high proportion of grindstone fragments at this site. Ngandalarra (6) was an important ceremonial site and contained the highest proportions of ochre in the region (5.9%). It seems likely therefore that the relatively high proportion of grindstone fragments may be also the result of their use in the preparation of ochre for ceremonial purposes.

I have no convincing explanation for the high proportion of seed grinding artefacts at Guralba (8). It is possible that my reconstruction of economic activities at this site was inaccurate and seeds were more important than I thought (possibly Panicum cymbiforme on the lunette on the western margin of this site). It is also possible that the sample taken at this site was too small to be representative. The sample (65 sq m) only contained 64 artefacts of which 10 were grindstones.

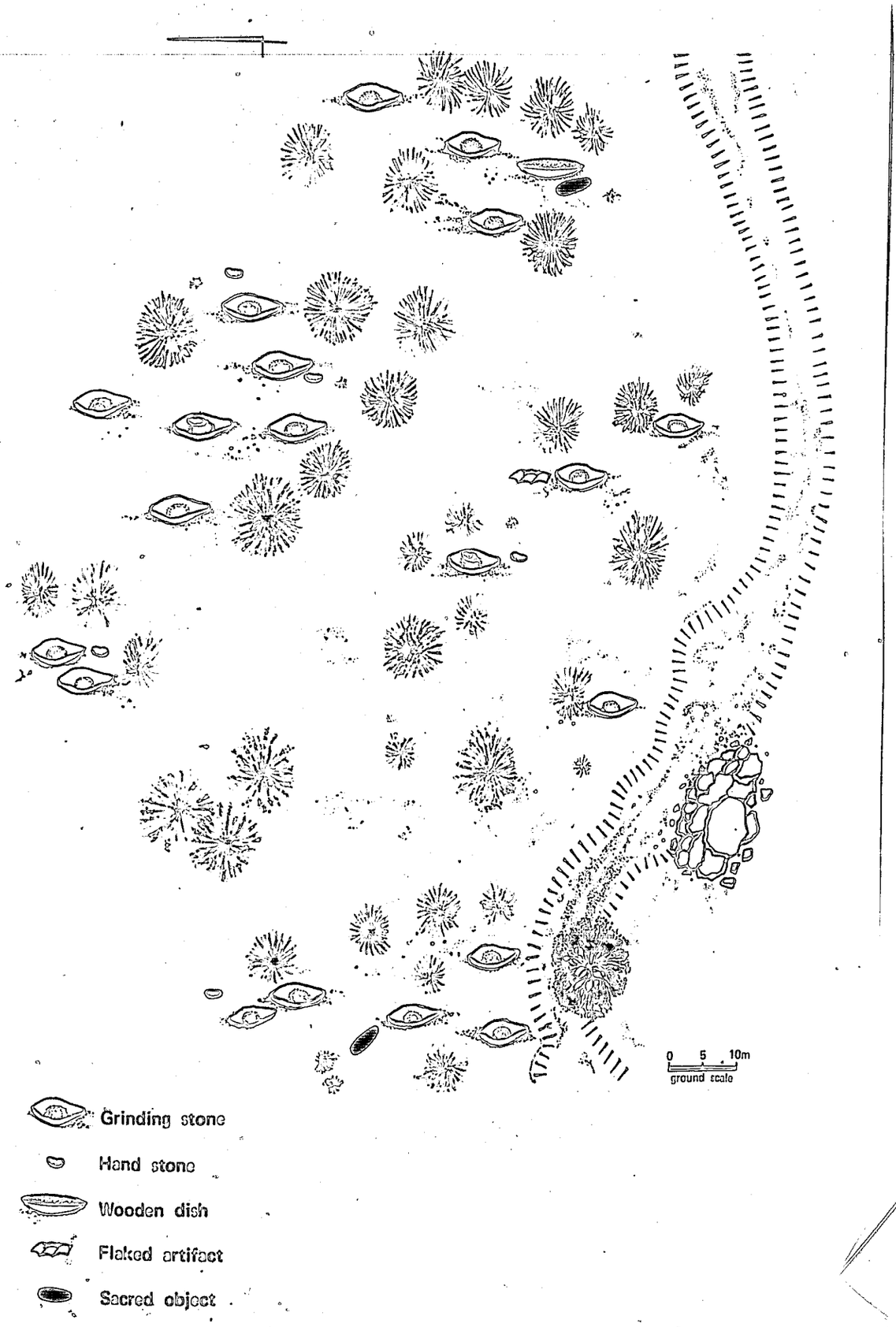
Grindstones and Population

I think another important anomaly not yet discussed in the regional distribution of seed grinding artefacts in the study area was the presence of an important seed processing site 3km north west of Djungurr (4). I have mentioned this site (Wirribil (12)) briefly before but it is such an interesting site that it is worthy of extra discussion.

This site was the most important seed processing site in the entire region and was the place women congregated to prepare food for the men participating in the "bush potato" ceremony held nearby. I sampled about one fifth of this site (12,600 sq m) and recorded 20 grinding slabs, six handstones, one sacred stone, one sacred piece of wood, and a part of a women's wooden digging dish (Fig.9.3).

Figure 9.3

Site plan of Wirribil (12).


0 5 10m
ground scale
Grinding stone
Hand stone
Wooden dish
Flaked artifact
Sacred object

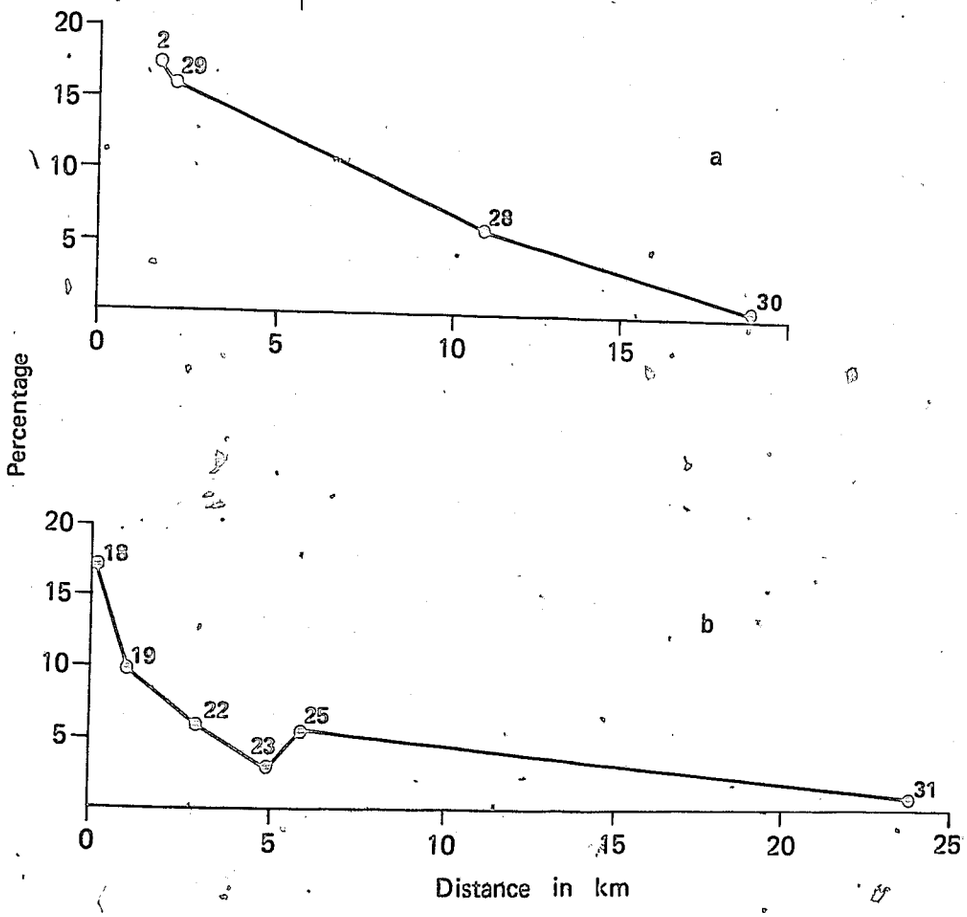
The number of grinding slabs at this site is of particular interest. If the number of grinding slabs recorded is consistent for the whole site then there may have been approximately 100 grinding slabs at this location. This provides tentative evidence for 100 women and possibly up to 100 families living in this area (assuming each grinding slab was owned by a different woman, and they were used contemporaneously). If the average number of people per family was five, as indicated in Chapter 3, then the number of grindstones at this site suggests there may have been up to 500 people occupying the region. Even with two wives per family there is still archaeological evidence for about 250 people. Both figures are consistent with the Aborigines observation that "a big mob" of people came into the region for the ceremony held near this site.

Grindstones and Seed Collection

A further point which can be made while discussing the proportional distribution of grindstones is the strong correlation between the geographic availability of edible seed and the proportions of seed grinding artefacts at archaeologial sites in the region. This relationship is represented in Figure 9.4 and it can be seen that the proportion of seed grinding artefacts decreases quite sharply as the distance between sites and the major concentration of grass seeds increases. Specifically, the proportion of grindstones decreases from 17.2% at Djarrga Djarrga (2); which is adjacent the southern most concentration of grass seeds (Fig.4.2;Chapter 4) to 5.8% at Birbayga (28) which is only 10km away (Table 8.2). The same

Figure 9.4

Decrease in the proportion of seed grinding artefacts as the distance between sites and the major concentrations of grass seeds increased.


20
15
10
5
0
5
10
15
2
29
28
30
a
Percentage
20
15
10
5
0
5
10
15
20
25
18
19
22
23
25
31
b
Distance in km

pattern is more evident at sites near the central concentration of grass seeds. Here the proportion of grindstones drops from 16.8% at Dalabanda (18), which is central to this concentration, to approximately 5% at Migiliri (22) and Diedi (25) which are only 5km away.

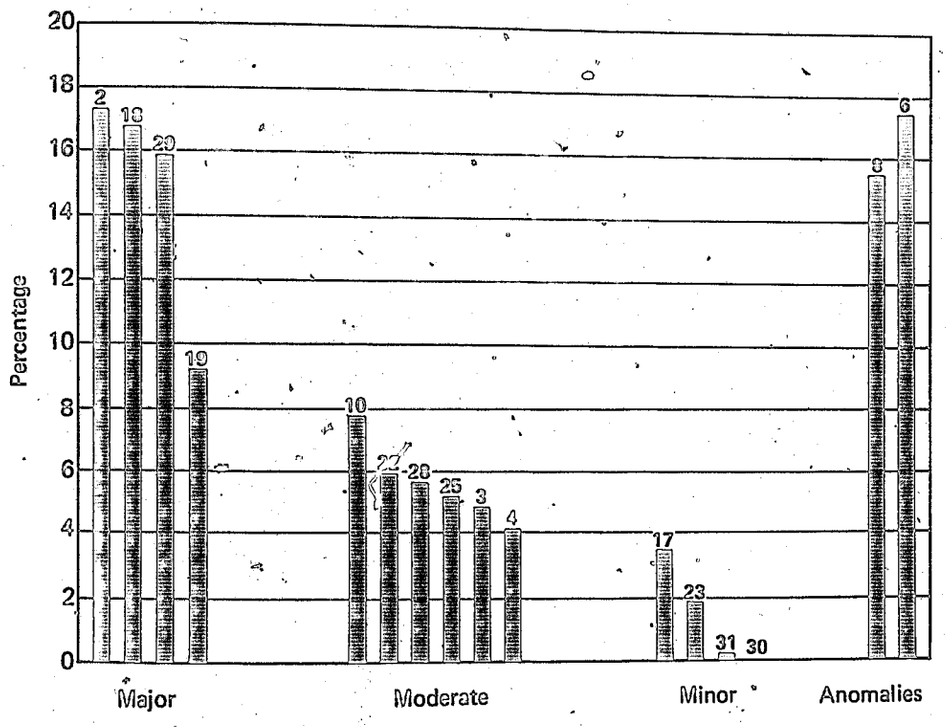
The magnitude of this decline in both cases is very significant statistically ($P<0.001$; Appendix 2.7) and suggests that grass seeds were only a major resource at sites adjacent to the major concentration of grass seeds. It also indicates that the foraging radius over which people were prepared to collect seeds was small, in this case less than 5km. The proportional distribution of grindstone is therefore consistent with the ethnographic evidence indicating seed processing was a time consuming and arduous task and that the effort required for processing made it unprofitable to travel great distances to collect seeds. It is also consistent with the interpretation that in the normal course of events seeds were not used as an important resource unless large quantities of easily gathered seeds were readily available at sites.

Summary: Grindstones and Aboriginal Behaviour

Figure 9.5 provides a diagramatic summary of the proportion of seed grinding artefacts at each site compared to the relative importance of seeds to the inhabitants of each site. From this it is apparent that, with the exception of Ngandalarra (6) and Guralba (8) the relationship between the proportion of seed grinding artefacts

Figure 9.5

The proportion of seed grinding implements at sites compared to the relative importance of seeds in the economy at those sites.


Percentage
20
18
16
14
12
10
8
6
4
2
0
2
16
20
19
10
22
28
25
3
4
17
23
31
30
8
6
Major
Moderate
Minor
Anomalies

and the relative importance of seeds at each site was very close. The most important seed processing sites in the region were Djulyurrulyurru (19), Dalabanda (18), Djarrga Djarrga (2) and Gawayurru (29). Here seed grinding artefacts constituted between 9.2% and 17.2% of the artefacts at these sites. The reverse is true at Balgo Balgo (17), Mindirr (23), Gundjimarra (30) and Yurinubadu (31). These sites were occupied during seasons when supplies of seeds were poor. Here the average percentage of seed grinding artefacts varied from 0% to 3.6%. assemblage at each camp site. A statistical comparison of the difference between the percentage of seed grinding artefacts at each site in these two sets of sites reveals a very high level of statistical difference (P varies between 0.01 and 0.001).

Between both these extremes are sites such as Nganawalbinyu (3), Djungurr (4), Migiliri (22, Birbayga (28), Nabulabanda (10) and Diedi (25) where the consumption of seeds was a moderate economic importance. These sites are less easy to define statistically and here the proportion of seed grinding artefacts contributes between 4.2% and 7.8% archaeologically. Nevertheless, if we examine the average proportion of seed grinding implements in these three groups they are quite clearly defined. In this case the proportion of seed grinding artefacts varies from 14.8% at major seed processing sites, to 5.3% at sites where seeds were of moderate importance, to 1.6% at sites where seeds were of little economic importance.

In summary the distribution of seed grinding artefacts provides a very strong economic indication. Most obviously, they provide direct evidence for the relative importance of grass seeds in the economy of inhabitants of individual sites. In addition the low proportion of grindstones at sites occupied during the end of the dry season or during the wet season provides archaeological evidence for the seasonal occupation of those sites. Also the geographic distribution of grindstones provides evidence for the foraging radius over which people were prepared to collect seeds. Lastly, providing my assumptions are correct; the distribution of complete grinding slabs not only provides evidence of the number of women at camps (and thereby the approximate number of people at those camps: see also Peterson (1968)) but the frequency of grinding slabs recorded at one exceptional seed grinding site in this region provides evidence for a population of up to 500 people inhabiting the area and taking part in the major ceremonial event that took place in the study area.

STONE TOOL MANUFACTURE

Cores

The distribution of cores across the landscape does not conform to a strong, coherent pattern. The expected pattern was for the proportions of cores to increase at sites which were furthest from quarries; indicating the transportation of cores from quarries and their use at sites across the landscape until they were exhausted and

discarded. This pattern was not entirely consistent throughout the region. For example some sites, such as Gundjimarra (30) and Djulyurrulyurru (19) contained high proportions of cores yet were relatively close to quarries whereas others such as Dalabanda (18) and Gawayurru (29) were further from quarries but contained no cores at all. These inconsistencies invite some explanation.

Distribution of Cores

The majority of cores in the region were made from white chalcedony and if we examine the distribution of these (Fig.9.6a) it clearly corresponds to the generalized pattern discussed above. Further, if we examine the distribution of these cores as well as the relative approximate size of cores (based on the multiplication of the length and width of cores at each site) it is apparent that the size of cores decreases as the distance between sites and quarries increases (Fig.9.6b). This is consistent with the hypothesis that more worked out cores were discarded in stone poor regions.

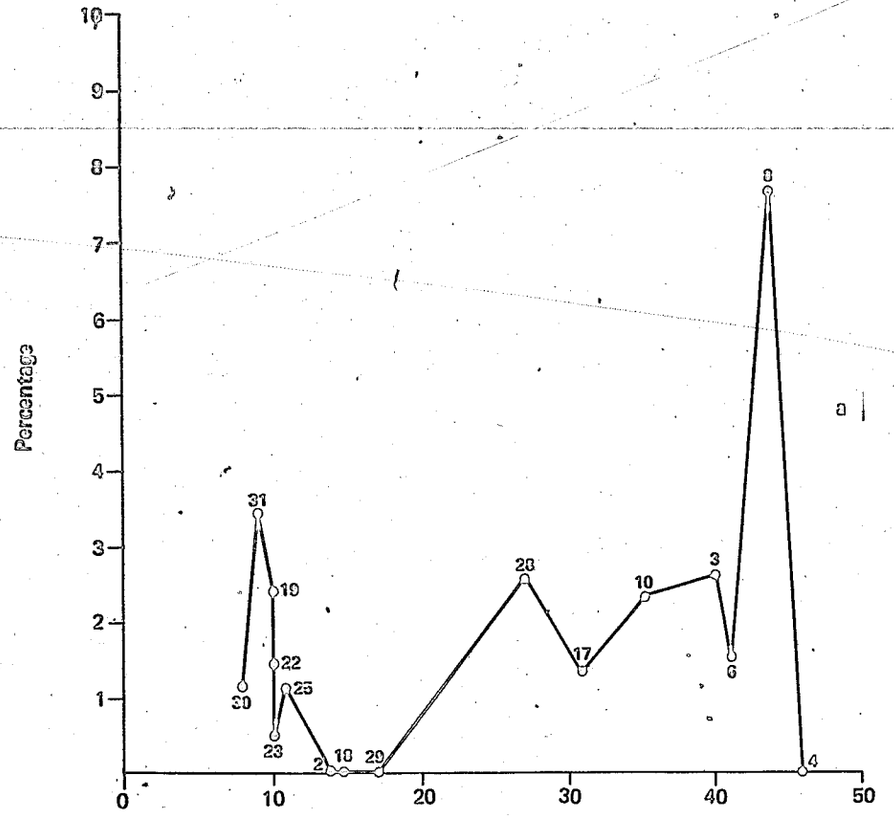
However, this increase in the discard rate of small cores was not uniform across the landscape. Rather there was a tendency for a relatively high proportion of large cores to be discarded at sites within the first 10km of a quarry source; followed by a dramatic fall off in the discard rate of cores over the next 10-17km and a substantial increase in the discard rate of small cores at sites greater than 25km from supplies of stone. In other words there were more big cores discarded at sites close to quarries; more small cores discarded at sites furthest from quarries and no cores (or very few

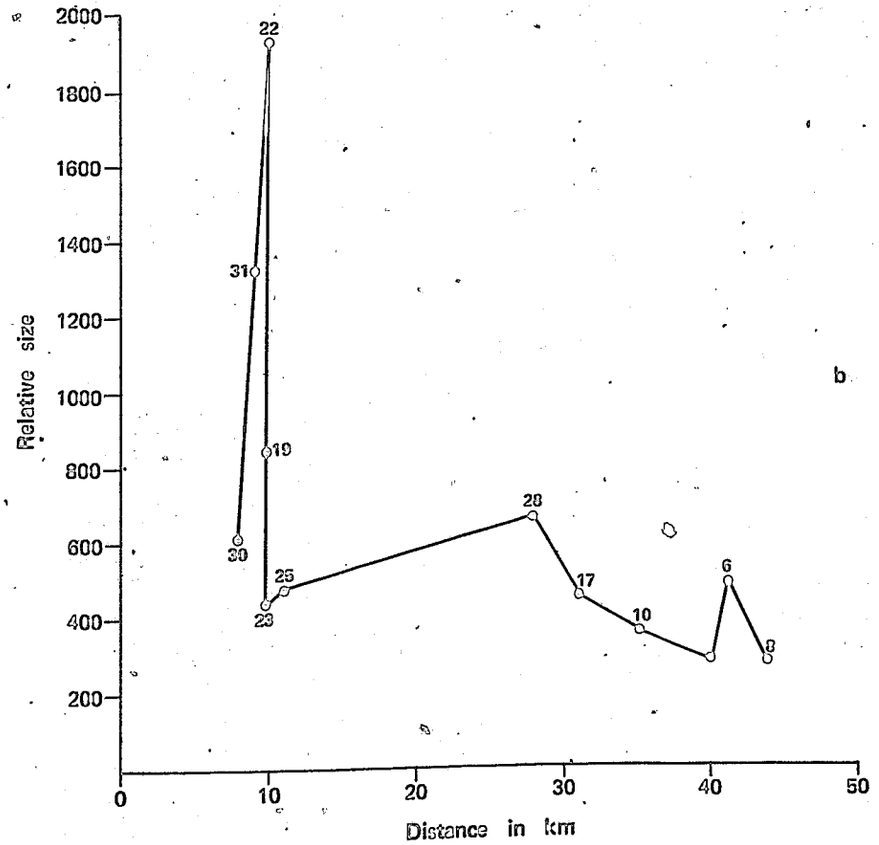
Figure 9.6a

Percentage of cores in sites as the distance between sites and the nearest source of white chalcedony increased.

Figure 9.6b

Relative size of cores as the distance between sites and the nearest white chalcedony quarry increased.


Percentage
a
31
19
22
25
30
23
2
18
20
28
17
10
3
6
8
4
0
10
20
30
40
50
1
2
3
4
5
6
7
8
9
10


Relative size
b
22
31
19
30
25
23
28
17
10
6
8
Distance in km
0
10
20
30
40
50
200
400
600
800
1000
1200
1400
1600
1800
2000

cores) discarded at sites in between.

One would normally expect all cores to be more or less the same size when they were discarded and this leads one to ask why the Aborigines discarded different sized cores at different locations and what criteria influenced the extent to which cores were reduced at respective sites? I think the answer to this probably lies in the individual value of cores as sources of stone; a feature which was in turn governed by the relative availability of alternative supplies of raw material. I would suggest that one can view the high proportion of large cores discarded at sites close to quarries (Gundjimarra (30) and Migiliri (22)) as evidence that the Aborigines were discarding cores before they were truly exhausted, in the face of an abundant supply of flakable stone. Byrne (1980:118) recorded a similar pattern in the distribution of cores in south western Australia. He concludes that "where the supply of stone was great" cores were discarded which "technically are not by any means exhausted". This contrasts to the situation at Balgo Balgo (17), Nganawalbinyu (3), Ngandalarra (6), and Guralba (8) where there was a shortage of white chalcedony. At these sites there was a high proportion of small cores, indicating that the Aborigines were attempting to get the maximum number of flakes from each core before they threw it away.

This explanation does not account for the absence of cores at Djarrga Djarrga (2), Dalabanda (18) and Gawayurru (29) although it does provide an interpretative model, which in association with the geographic location of these sites, helps explain the absence of cores. If, for example, the hypothesis that cores were transported from site to site and discarded when they were worked-out is correct then it follows that at some sites along the way the distance between sites and quarries would have been too great to replenish supplies of stone easily. It is logical that at these sites it would have been more expedient to hold onto the cores in hand, carrying them to the next site, than to throw them away and return to the quarry for fresh stone.

This is what I think is reflected by the absence of cores at Djarrga Djarrga (2), Dalabanda (18) and Gawayurru (29). These sites were located between 12-17km from the nearest quarry and were situated in a kind of middle ground where it was easier to hold onto the raw materials in hand than to make the effort to walk to quarries to replace them.

If this explanation accounts for the absence of cores at these sites then it seems reasonable to assume that sites at an equivalent distance from quarries of green silcrete and black ferecrete would also be too far from these quarries and would not contain any cores either. Unfortunately the sample of cores in these instances are too small (9 and 12 cores respectively). (Table 9.2) to be particularly meaningful, but nevertheless one finds there are in fact no black

TABLE 9.2 Raw materials from which cores were made

SITES	RAW MATERIALS						
	Miscellaneous	White chalcedony	Green silcrete	Black-fleckrete	Grey silcrete	Quartzite	Total
1. Djulugan	0	8	0	0	0	0	8
2. Djarrga Djarrga	1	0	0	0	0	0	1
3. Nganawalbinyu	2	10	1	1	0	0	14
4. Djungurr	2	0	0	6	0	2	10
6. Ngandalarra	0	1	0	0	1	0	2
8. Guralba	0	5	0	0	0	0	5
10. Nabulabanda	2	5	0	2	0	1	10
17. Balgo Balgo	0	11	0	0	0	0	11
19. Djulyurrulyurru	0	7	1	0	0	0	8
22. Migiliri	0	9	0	0	0	0	9
23. Mindirr	0	1	0	0	2	0	3
25. Diedi	0	2	0	0	0	0	2
26. Rundju Rundju	1	1	1	0	0	0	3
27. Wilbarinyu	0	1	6	0	0	0	7
28. Birbayga	1	9	0	3	0	1	14
30. Gundjimarra	0	5	0	0	0	0	5
31. Yurinubadu	0	7	0	0	0	0	7
Total nos	9	82	9	12	3	4	119

ferecrete cores or green silcrete cores at the six sites located between 10 and 15km from the nearest quarry (Fig.9.7a and b). Therefore, while the sample of cores in these cases is too small to lend strong support to this interpretation, the distribution of these ferecrete and silcrete cores does not contradict the pattern which emerges in the distribution of cores made of white chalcedony.

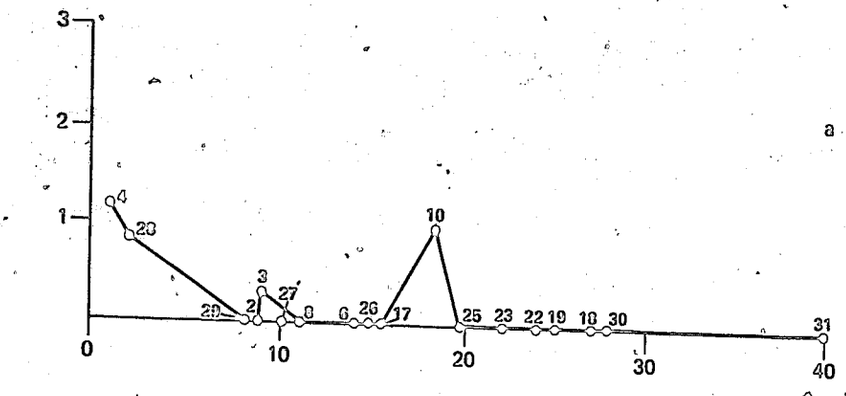
Consequently I think there is justification for interpreting the absence of cores at Djarrga Djarrga (2), Dalabanda (18) and Gawayurru (29) as a simple reflection of the optimal balance between the particular distance these sites were from quarries and the functional life still left in the cores transported to them. If true, a distance of approximately 15km reflects the maximum distance over which people were prepared to travel in order to collect stone for making stone tools. An interesting, though not necessarily significant point to add here is that this distance corresponds to the maximum distance the Aborigines were prepared to forage for food. It may be, therefore, (without stretching the bounds of possibility too far) that the distance people were prepared to forage for stone may provide an accurate indication of the daily foraging radius of Aborigines. Therefore the distribution of cores across the landscape may provide an indirect means for archaeologists to determine the likely foraging radius of hunter gatherers in areas where little is known about the foraging behaviour of those people.

Figure 9.7a

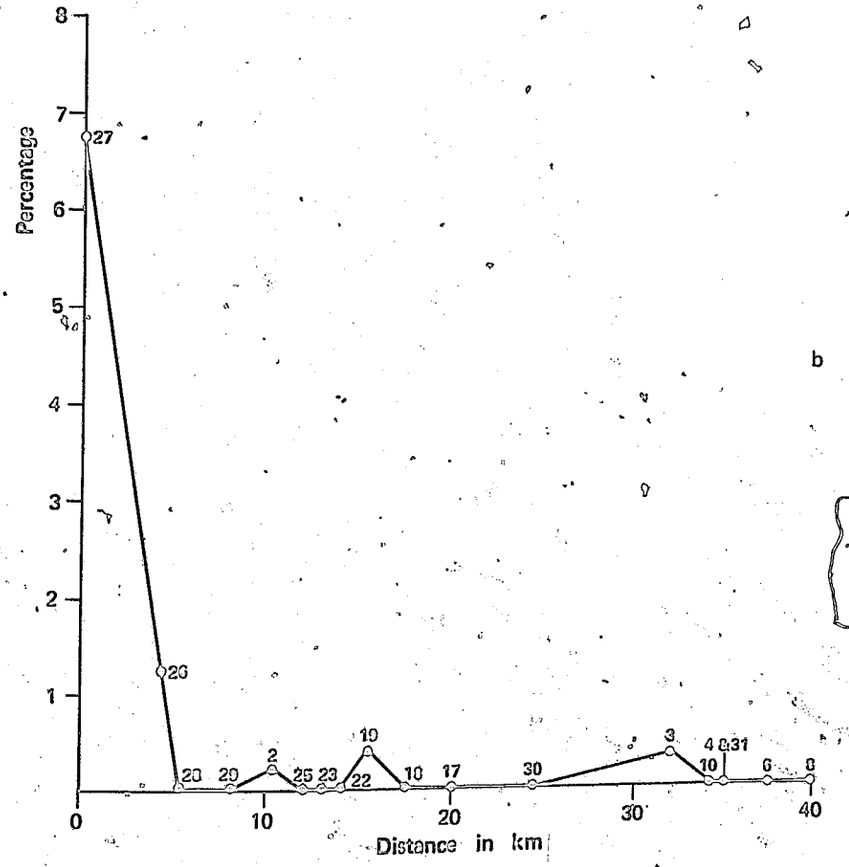
The proportion of black ferecrete cores at sites as the distance between sites and the nearest black ferecrete quarry increased.

Figure 9.7b

Proportion of green silcrete cores as the distance between sites and the nearest green silcrete quarry increased.


3
2
1
0
10
20
30
40
4
28
3
27
29
2
8
6
26
17
10
25
23
22
19
18
30
31

a


Percentage
8
7
6
5
4
3
2
1
0
10
20
30
40
Distance in km
27
28
20
20
2
25
23
22
10
10
17
30
3
4
8
31
10
6
8

b



One further anomaly in the distribution of cores which should be discussed before leaving this aspect of the archaeological debris is that the proportion of cores made from black ferecrete and green silcrete does not increase as the distance between sites and quarries increases (Fig.9.7a and b); as was the case with cores made of white chalcedony. This suggests that people were only using these materials for making stone tools at camps near the individual quarries, and that the value of these materials was not sufficient for the Aborigines to have bothered transporting them significant distances. This interpretation is consistent with the limited distribution of unretouched flakes made from these materials (see below) and the minimal value of these materials traditionally (see Chapter 6).

Summary: Cores and Aboriginal Behaviour

In summary I think it is fair to say that the apparently inconsistent and anomalous distribution of cores across the landscape reflects more than the simple random use and discard of cores in the production of stone tools. In this instance the value of different raw materials clearly effects the way in which cores were used and discarded. Most obvious here is the way the most valuable raw material, white chalcedony, was used most frequently and transported the greatest distance. Secondly the relative availability of this material altered the Aborigines' attitude to stone and the extent to which cores were reduced. Where stone was readily available the Aborigines seem to have discarded large numbers of cores in a rather affluent manner, but as the distance between sites and quarries

increased this attitude changed and the Aborigines became more parsimonious and held onto their cores until they were exhausted. This is expressed archaeologically by the absence of cores at sites about 15km from supplies of stone and the progressive increase in the discard rate of small cores at sites furthest from the nearest quarries. I have no specific ethnographic evidence for this behaviour but the Aborigines did comment on some of the smallest cores found in some distant sites in the north of the study area, explaining they had to "knock him" "knock him" because there was "no djimeri this country".

Unretouched Flakes

The proportion of waste flakes at each site decreased at sites furthest from the source of the dominant raw material used at each site. As can be seen from Fig.9.8a this decrease was quite consistent throughout the region. The overall change in the percentage of debitage decreased from over 90% at sites such as Yurinubadu (31) and Gundjimarra (30) which were close to major supplies of raw material, to approximately 60% at Ngandalarra (6) and Guralba (8) which were a long way from a major supply of raw material (Fig.8.2). The extent of this proportional variation is obviously quite extreme and not surprisingly the statistical significance between the extremes represented by these four sites is very high ($P<0.001$; Appendix 2.1). Quite obviously, therefore the amount of stone tool manufacture conducted at sites decreased as the availability of stone decreased. As a consequence the proportion of waste flakes in each site provides

Figure 9.8a

The proportion of unretouched flakes in sites as the distance between sites and the major supply of stone increased.

Figure 9.8b

The proportion of unretouched flakes made of white chalcedony in sites as the distance between sites and the nearest white chalcedony quarry increased.

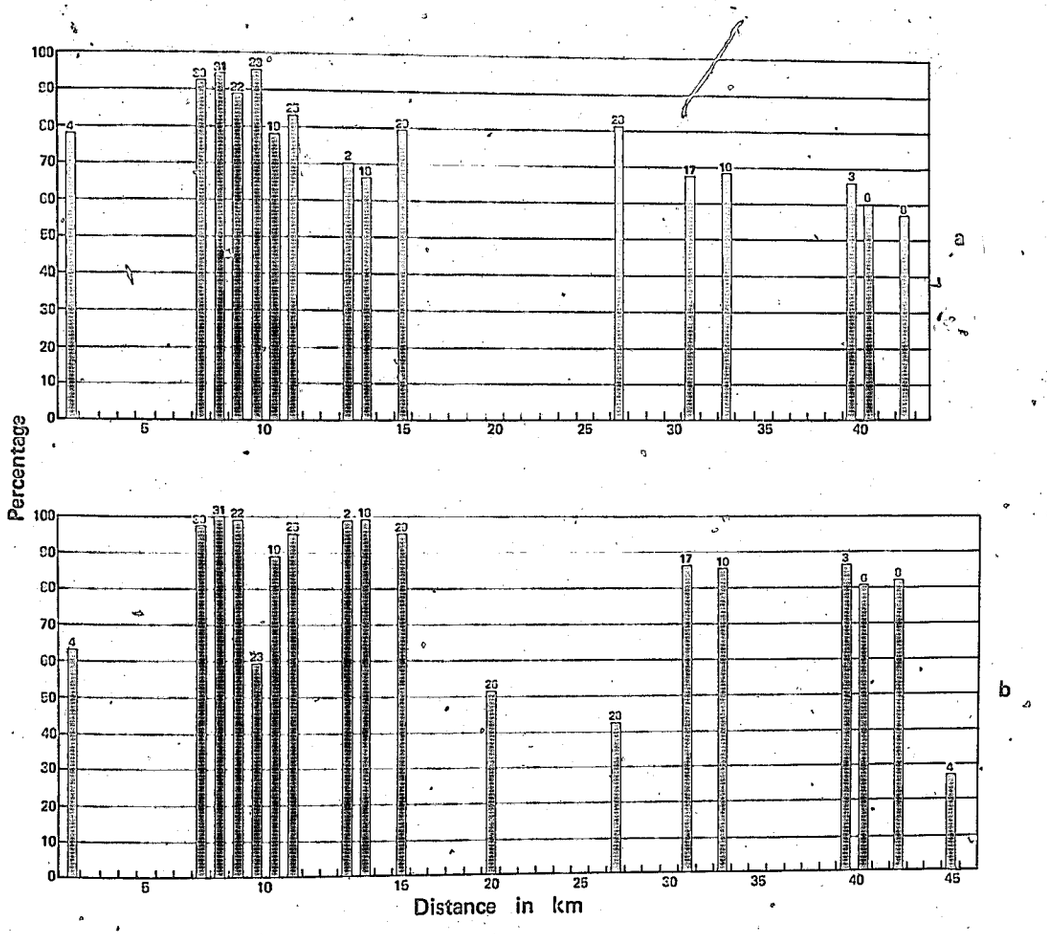

Percentage
Distance in km
b

TABLE 9.3 Raw materials from which unretouched flakes were made

SITES		RAW MATERIAL TYPES: Miscellaneous	White chalcedony	Green silcrete	Black fersecrete	Grey silcrete	Quartzite	Sandstone	Total
1. Djulugan	n	3	437	0	0	0	0	2	442
	%	0.7	98.9	0.0	0.0	0.0	0.0	0.5	
2. Djarrga Djarrga	n	4	336	1	0	0	1	3	345
	%	1.2	97.4	0.3	0.0	0.0	0.3	0.9	
3. Nganawalbinyu	n	16	219	4	5	0	6	2	252
	%	6.3	86.9	1.6	2.0	0.0	2.4	0.8	
4. Djungurr	n	54	134	3	177	0	37	0	405
	%	13.2	33.1	0.7	43.7	0.0	9.1	0.0	
6. Ngandalarra	n	0	33	0	0	0	0	8	41
	%	0.0	80.5	0.0	0.0	0.0	0.0	19.5	
8. Guralba	n	2	31	0	0	0	4	0	37
	%	5.4	83.8	0.0	0.0	0.0	10.8	0.0	
10. Nabulabanda	n	2	120	3	14	1	1	0	141
	%	1.4	85.1	2.1	9.9	0.7	0.7	0.0	
17. Balgo Balgo	n	16	224	15	2	0	4	0	261
	%	6.1	85.8	5.7	0.8	0.0	1.5	0.0	
18. Dalabanda	n	0	90	0	0	1	0	0	91
	%	0.0	98.9	0.0	0.0	1.1	0.0	0.0	
19. Djulyurrulyurru	n	2	197	8	7	1	3	8	226
	%	0.9	87.2	3.5	3.1	0.4	1.3	3.5	

TABLE 9.3 (continued)

RAW MATERIAL TYPES.

SITES		Miscellaneous	White chalcedony	Green silcrete	Black silcrete	Grey silcrete	Quartzite	Sandstone	Total
22. Migiliri	n	1	536	1	0	0	0	2	540
	%	0.2	99.3	0.2	0.0	0.0	0.0	0.4	
23. Mindirr	n	0	154	2	0	102	2	3	263
	%	0.0	58.6	0.8	0.0	38.8	0.8	1.1	
25. Diedi	n	1	140	4	0	2	0	0	147
	%	0.7	95.2	2.7	0.0	1.4	0.0	0.0	
26. Rundju Rundju	n.	1	23	6	0	12	1	1	44
	%	2.3	52.3	13.6	0.0	27.3	2.3	2.3	
27. Wilbarinyu	n	0	0	28	0	0	0	0	28
	%	0.0	0.0	100.0	0.0	0.0	0.0	0.0	
28. Birbayga	n	16	128	16	120	2	3	1	286
	%	5.6	44.8	5.6	42.0	0.7	1.0	0.3	
29. Gawayurru	n	0	163	2	1	0	0	5	171
	%	0.0	95.3	1.2	0.6	0.0	0.0	2.9	
30. Gundjimarra	n	3	129	0	1	0	0	0	133
	%	2.3	97.0	0.0	0.8	0.0	0.0	0.0	
31. Yurinubadu	n	1	622	1	0	0	1	0	625
	%	0.2	99.5	0.2	0.0	0.0	0.2	0.0	
Total nos		119	3716	94	327	121	63	35	4478
Total %		2.7	83.0	2.1	7.3	2.7	1.4	0.8	

a reasonably accurate indication of the relative distance each site was from its major source of raw material as well as the amount of stone tool manufacture conducted at each site in the region.

Anomalies in the Distribution

This general trend is also apparent in the regional distribution of unretouched flakes made from the four major raw materials used in the study area. However in each of these cases there are some striking irregularities which require explanation.

White Chalcedony

The distribution of unretouched flakes made of white chalcedony for example (Fig.9.8b;Table 9.3) declines in a similar way to the general trend outlined in Fig.9.8a although there are some obvious irregularities in this pattern. If Rundju Rundju (26) and Wilbarinyu (27) are included in this discussion it is apparent that white chalcedony is present in 18 sites in the region and was transported over 40km from the nearest quarry. With the exception of five sites the proportion of white chalcedony declines gradually from sites near quarries where it constitutes virtually 100% of the unretouched flakes, to the most distant sites where it constitutes between 80% and 90%. This indicates that as supplies of white chalcedony dwindled there was an increased use of alternative materials for making stone tools.

Mindirr (23), Rundju Rundju (26), Wilbarinyu (27), Birbayga (28) and Djungurr (4) are exceptions to this general pattern as all these sites contain uncharacteristically low proportions of white chalcedony. The reason for this is that these sites are all near alternative supplies of stone (Fig.6.3;Chapter 6). Mindirr (23) is adjacent to a supply of poor quality grey silcrete. Wilbarinyu (27) is adjacent to a large quarry of green silcrete and Rundju Rundju (26) is only 5km from the same quarry. Birbayga (28) was less than 1km from a supply of black ferecrete and was only 6km from another quarry of green silcrete. Djungurr (4) was within 1km of another supply of black ferecrete. This is quite an interesting result and confirms one of Gould's predictions regarding the proportional distribution of raw materials in sites. He proposed that

> wherever random factors of geography place sources of usable stone ... at or in close proximity to a water source where a habitation base/camp will occur, ease of procurement will outweigh other factors and unusually high percentages of artefacts of these locally available stones will be made, used and discarded at such campsites (1980:134).

Other Raw Materials

Figure 9.9a represents the regional distribution of unretouched flakes made from green silcrete. This material was not as popular as white chalcedony and was only found at 14 sites in the region (Table 9.3). The amount of green silcrete in most sites was low compared to the quantities of white chalcedony. This proportion decreased rapidly within the first few kilometres of the nearest quarry and was only transported about 35km from the nearest source. A curious

Figure 9.9a

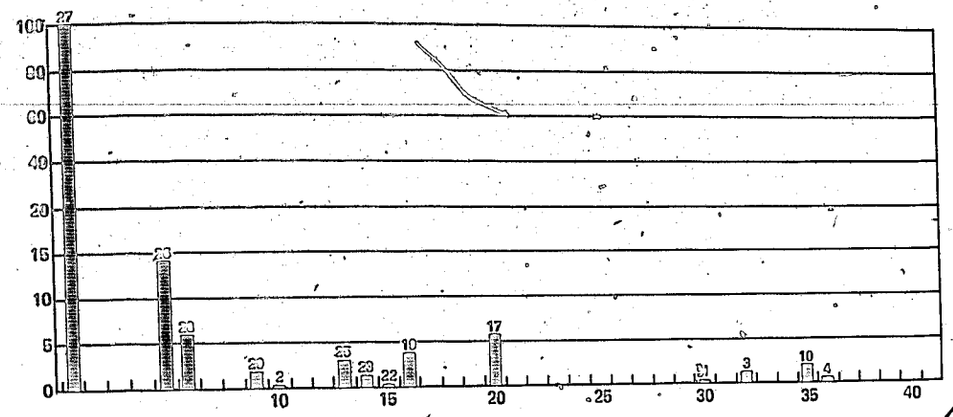
The proportion of unretouched flakes made of green silcrete as the distance between sites and the nearest green silcrete quarry increased.

Figure 9.9b

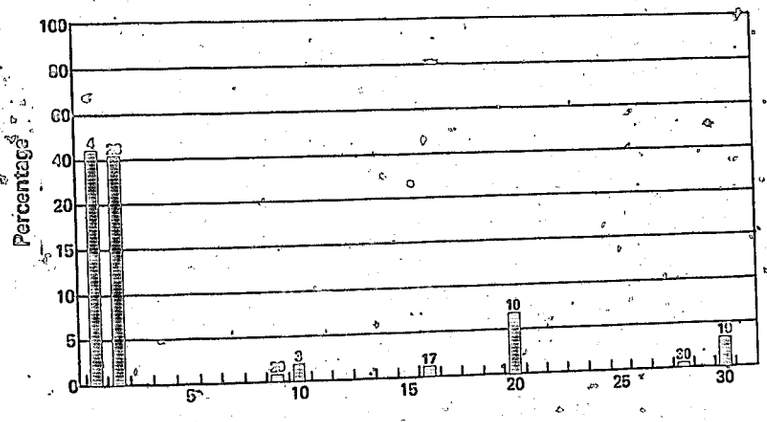
The proportion of unretouched flakes made of black ferecrete as the distance between sites and the nearest black ferecrete quarry increased.

Figure 9.9c

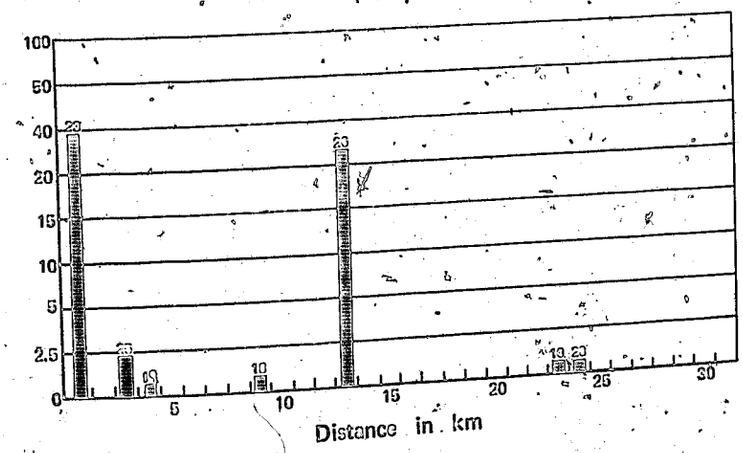
The proportion of unretouched flakes made of grey silcrete as the distance between sites and grey silcrete quarry increased.


100
80
60
40
20
15
10
5
0
27
23
23
20
2
23
23
22
10
17
21
3
10
4
10
15
20
25
30
35
40

a


Percentage
100
80
60
40
20
15
10
5
0
4
23
20
3
17
10
30
1
10
5
10
15
20
25
30

b


100
50
40
20
15
10
5
2.5
0
23
23
23
10
10
20
25
30
5
10
15
20
Distance in . km

c

irregularity in the proportional distribution of unretouched flakes made of green silcrete was the unexpectedly high percentage of unretouched flakes made of green silcrete at Balgo Balgo (17), compared to other sites which were closer to the two green silcrete quarries in the region.

A similar thing occurs with the distribution of black ferecrete and grey silcrete (Fig.9.9b and c; Table 9.3). The distribution of unretouched flakes made of black silcrete (Fig.9.9b) across the landscape was similar to the pattern displayed by green silcrete. Black ferecrete was the least popular of these two ray materials and was only found at eight sites in the region. It was only transported 30km from the nearest quarry and the proportion of unretouched flakes made with this material decreased rapidly after the first few kilometres of the nearest quarry. As one moved away from the material sources the proportion of black ferecrete in sites was low except at Nabulabanda (10), which contained more black ferecrete (9.9%) than three sites which were closer to sources of black ferecrete.

The same sort of thing occurred with the distribution of grey silcrete (Fig.9.9c;Table 9.3). This material was the least popular of the four major materials used in the region. It was only found at seven sites and was transported less than 25km from the original source of the material. The quantity of the material decreased rapidly within the first few kilometres of each site and was then found in very low proportions at all sites except Rundju Rundju (26). The proportion of unretouched flakes made of grey silcrete at this

site was higher (27.3%) than at two sites closer the source of the material.

The regional pattern for unretouched flakes made from each of the raw materials described above demonstrates that as the distance between sites and respective supplies of raw materials increased the use of those materials in the production of stone tools decreased. This pattern is consistent except at Nabulabanda (10), Balgo Balgo (17) and Rundju Rundju (26), where there is more black ferecrete, green silcrete and grey silcrete respectively than would be expected given the distance these sites are from quarries of these materials.

This leads one to ask why stone was being transported and used at these sites in higher proportions than at sites which were closer to respective supplies of raw materials? The answer to this seems to lie in the way people generally travelled across the landscape throughout the year.

Aboriginal Movement and the Distribution of Stone

In Chapter 5 (Fig.5.2) Bye Bye described that when her family moved north along the Stansmore Range during the "green grass time" they stopped briefly at Migiliri (22) and Diedi (25) before travelling to Balgo Balgo (17) where they repaired digging sticks for collecting Ipomoea tubers. This pattern of movement is reflected in the minimal presence of green silcrete in the archaeological debris at Migiliri (22) and Diedi (25) compared to the substantial quantity

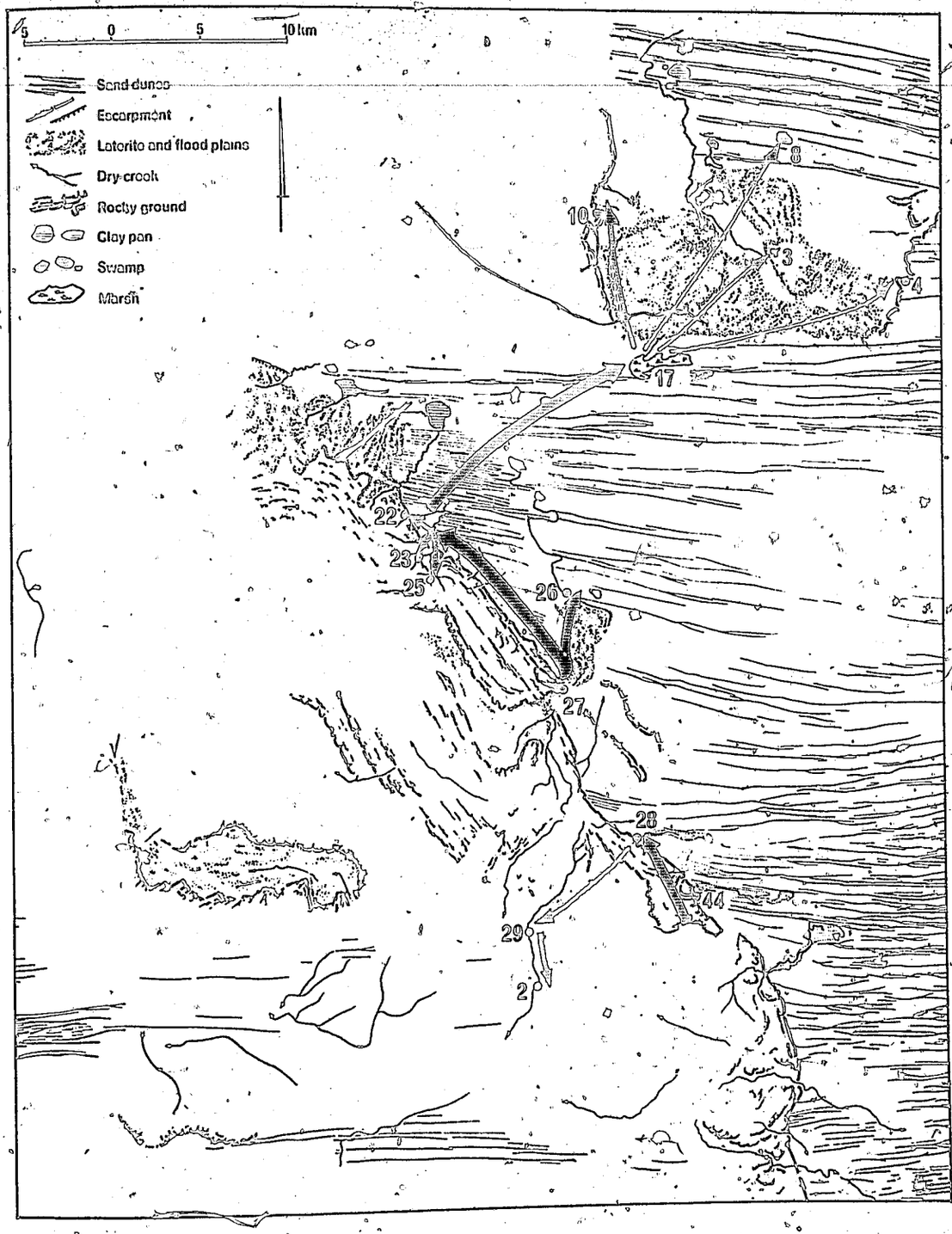
of green silcrete in the archaeological debris at Balgo Balgo (17) (Fig.9.10;Table 9.3).

From here her family travelled north, usually via Djungurr (4), before bypassing Nganawalbinyu (3) and walking to Nabulabanda (10). Once again this pattern of movement is consistent with the distribution of raw materials at these sites (Fig.9.11;Table 9.3). In this instance the pattern of movement is reflected archaeologically by the unusually large proportion of black ferecrete at Nabulabanda (10) from the supply of black ferecrete near Djungurr (4). A third pattern of movement is also reflected by the archaeological debris (Fig.9.12;Table 9.3). In this case the movement of people from Mindirr (23), south via Rundju Rundju (26), along the Stansmore Range at the start of the wet season is indicated by the high proportion of grey silcrete, from Mindirr (23) at Rundju Rundju (26).

The extent of the correlation between the distribution of raw materials and the movement of people across the landscape in these instances is quite exceptional and suggests that the distribution of raw materials from which unretouched flakes were made can be used as a reliable guide to the pattern of movement of prehistoric populations.

Figure 9.10

Movement of people indicated by the proportional distribution of green silcrete (note major direction of movement suggested by raw material is indicated by heavy arrows).


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
8
10
3
4
17
22
23
25
26
27
28
44
29
2

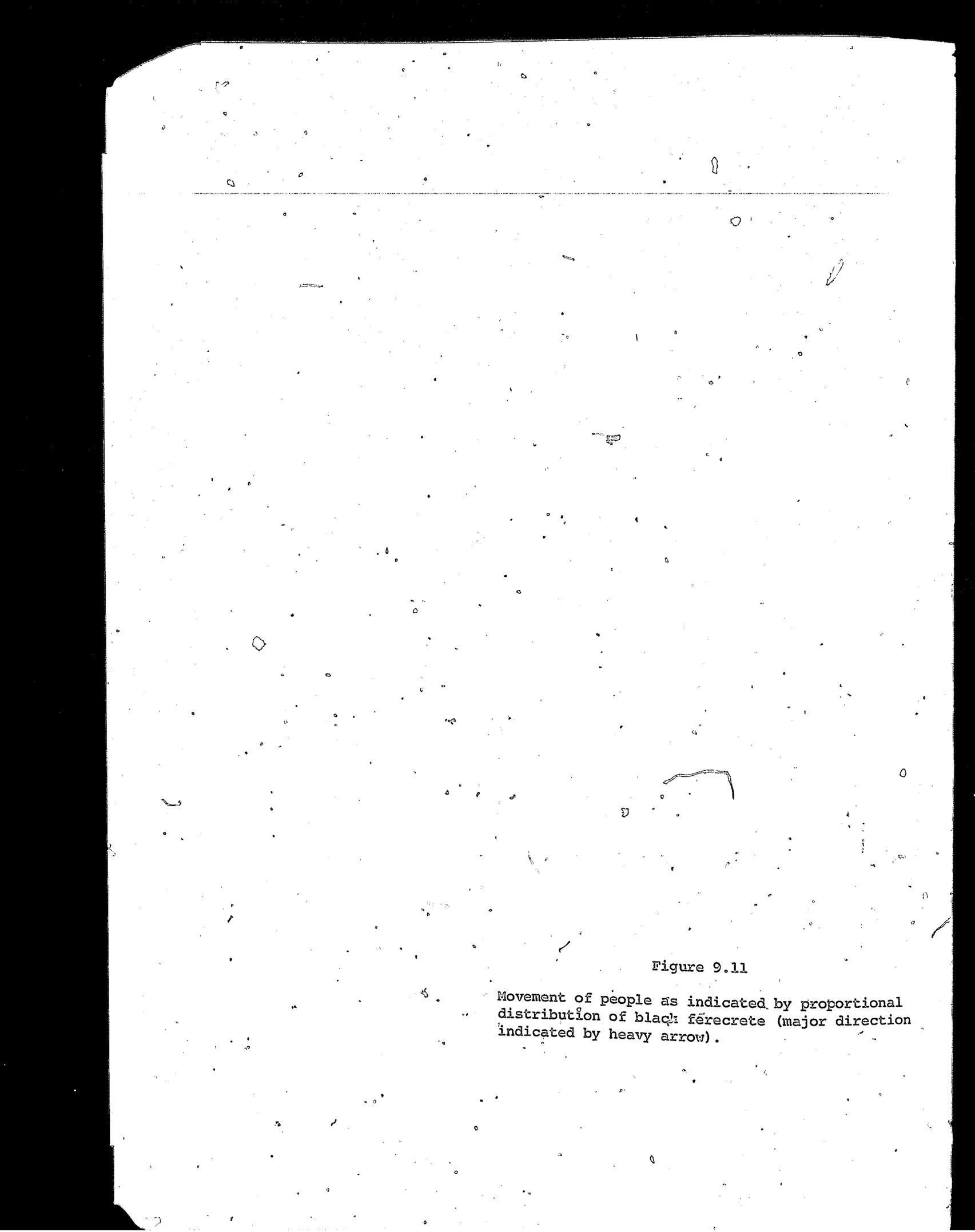


Figure 9.11

Movement of people as indicated by proportional distribution of black ferecrete (major direction indicated by heavy arrow).

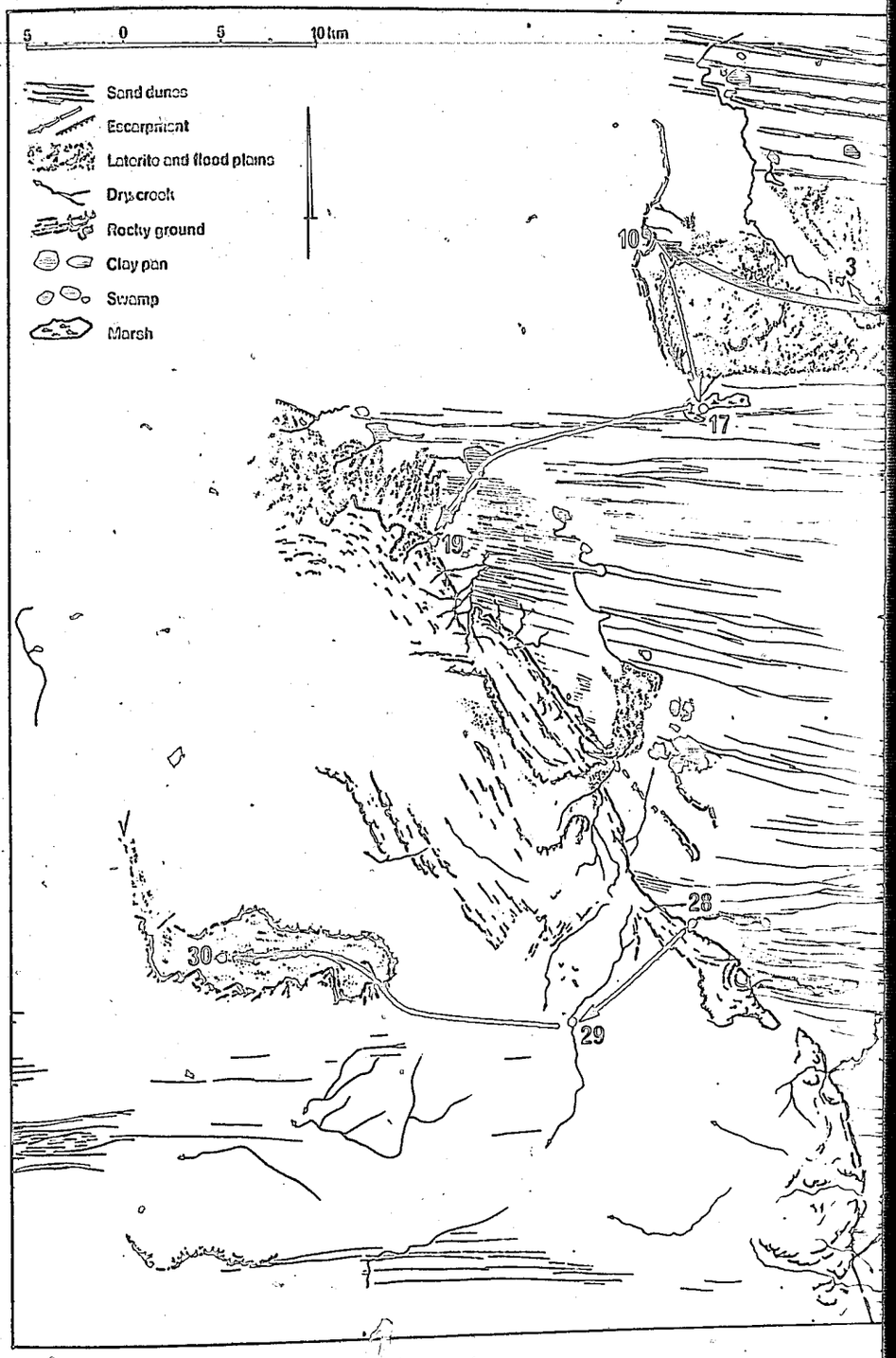
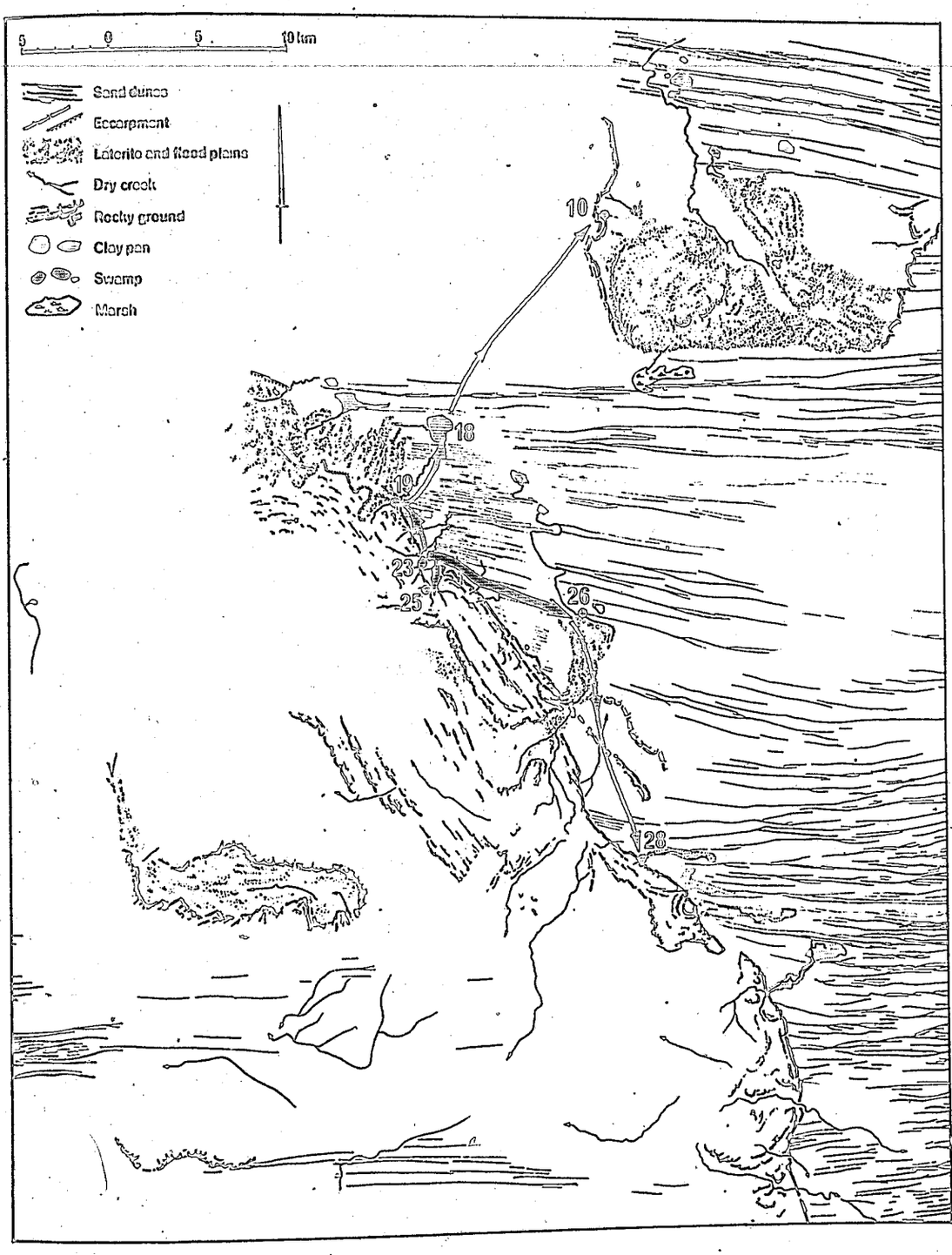

5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
10
3
17
19
28
30
29

Figure 9.12.

Movement of people indicated by the proportional distribution of grey silcrete (major direction indicated by heavy arrow).


5 0 5 10 km
Sand dunes
Escarpment
Laterite and flood plains
Dry creek
Rocky ground
Clay pan
Swamp
Marsh
10
18
19
23
25
26
28

Further, if we examine the distribution of unretouched flakes made of green silcrete, black ferecrete and grey silcrete at other sites where they are represented in very low proportions we find that the subtle pattern in the spread of these materials also bears some resemblance to the broader, seasonal movements in the study area. Figure 9.12 shows the movement of people from Mindirr (23) implied by the distribution of grey silcrete in the region. In this instance, grey silcrete is transported north via Dalabanda (18) and south via Rundju Rundju (26) to Birbayga (28); two of the three major directions people travelled during the wet season. The distribution of green silcrete and black ferecrete (Fig.9.10,9.11) also corresponds with the way people moved across the landscape between the "green grass time" and the "goanna get up time". In this case the major directions indicated by the distribution of green silcrete (Fig.9.10) shows the movement of people north into the study area via Balgo Balgo (17). Small quantities of green silcrete at Mindirr (23), Migiliri (22) and Diedi (25) suggests (and is consistent with the fact) that people occasionally made brief stops at these sites as they moved north from Wilbarinyu into the "bush potato country".

In the north of the study area black ferecrete (Fig.9.11) is found at Nabulabanda (10), Balgo Balgo (17) and Djulyurrulyurru (19) indirectly indicating the movement of people from Djungurr (4) to Nabulabanda (10) during the cold season, then south to Djulyurrulyurru (19) in the Stansmore Range via Balgo Balgo (17), during the "goanna get up time". This distribution is consistent with the direction people travelled at that time of year. In the southern

part of the study area the presence of black ferecrete at Birbayga (28), Gawayurru (29) and Gundjimarra (30) also correlates with the movement of people from Birbayga (28) to these sites. The presence of green silcrete from Mirrilmirril (44) and Wilbarinyu (27), at Birbayga (28), and the transportation of this material to Gawayurru (29) and Djarrga Djarrga (2) (Fig.9.10) is also consistent with the movement of people between these sites during the "goanna get up time".

Exotic Materials

While discussing the distribution of unretouched flakes made from various raw materials in the region it is worth drawing attention to the unusually high proportion of miscellaneous or exotic raw materials found at some sites in the region (Table 9.3). The most common of these materials were an attractive brown and pink chalcedony, a "yellowish" silcrete and several dark coloured quartzites. The Aborigines I was working with said they did not know where these materials had come from.

The highest proportion of these materials were found at Nganawalbinyu (3), Djungurr (4), Guralba (8), Balgo Balgo (17) and Birbayga (28) (see Table 9.3). With the exception of Birbayga (28) these sites were all located in the north of the study area. The presence of an unusually high proportion of exotic stone at these sites is therefore consistent with (and I would interpret as archaeological evidence for) the occupation of this area by the variety of "foreign" Aborigines who came to this region in the past

to harvest Ipomoea tubers and/or participate in the "bush potato" ceremony (see Chapter 3).

Birbayga (28) is located in the south of the study area and the high proportion of exotic materials at this site may provide evidence of the occupation of this rockhole by people to the south of the study area. However I do not know how frequently this occurred in the past.

Summary; Unretouched Flakes and Aboriginal Behaviour

The proportional variations in the distribution of waste flakes across the landscape provides evidence for several aspects of traditional Aboriginal behaviour. The most obvious is that the amount of stone tool manufacture undertaken by the Aborigines decreased progressively as the distance between sites and quarries increased. This proportional variation in unretouched flakes at sites therefore provides an implicit means of measuring the relative distance sites were from quarries.

The distribution of the raw materials which waste flakes are made of also provides archaeologists with a means of determining which kind of stone was most preferred by Aborigines for making stone tools. In this project the most popular materials were found in the highest proportions at the greatest number of sites in the region and were transported the maximum distances from quarries.

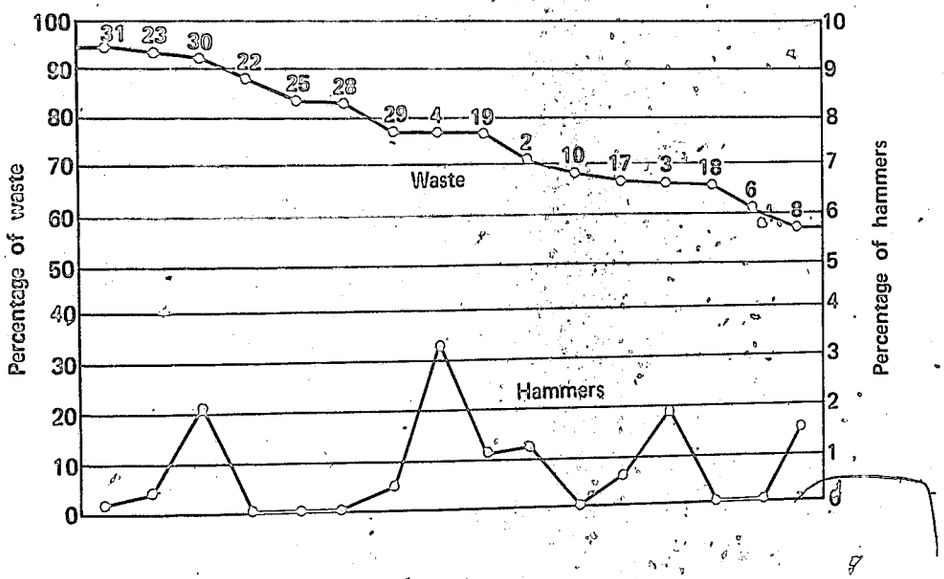
Lastly, and of particular importance, the direction people moved across the landscape can be determined very accurately from an analysis of the anomalous characteristics in the distribution of unretouched flakes. Such an analysis in this project has revealed the striking ability of this aspect of the archaeological debris to reflect the traditional pattern of movement of people through this area in the past. Because unretouched flakes were less likely to have been used once detached from cores they were also less likely to have been transported. Thus, they assume a new importance in the archaeological record. They offer a measure of the distance and direction raw materials travelled from sources, uncluttered by the "noise" inherent in the distribution of other artefact types which may have been carried backwards and forwards across the research area in the course of their use. Unretouched flakes therefore provide a permanent, cumulative record of the direction materials moved across the landscape and indirectly the way the people carrying these materials travelled from site to site during the past.

Hammers

The distribution of hammers probably conformed least consistently to the predicted pattern of distribution. In Fig.9.13 it can be seen that there is no correlation between the proportion of unretouched flakes and the proportion of hammerstones thus indicating, contrary to expectations, that there was no relationship between the number of hammers used and broken and the amount of stone

Figure 9.13

The proportion of hammers at sites (right hand side of graph) compared to the proportion of unretouched flakes at sites (left hand side of graph).


Percentage of waste
Percentage of hammers
Waste
Hammers
31
23
30
22
25
28
29
4
19
2
10
17
3
18
6
8
100
90
80
70
60
50
40
30
20
10
0
10
9
8
7
6
5
4
3
2
1
0

tool manufacture at individual sites. Obviously sites containing the greatest quantity of debitage did not contain the highest proportion of hammers.

Unfortunately the sample of hammers was small and only accounted for 53 of the total 5,714 artefacts, (0.9% of the assemblage). Therefore the sample is likely to have been too small to be given a chance of conforming to any distinct pattern. It must also be noted that many miscellaneous rocks, apart from quartzite pebbles and cobbles of chalcedony and silcrete were used as hammers. The difficulty in recording every miscellaneous piece of stone in each sample probably means that the number of hammers actually used has been significantly underestimated. Therefore the distribution of artefacts defined as hammerstones may not be an accurate reflection of their true distribution.

One feature of the distribution of hammerstones which was not totally unexpected was the high proportion of hammer fragments recorded at Djungurr (4). The greatest quantity of quartzite pebbles in the study area were found eroding from the escarpmemnt north and south of Djungurr (4) and the high proportion of quartzite hammer fragments at this site provides evidence of the use of this supply by the Aborigines.

OCHRE

Only 35 pieces of ochre were recorded in the project (0.6% of the entire assemblage) and therefore the sample is too low to have much chance of showing any correlation with related patterns of Aboriginal behaviour. Nevertheless red ochre was found in abnormally large amounts at Ngandalarra (6) and Nabulabanda (10). The proportion of ochre at these sites was significantly higher than at other sites in the region ($P < 0.05$; Appendix 2.8) and in both cases reflects different aspects of Aboriginal behaviour. Of greatest interest perhaps is the high proportion of ochre at Ngandalarra (6) (5.9%). This site was the most sacred area investigated in this project and was a very important ceremonial location. The high proportion of ochre is therefore strong archaeological evidence for the ceremonial activities which took place there.

The high proportion of ochre recorded at Nabulabanda (10) is also of interest. This was not a particularly sacred place but was the only place in the north of the study area where good quality ochre could be collected. In this case the abnormally high proportion of ochre at Nabulabanda (10) provides strong archaeological evidence for the collection, preparation and use of ochre at that site in the past.

MANUPORTS

The miscellaneous collection of pieces of unflaked stone I have called manuports only constituted 1.4% of the entire archaeological assemblage. So far, with the exception of a brief discussion of the abnormally high percentage of manuports at Rundju Rundju (26) and Wilbarinyu (27) (chapter 8) I have not yet made any reference to the distribution of manuports.

Manuports at these two sites constituted almost half the entire quantity of manuports recorded and have been interpreted as heat retainers and hammerstones respectively. The remaining proportion of manuports only constitutes 0.7% of the entire assemblage of artefacts examined. Not surprisingly, given this small sample, there is little significant variation in the proportion of manuports at sites examined in the region (Table 8.2;Appendix 2.9). However the subtle variation that does exist is of particular interest.

The highest percentage of manuports were recorded at two sites; Djulyurrulyurru (19), (3.1%) and Nganawalbinyu (3) (2.7%). The proportion of manuports at Djulyurrulyurru (19) consisted of a handful of rubble and the Aborigines thought these had most likely been collected for use as hammerstones. The proportion of manuports at Nganawalbinyu (3) was more interesting. Sixty-percent of the manuports recorded here were randomly engraved pieces of rock and were said by the Aborigines to have been produced by doodling on rocks with pieces of chalcedony. This is the densest concentration of

these artefacts in the region. Nganawalbinyu (3) was probably the nicest habitation site in the region. It was occupied during the cold season and was a large deep waterhole, central to all the best resources in the area. Life at this site was probably the easiest of any site in the region and it is tempting therefore to interpret the extensive evidence of doodling in the archaeological record as evidence for the peaceful and leisurely nature of habitation at this site.

Chapter 10

CONCLUSION AND WIDER IMPLICATIONS

In the course of the presentation and discussion of data in this thesis it has become apparent that the variation in the proportional distribution of some categories of stone tools in the northern area of the Western Desert is diverse and well defined. It has also become apparent that the pattern of inter-assemblage variability corresponds to various patterns of Aboriginal behaviour and that, by and large, sites that were alike environmentally and economically contained more or less the same kind of archaeological debris. Thus the correlation between the distribution of stone artefact residues and the variety of Aboriginal activities which took place in this region appears to be sufficiently strong to suggest that stone tools do indeed provide a partial summary of the behaviour of prehistoric societies.

With the exception of two sites (Djulugan (1) and Rundju Rundju (26)), at which the proportions of artefact samples appears to have been biased by inadequate samples and poor exposure, the artefactual components of the sites examined in this project appears to provide a reliable means for ascertaining different aspects of (a) the economic importance of seeds, (b) the manufacture of implements made of wood and stone, (c) the pattern of movement and some aspects of the

foraging behaviour of the local population, (d) the seasonal occupation of sites. As well, it provides some insight into local population densities and various ceremonial activities.

Seed Processing

Seed grinding artefacts appear to be a very strong economic indicator. With two exceptions the proportional distribution of seed grinding artefacts provides a direct indication of the relative importance of seeds in the economy of the inhabitants at different sites in the region. Thus the archaeological debris confirms broadly to the ethnographic reconstruction of seed grinding activities at sites. Specifically it was apparent that:

(a) Seeds were an important aspect of the Aboriginal economy at sites in which seed grinding artefacts constituted approximately 10% or more of the assemblage. In this region the proportion of seed grinding artefacts at such sites varied from 9.2% to 17.2%.

(b) That seeds were of minor economic importance at sites in which the percentage of seed grinding artefacts constituted less than 4% of the assemblage. In this project the percentage of seed grinding artefacts at such sites varied between 0% and 3.6%.

At six of the 19 sites in the region seeds were a moderately important resource. At these sites the proportion of seed grinding artefacts fall into the middle range, which is less easy to define archaeologically. This group of sites cannot be separated statistically from the sites in the other two groups. In this project the proportion of seed grinding artefacts in the assemblage at these sites varied between 4.2% and 7.8%.

Attention must also be drawn to two sites (Ngandalarra (6) and Guralba (8)) at which the high proportion of ground pieces of sandstone apears not to reflect the importance of seeds very accurately. At Ngandalarra (6) the high proportion of these artefacts seems to be related to the manufacture of seed grinding artefacts and may also be connected to the preparation of ochre for ceremonial purposes. At this site the alternative interpretation could be ascertained from an analysis of the archaeological debris because of the location of a source of sandstone nearby and an unusually high proportion of sandstone flakes and ochre at the site. This is not the case at Guralba (8) and here there are no activities which I am aware of that account for the unusually high proportion of ground fragments of sandstone. To the best of my knowledge this site was not an important seed processing location, and unless my reconstruction of activities at that site is incorrect, the proportion of seed grinding artefacts here is misleading.

Woodworking locations and activities:

The correlation between the distribution of woodworking implements I have identified as scrapers and the relative importance of different sites as woodworking locations was sufficiently strong to be able to infer from the archaeological debris that:

(a) A site was an important woodworking location if approximately 17% or more of the assemblage was composed of scrapers. In this project the proportion of scrapers at such sites varied between 17.4% and 19.7%.

(b) Woodworking was a relatively minor activity where scrapers constituted less than approximately 5% of the assemblage. In this project the proportion of scrapers at these sites varied between 1.4%

and 5.8%.

There were also seven sites at which it seems woodworking was a moderately important activity. As in the case of seed grinding artefacts the percentage of woodworking artefacts at these sites falls into the middle range which is less easy to define archaeologically. In this project the proportion of scrapers at such sites varied between 7.3% and 14.1%.

Specialized woodworking activities:

There was a certain amount of correlation between the distribution of blades and engravers (points and burins) and the use of these artefacts for special woodworking activities.

(a) The proportional variation in the distribution of engravers was rather subtle and displayed little statistically significant variation. The proportion of engravers recorded at four sites appears to correspond to the manufacuture of ceremonial boards at those sites. At this stage, however I would not suggest that the presence of these artefacts at those sites be taken as reliable archaeological evidence for this activity until a larger sample of engravers was recorded and more definite patterns in their distribution were defined.

(b) Significantly high proportions of blades were recorded at Dalabanda (18) and Balgo Balgo (17) and this is thought to correspond to particular woodworking activities at both sites. At Balgo Balgo (17) the proportion of blades appears to be strong archaeological evidence for their use in finishing wooden implements made at that

site. The high proportion of blades at Dalabanda (18) appears to be related to their use in the construction of women's softwood dishes.

Stone tool manufacture

Various aspects of Aboriginal behaviour associated with the manufacture of stone tools can be determined from an examination of the artefactual content of each site in the region.

(a) One of the most obvious is the traditional preference for certain raw materials. The most valued material for making stone tools traditionally was white chalcedony and this was followed by green silcrete, black ferecrete and grey silcrete in decreasing popularity. A very strong indication of the relative popularity of each of these materials can be ascertained through the extent to which each was transported and used at different sites. For example there is evidence for the use of white chalcedony in the manufacture of stone tools at 18 sites and that it was transported at least 45km from the nearest quarry. This compared to green silcrete which was used at only 14 sites and transported 35km. Black ferecrete was only found at eight sites and was transported 30km from the nearest quarry. Grey silcrete, the least popular material, was only found at seven sites and only transported 25km. Therefore there is a very obvious correlation between the distance these materials were transported, the number of sites at which they were used and the traditional popularity of each material.

(b) White chalcedony constituted 80-90% of the unretouched flakes at all but five sites in the region whereas the other raw materials were recorded in particularly low proportions at all sites

except those immediately adjacent to quarries of those less popular materials. The five sites which contained abnormally low proportions of white chalcedony were adjacent to alternative supplies of stone and suggests the Aborigines found it more expedient to use local, inferior supplies of stone than collect better material from more distant quarries.

(c) The proportion of unretouched flakes in sites provides both a direct indication of the amount of stone tool manufacture conducted at each camp site and an indirect indication of the relative distance respective sites were from the nearest major supply of stone. In this project the percentage of unretouched flakes in individual sites declined steadily from over 90% to less than 60% in the assemblage at individual sites as the distance between sites and major quarries increased from 10km to 40km.

(d) With regard to cores it is apparent that as the supply of stone fell off the Aborigines ceased discarding cores until they were completely worked-out. This was reflected archaeologically by a high proportion of large cores at sites near quarries; the absence of cores at sites approximately 15km from quarries and a proportional increase in the quantity of small cores at sites further than 20km from quarries.

Movement of people

Another aspect of behaviour which appears to be reflected by the distribution of stone artefacts is the traditional patterns of population movement within the study area. In this project it was apparent that there was a strong correlation between the distribution

of unretouched flakes made from green silcrete, black ferecrete and grey silcrete and the way people moved south down the Stansmore Range during the wet season and into the north of the study area during the cold season. In addition the unusually high proportion of foreign raw materials recorded at sites at which people foraged for Ipomoea tubers in the north of the study area is consistent with, and would seem to be evidence for, the occupation of these sites by Aborigines from outside the study area during important ceremonies. Thus the distribution of unretouched flakes made from distinctive raw materials provides a reliable trace of the movement of prehistoric groups of people.

Population

In general the distribution and density of stone artefacts does not have the capacity to reflect the size or density of local Aboriginal populations. However, in accordance with Peterson's example (1968) of the distribution of pestles and mortars in Arnhem Land, it would appear that individual seed grinding slabs indicates the presence of one woman and thus, in conjunction with the approximate size of an average family, provides a rough guide to the number of people inhabiting various camps. Of particular interest also is the presence of numerous seed grinding slabs at a large seed processing site in the north of the study area (Wirribil (12)). The potential number of grindstones recorded at this site suggests there may have been between 250 and 500 people occupying the region on particular occasions. This is consistent with and can be interpreted as archaeological evidence for a large number of people who periodically congregated in the area for ceremonies.

Foraging behaviour

Different aspects of the foraging behaviour of the Aboriginal people in this region can also be inferred from an examination of the relationship between the distribution of cores and grindstones and the location of major stone and seed resources.

(a) From an examination of the distribution of cores in this project it appears that the maximum distance over which people were prepared to travel to collect stone was about 15km. This can be determined from the absence of cores at all sites which were located between 12km and 17km from particular raw materials. The absence of cores at these sites suggest that cores were being transported away from these sites rather than discarded and replaced with new raw materials. Thus the absence of cores provides indirect evidence of the distance over which people were prepared to travel to collect stone.

(b) In this project it was found that the proportion of seed grinding artefacts declined rapidly at sites over 5km from the major concentration of grass seeds. This suggests that the distances people were prepared to travel to collect seeds was small and is consistent with the ethnographic evidence indicating seed processing was a time consuming and arduous task. Thus the rapid decrease in the proportion of seed grinding artefacts over distance seen in this region appears to be archaeological evidence of the distances Aborigines were prepared to travel to collect seeds.

Seasonal occupation of sites

The view has been put forward that in the absence of plant and animal remains the seasonality of individual sites is unlikely to be inferred from "lithic materials" (O'Connell 1977:280). This is true to a certain extent but nevertheless in this region it appears that some aspects of the seasonal occupation of sites can be recognized from the stone debris contained in them.

(a) One of the most obvious seasonal indicators is the presence of collections of heat retainers the Aborigines called gardang. These were used to cook termite larvae during the wet season and their presence provides evidence of the seasonal occupation of those sites.

(b) The seasonal occupation of sites can also be inferred indirectly from the presence of grindstones at sites. The quantity of seeds available for consumption during the year varied somewhat and as a result the numbers of seed grinding artefacts used and discarded at sites also varied. Seeds were consumed in their greatest quantities between April to November and in their smallest quantities during the end of the hot season and through the wet season (December to April). I have already indicated that sites occupied during the latter part of the year contained much lower percentages of seed grinding artefacts (approximately 2% of the assemblage) than any other sites in the region. Because of this it is possible to recognize sites which were occupied at that time by their unusually low proportion of seed grinding artefacts.

Sacred activities

Archaeological evidence in the form of stone arrangements, painting sites and ceremonial boards provides abundant archaeological evidence for the sacred activities of Aborigines in the region. I

have also suggested that the presence of engraving tools at four sites in the region may be related to sacred woodworking activities. One also occasionally finds carved rocks at sites and some of these appear to have sacred significance. The dominant aspect of archaeological debris at camp sites which relates to ceremonial behaviour however is the presence of ochre and coloured pigments. White and yellow pigments were always used for ceremonial purposes but are rarely seen in the refuse of domestic camp sites. Red ochre is more common and was used for both sacred and non-sacred decoration. The presence of red ochre at most sites can generally be viewed as evidence for the routine, non-sacred decoration of men, however at two sites (Nabulabanda (10) and Ngandalarra (6)) it was found in significantly large amounts and appears to reflect the collection and use of ochre for ceremonial activities.

In summary therefore, one finds that contrary to previous assessments of the inter-assemblage variability in the Western Desert (Hayden 1976, 1979) there is indeed considerable variation in the composition of assemblages at major habitation sites and that this relates to the environmental and economic characteristics of different sites rather than stylistic, cultural and ethnic differences as suggested by Hayden (1976:1,459,469). White and O'Connell (1982:88) observe that in no area has "a high correlation between ethnographically known and archaeologically recovered data" been demonstrated and suggest that Hayden's (1979) work "illustrates this superbly". This thesis has, however, demonstrated that there is a high correlation between certain important aspects of behaviour and the archaeological debris resulting from them. Briefly the following

activities have been shown to correlate with the proportional respresentation of artefacts at respective sites and I would suggest that these aspects of hunter gatherer behaviour can be reliably interpreted from a study of stone artefacts.

Djarrga Djarrga (2): major use of seed foods, moderate woodworking, curation of cores, moderate manufacture of stone tools, site occupied between April and November.

Nganawalbinyu (3): minor stone tool manufacture, moderate use of seed foods, major woodworking site, visited by Aborigines from different areas, occupied between April and November.

Djungurr (4): major stone tool manufacture (use of local stone), moderate use of seed foods, moderate woodworking site, collection and use of local quartzite hammers, visited by people from different areas, occupied between April and November.

Ngandalarra (6): minor manufacture of flaked stone tools, major manufacture of grindstones, moderate woodworking site, possibly manufacture of ceremonial boards, extensive use of ochre, possible ceremonial site, occupied between April and November.

Guralba (8): minor manufacture of stone tools, visited by people from other areas, moderate woodworking site, possible manufacture of ceremonial boards.

Nabulabanda (10): minor stone tool manufacture, extensive use of ochre, moderate use of seed foods, moderate woodworking site. Generally occupied by people travelling directly from Djungurr (4) between April and November.

Balgo Balgo (17): minor stone tool manufacture, major woodworking site; wooden artefacts were finished and repaired, minor use of seed foods, occupied by people from different regions and people travelling from the Stansmore Range, between December and April.

Dalabanda (18): minor stone tool manufacture, curation of cores, moderate woodworking site, construction of softwood dishes and possibly ceremonial boards, major use of seed foods.

Djulyurrulyurru (19): major manufacture of stone tools, major use of seed foods, minor woodworking site, occupied between April and November.

Migiliri (22): major manufacture of stone tools, minor woodworking site, moderate use of seed foods, occupied between April to November.

Mindirr (22): major manufacture of stone tools (use of local stone), minor use of seed foods, minor woodworking, occupied between December and March.

Diedi (25): major manufacture of stone tools, moderate use of seed foods, moderate woodworking site with possible construction of ceremonial boards, occupied between April and November.

Wilbarinyu (27): camp adjacent quarry, major stone tool manufacture, use of local stone, removal of flakes to other camps.

Birbayga (28): major stone tool manufacture, use of local materials, moderate use of seeds, minor woodworking site, occupied between April and November.

Gawayurru (29): moderate stone tool manufacture, transportation of

cores, minor woodworking, major use of seed foods, occupied between April and November.

Gundjimarra (30): major manufacture of stone tools, minor woodworking, minor use of seeds, occupied between December and April.

Yurinubadu (31): major manufacture of stone tools, minor woodworking, minor use of seed, occupied between December and April.

Wider Implications

The extent of the ethnographic and archaeological correlation depicted in this thesis signifies that particular kinds of stone artefacts were used for particular functions and that their distribution generally provides a reliable archaeological reflection of the location and character of those activities during the past. When taken in conjunction with ethno-functional and taxonomic data, these results represent a substantial body of information which can be used to confirm and clarify various functional aspects of the stone tool typology generally used by archaeologists. Also, it appears from the extent of the ethno-archaeological correlation that the pattern of Aboriginal behaviour practiced in the Western Desert has not changed significantly during the period of Aboriginal occupation. Thus it would seem that the social and economic data presented in this thesis are reliable analogues of prehistoric Aboriginal behaviour in the region. As they stand these data differ from some currently held beliefs about subsistence behaviour in the Western Desert and modify the concept of an Australian desert culture (Gould 1977).

Stone Tool Form and Function

Within some sections of the Australian archaeological community there appears to be a growing disenchantment with the functional justification for traditional stone tool typologies. Dr. Hayden (1977,1979) and Gould (1970 et al. 1971,1980) have remarked on the casualness with which the Aborigines approached stone tool manufacture and record the use of unretouched flakes as "informal" tools and other artefacts which would not be recognised archaeologically as tools. These and other ethnographic accounts (Horne and Aiston 1924; Wright 1977) have prompted various archaeologists to question the validity of stone tool typologies and draw attention to the fact that "stone tools tended to be ad hoc and unspecialized implements" (Stockton 1981:6), that "formal patterning was far from common" (White and O'Connell 1982:84) and that the "Aborigines do not invariably shape functionally specific and easily recognizable implements" (Hiscock 1983:50).

However there is also a rich supply of ethnographic data which reveals definite form and definite function for the stone tools used by Aboriginal people (Spencer and Gillen 1899; Stirling 1896; Carnegie 1898; Horne and Aiston 1924; Love 1936; Tindale 1965; Gould et al. 1971). Even Hayden's research led to the conclusion that "by and large there seemed to be a distinctive tool morphology for each major function" (1979:14, 1976:277) even though the bulk of his morphologies are not very reminiscent of artefacts recorded archaeologically in the Eastern Desert (compare Hayden 1979:36,42,44,46 with Gould 1977:128-143 and O'Connell 1977:271-279).

The bulk of these earlier ethnographic accounts have formed the basis for the traditiondl stone tool typology generally in use today (McCarthy 1946; Mulvaney 1961, 1975) which seems to be increasingly under review. In the face of this debate therefore, the ethno-taxonomic and functional data recorded in this thesis has some relevance and can contribute to our understanding of the relationship between the form and function of stone tools.

One of the most obvious areas in which these data have relevance is the functional importance of unretouched flakes. Archaeologists have generally viewed these as being no more than the unused rubbish produced in stone tool manufacture. More recently however the view has been expressed that these were in fact frequently used as implements (Gould et al. 1971:163, 1980:72-131; Hayden 1977:179; Byrne 1980:113; White and O'Connell 1982:84,85,87; Hiscock 1983). In view of this diversity of opinion it is of particular relevance to document that the Aborigines themselves felt that 98.9% of the unretouched flakes recorded in this project were rubbish; simply the unwanted by-product of stone tool manufacture. This implies that traditionally very few unretouched flakes were likely to have been used as tools by Aborigines in this area and tends to de-emphasize the importance of unretouched flakes in the Aboriginal tool kit. It suggests that the so called "waste" found in archaeological sites is indeed rubbish.

With regard to other tool types the Aborigines also provided a range of information which will help refine and confirm our understanding of many traditionally defined tool types. For example

they identified tula adze flakes as an ideal general woodworking tool and indicated that burren adze flakes were simply a morphological variant of the same implement. They said that new, large tula flakes were used for heavy duty woodworking and that smaller older ones were only used for gentle scraping. They also pointed out that adze slugs were sometimes inverted in the haft and the dorsal margin of the striking platform used as a scraping edge and that slugs which had been reduced to a point were sometimes rehafted with the point exposed and used as engraving tools. Utilized flakes on the other hand were generally used in an impromptu fashion. These were generally hafted and used for the same functions as tula adze slugs. The Aborigines identified "notched" flakes as artefacts used to scrape spear shafts and they identified small "micro-retouch scrapers" (O'Connell 1977:273) as hand-held artefacts used for gentle scraping activities such as smoothing the surfaces of wooden implements.

The Aborigines did not consider any functional difference in the variety of multiplatform, single platform and horsehoof cores recorded (Gould 1977:80,81) although they did comment that some "levallois point and blade cores" (Dortch 1977:120) were used for producing razor sharp flakes for initiations or blanks for stone points. Further, they said that the more regular variety of core scrapers recorded (O'Connell 1977:277) were hafted heavy duty woodworking tools, whereas those which were less regular in shape were sim[illegible]s.

The Aborigines associated large leilira blades with ceremonial activities similar to those ascribed them by other ethnographers (Stirling 1886; Spencer and Gillen 1898; McCarthy 1946) although they did not differentiate between men and women's blades. Many of the blades found on archaeological sites had been broken and they were thought to be hafted woodworking tools used primarily in the construction of women's softwood bowls.

The dominant function for the unifacial points recorded was engraving, although some of the more beautiful and attractively trimmed points were thought to have been used in ceremonies and acts of sorcery. Sorcery and ceremonial activities were also the dominant functions given for the few bifacial flaked points seen. The few burins recorded were said to have been used as engraving tools.

Women's seed grinding tools have received very little attention in the archaeological literature. However they are such a strong economic indicator they deserve more detailed consideration. In the course of this project I found a variety of activities can be inferred from the morphological attributes of these tools. Most obvious is that grinding slabs used for processing seeds with water can be identified because of the presence of a linear grinding groove which extends from the margin of the grinding slab to the centre of the slab. These diagnostic grinding slabs thus provide archaeologists with evidence for the preparation of wet ground seeds. It was also apparent that hammer dressing of the grinding slab reflected the reshaping and lightening of the slab and not its use as an anvil for bone crushing, powdering native tobacco or stone tool manufacture as

insight may suggest. I also noted that as a grinding slab became older grinding grooves became too deep and too long. Thus new grooves were used and the length of the old grooves was reduced by flaking. This results in the production and deposition of diagnostic flakes of ground sandstone in the archaeological record. Other amorphous unground flakes of sandstone in the archaeological record reflect the preparation of an original blank for seed grinding. Lastly, with continual modification and use an exhausted grinding slab which has been discarded will be characterized by numerous deep grinding grooves, hammer dressing and groove reduction.

I do not know how long individual grinding slabs were expected to last but would estimate they lasted several years. When discarded they were usually broken up and used for a variety of secondary functions such as heat retainers, bone crushing stones and ochre preparation. They were also broken up when a woman died and were occasionally broken during manufacturing, in domestic arguments or by simply being dropped.

Handstone or seed grinding mills were usually hammer dressed from naturally occurring pieces of stone. Domed handstones were generally preferred although flat handstones were also used. Flat handstones were often sharpened by percussion to prevent them rolling over the seeds they were meant to crush. Handstones were sometimes used as hammers and thus display percussion damage on their margins. With age handstones become multifaceted and will be discarded when they become too small to be held comfortably when grinding. Thus a discarded handstone will have reduced to about 7cm x 5cm in size,

will be multifaceted and often display percussion damage on its peripheral margins.

One final point to consider before leaving this summary of stone tool form and function is that while the range of artefacts recorded in this thesis are similar in form to those recorded in other parts of arid Australia (O'Connell 1977; Gould 1977) they are most unlike the artefacts recorded by Hayden in his technological projects (1977,1979). The artefacts made by the Aboriginal informants working with Hayden are most unlike anything one finds on archaeological sites in the Great Sandy Desert and this makes me suspicious of the relevance of Hayden's research to prehistoric studies in the Western Desert. This suspicion is underlined by Hayden's claim that no one at Cundeelee "could make wooden objects using only stone tools" (1979:23) and that at Papanya "the possible tendency to produce inferior implements to those that the Aborigines would have considered personally suitable was a problem" (ibid. 24). He also points out there were shortages of time and that there was a certain (understandable) reticence on behalf of the Aborigines to manufacture wooden implements with stone tools (ibid.). My own experiences of Aboriginal stone tool manufacture leads me to suspect that the skills of even the oldest, most traditionally oriented men are out of practice and that Hayden's project was rather forced. Therefore unlike some archaeologists (Stockton 1971; White and O'Connell 1972; Hiscock 1983) I am inclined to be wary of his results and skeptical of their general application to stone tool analysis in (or outside) the Western Desert.

Curation

With the exception of the transportation of stone tools to habitation sites, and the removal of cores from sites approximately 15km from quarries the influence of artefact curation does not appear to have had a major impact on the distribution of arefacts at major camp sites. In this project the correlation apparent between particular activities and the proportions of related artefacts suggests that artefacts were generally discarded at the sites at which they were most intensely and frequently used. Contrary, therefore to the apparent influence of curation on the distribution of archaeological debris at sites inhabited by Numamiut eskimos (Binford 1973:242) and speculation about the likely influence of curation on the composition of assemblages (Ammerman and Feldman 1974; Munday and Lincoln 1979; Bettinger 1979) curation does not seem to be an aspect of prehistoric behaviour which has a major influence on the formation of archaeological assemblages at habitation sites in the Great Sandy Desert.

Subsistence and the Australian Desert Culture

One of the most obvious implications of the correlation found between the distribution of stone artefacts in this region and the recent pattern of Aboriginal behaviour is that it suggests that the various aspects of Aboriginal behaviour which are reflected archaeologically have not changed significantly from the time Aborigines first adapted to the region. Unfortunately, in the absence of organic remains and stratigraghy it is not possible to date the archealogical debris examined in this project with precision. On typological grounds alone, however, the presence of artefacts associated with the small tool tradition (such as tula and burren

adze flakes, unifacial and bifacial points and stray backed blades) suggests the sites are not older than 4,000 to 5,000 years (Dortch 1977; Lorblanchet and Jones 1979; White and O'connell 1982). This is consistent withy the oldest dates from Central Australia (Stockton 1971; Gould 1980; Smith 1983) although Gould's (1977) excavation at Puntutjarpa revealed occupation of the Western Desert back as far as 7,000 to 10,000 years.

Thus, the pattern evident in the stone residues recorded in this project suggests that the Aborigines were using the same tools for the same activities at the same sites consistently for possibly the last 5,000 years. The archaeological evidence also indicates that the Aborigines were using the same waterholes for camp sites, were using the same stands of wood for making wooden implements, were utilizing the same concentrations of grass seeds, were travelling along the same routes and performing ceremonies at the same locations today as they were when those patterns of behaviour first began. The extent of the ethnographic and archaeological correlation thus points to an era of cultural stability and implies that other apsects of desert life such as population size and social organization, which are often beyond the reach of archaeological interpretation, were also part of the same stable pattern of prehistoric existence. The extent of the archaeological correlation therefore implies that Aboriginal behaviour may not have altered substantially for many thousands of years.

Such a conclusion is consistent with archaeological, faunal and palaeo-climatic evidence suggesting there have been no major environmental or cultural changes during the Holocene in the Western Desert (Gould 1971a, 1977; Bowler 1976; Beard 1982; Mabbutt 1971). Gould (1971:174,1977) in fact hypothesized that during most of the "post Pleistocene period there has existed a stable hunting and foraging way of life" and terms it the "Australian Desert culture" after Jenning's (1957) model for the American Great Basin. Gould (1971:174) supposed it might be "possible to propose that the entire arid interior of Australia was a single diffusion-sphere ... within which a broadly uniform and distinctive foraging way of life developed".

The concept of an "Australian desert culture" therefore appears to have temporal application and indeed the data presented in this thesis suggests that the Aborigines in the Great Sandy Desert did practice a "stable hunting and foraging way of life" during the span of prehistoric occupation. Contrary, however, to Gould's expectation this model does not appear to have the same "uniformity in space" as originally anticipated (1971:174). In fact in terms of subsistence strategies the Gugadja Aborigines of the Great Sandy Desert appear to have more in common with the Alyawarra from Central Australia (O'Connell et al. 1983) and the !Kung bushmen (Lee 1979) than the neighbouring Nagatatjara of the Gibson Desert. For example the Aborigines of the Great Sandy Desert appear to have enjoyed greater economic diversity and greater seasonality in the availability of resources than the Nagatatjara. The Nagatatjara did not enjoy access to important resources such as Ipomoea or Vigna tubers and are not

recorded to have stored and utilized acacia and eucalyptus seeds. Conversely Chenopodium and Eragrostis seeds and Ficus fruit were major resources in the Gibson Desert, but were comparatively unimportant to the Aborigines in the Great Sandy Desert. However, the Gugadja did not have access to Canthium or Quandong fruits (Santalum acuminatum) (Gould 1969,1977,1982). Similarly the annual subsistence round practised by the Gugadja was not stimulated or governed by the location and size of erratic rain showers. Unlike the Ngatadjara, who seemed to be forever on the lookout for rain, the seasonal round practised by the Gugadja was predictably seasonal. In the Great Sandy Desert the Aborigines spread out during the summer in search of unused supplies of food. They congregated around large waterholes during the winter where abundant supplies of fruits, seeds and roots allowed participation in large ceremonies. Towards the end of the dry season the Aborigines contracted back to major rockholes and practised a generalized hunter gatherer subsistence strategy.

Highlighting the regional diversity in the subsistence strategies practised by desert Aborigines is the difference between these two groups and the Bagundji of eastern Australia (Allen 1974). Here the Aborigines congregated in large groups along river banks during the summer months. This was a time of high productivity and the Aborigines collected fish, shellfish, bulrushes and migratory birds. By comparison, winter was a difficult time and the Aborigines split up into small groups and focused their attention on mammals, seeds, fruits and tubers. Unlike the Ngadadjara, both the Gugadja and Bagundji practised seed storaging quite extensively.

Contrasting these differing patterns of subsistence is the similarity in the subsistence behaviour of the !Kung bushmen of southern Africa (Lee 1974) and the Gugadja. The environments of both societies were similar; they were situated on the same latitude, had similar topography and essentially the same climatic conditions. They enjoyed access to about the same quantity of edible plants, although it would appear the quality of the !Kung plant resources was better than the Gugadja as they did not utilize acacia seeds and did not store plant foods (1979:156) as extensively. Both groups relied heavily on one major staple - the mongongo nut by the !Kung (Lee 1979:182) and Ipomoea tubers by the Gugadja. Unlike the Gugadja, the !Kung had access to a greater variety of fauna. They did not eat small marsupials, lizards and insects. The mode of productions were also similar in both groups (1979:117). Both were characterized by sexual division of labour (although this was not rigid amongst the Gugadja), simple technology, extensive food sharing, common access to resources, mobility and flexibility in group size and foraging patterns and a loose concept of land ownership.

The seasonal pattern of subsistence was also similar (Lee 1979:104,294). Both groups spread out during the wet season and contracted back to major waterholes during the dry season. In the wet season both groups became very mobile and travelled widely to collect otherwise inaccessible foods. In both regions autumn and winter were a time of plenty, although supplies of vegetable foods were progressively depleted. During the spring subsistence required more work and foods such as fibrous roots (and, in the case of the Gugadja, acacia seeds), which were normally ignored were gathered and

consumed. Animals were more easily caught at this time of year in both regions. Towards the extreme end of the dry season vegetable foods were eaten out around the vicinity of major waterholes and both groups experienced a hungry season; although it would seem that the hungry season experienced by the !Kung was not as pronounced as the "hungry time" experienced by the Gugadja.

Thus, it is apparent that Aboriginal subsistence in the Western Desert was more diverse and less opportunistic than previously considered by Gould. Furthurmore, contrary to Gould's opinion (1969), the similarities between subsistence strategies practised in the Western and Kalahari Deserts were quite marked. In the final section of this conclusion I would like to summarise the dominant aspects of Gugadja subsistence in the Great Sandy Desert and comment on what I believe to be misconceptions regarding subsistence in the the Western Desert.

(a) The main foods were seeds, wild fruits, tubers, reptiles, marsupials, birds and grubs. Of these Ipomoea tubers and reptiles were the most important staples (constituting between 30% and 50% of the diet; Gould 1969, 1982) with other important foods such as Vigna tubers, Ficus fruits and large game being distinctly seasonal in their availability.

(b) Seeds were difficult to process and unless species which were relatively easy to prepare were particularly abundant they were generally used in a supplementary fashion; possibly contributing somewhere in the vicinity of 10%-20% of the diet.

(c) The desert was rich in minor foods such as birds eggs, insects,

nectars, less abundant fruits and seeds and these resources were used in a supplementary fashion; particularly if the major foods items failed to ripen in sufficient abundance.

(d) Most foods were available in a broadly defined season although some such as Ipomoea and Cyperus tubers, reptiles, birds and witchetty grubs could be obtained all year. Most of the vegetable foods ripened during the cold season (May-August) and as the year progressed a greater diversity of less abundant foods were available. Supplies of food began to run out and were often in short supply during the hot season and wet season (November-February).

(e) Vegetable foods did not always constitute between 70%-80% of the traditional diet (Meggitt 1957; Gould 1969, 1977). This figure may have been true for some of the winter months but it varied seasonally. Animal foods became increasingly important during the spring and eventually dominated the diet (i.e. lizards) during the early summer (December).

(f) Contrary to popular belief (Gould 1969; Peterson 1970; Hiatt 1970; Maddock 1970) women were not always the principal food gatherers. The role of the sexes in the collection of food varied seasonally. Women were the principal food gatherers during the cold season (May-August), whereas both men and women made a substantial contribution to the diet during the "goanna get up time" (August-October). Men took over the role of food collecting during the hot season (October-December) and again both men and women collected food during the wet season and "green grass time" (January-April). Men and women shared many of the subsistence activities. Neither sex was adverse to collecting wild fruits, eggs,

small marsupials, tubers or witchetty grubs although seeds were always processed by women and men always did the hunting.

(g) Desert subsistence was not overly opportunistic. The seasonal availability of resources combined with detailed ecological knowledge made hunting and gathering activities quite predictable. For example the availability of vegetable tubers during the cold season was very predictable and allowed relatively large groups of people to live semi permanently around large waterholes. Further, the Aborigines took conscious steps to store acacia, eucalyptus, Stylobasium seeds and Solanum fruits for the periods of food shortages. They also had a conscious policy of burning the land during the "goanna get up time" to stimulate new tubers, grass seeds, Solanum fruits and attract game. Hunter gatherer behaviour was most opportunistic and generalized between the "goanna get up time" and the wet season (August-March) when the Aborigines foraged widely for a variety of resources.

(h) Desert subsistence cannot be characterized as either "affluent" or unduly harsh (Thomson 1964; Sahlins 1968; Lee 1968; Gould 1969; Hawkes and O'Connell 1981). Rather it varied between both. The best time was the cold season when easily gathered resources such as tubers and fruits were abundant and women only had to spend a few hours to provide sufficient food for an average family. This was a time of affluence - characterized by feasting, leisure and social interaction. It was a time of ceremonial activity, when gatherings of up to 300 people could congregate for religious purposes. The "goanna get up time" (August-October) was more arduous and at this time of year both men and women spent most of the day foraging for

marsupials, reptiles, fruits and processing seeds. This pattern of foraging behaviour also characterized the wet season when people had to forage widely to gather small quantities of food. The hardest time was at the end of the dry season between November and December. At this time of year life was very harsh, food was difficult to find and men spent long hours in the quest of food. It was a time of water shortage, aggression and sometimes starvation. The harshness of this season probably transcends anything previously recorded of the subsistence behaviour of man in a desert environment.

(i) The Gugadja Aborigines did not "chase rain" (Gould 1977:169) except at the end of the dry season when they were desperate to get to new foraging areas. Rain water was vitally important but did not "dominate all other concerns" (Gould 1969:265). Obviously an abundance of food was of no use without water, but conversely an abundance of water was of no use without food. People could not live in the region without sufficient water, but also moved [illegible] the Ipomoea tubers failed to ripen.

(j) The strategy of water use was for people to spread out widely over the country with wet season rains and contract back onto the major rockholes as water supplies dried up. During the dry season local population centres of 15-30 people probably congregated around the major rockholes. This is essentially the same pattern as that outlined by Gould (1969) but was not rigorously enforced. People also took into consideration the availability of food, social and religious obligations when travelling to and from different camp sites.

(k) There were only two permanent springs in an area of about

18,000 sq km in this part of the desert. There were many large rockholes in the hills and ranges, which although not permanent generally held enought water from one season to the next. In the study area there was one such waterhole (Mindirr (23)) without which people could not have lived permanently in the study area at all.

(l) Population densities were very low; one person per 150 sq km. The economic wealth of the landscape seems to have had the capacity to support larger populations but low populations appear to have been maintained by the limited supplies of water during the extreme dry seasons.

(m) Permanent settlement could not have been possible in the Great Sandy Desert without the scatter of large rockholes. These reduced to a bare minimum at the end of bad dry seasons; with the major rockhole in the study area reducing to no more than a muddy soak. Thus, permanent settlement and survival from one year to the next was very precarious. If local waterholes dried out family groups had to travel to neighbouring rockholes to survive extended dry periods. It is this aspect of desert survival, rather than the problems of day to day existence, that made life in the Western Desert so marginal and unusually harsh.

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Sunfly (Djambidjin)

Sunfly was probably the oldest person with whom I worked. He is an aristocratic individual and has an immense amount of knowledge. He was highly respected by all the Aborigines in the the community and was described as "a proper king one". He is also a Pintubi man, and his country is west of Lake Mackay. According to mission records he was born between 1910 and 1920 and entered the mission in 1945. According to Aborigines he must have entered the mission after 1951. His second wife, Bye Bye, comes from the study area (see below).

Jimi Flatnose (Djambidjin)

Jimi was called "flat nose" because the septum of his nose was ripped out during an over enthusiastic initiation. He is a Gugadja man and his country is located between Carnegie Bluff and Lake Hevern (Yunbu). According to mission records he was born between 1905 and 1920 and entered the mission in 1951. He was a very widely travelled young man, has an excellent memory and is a good hunter. He first became aware of white people when he was about 16 and saw a plane. He recalls everyone was terrified and that they dropped their belongings and ran. The medicine men (Marban) spat and threw their magical objects at the plane. He recalls the same thing happened to people living near the Canning Stock route. The mission records say this group was seen by a mining party in 1956.

Jimi had a younger brother who died of cancer in January 1982. I worked very closely with both men and with their wives (Nyami and Linda). After spending so many desert nights with these families and

knowing how few old men are still alive who hold such rich traditional knowledge his death is very sad and very tragic.

Linda, Bye Bye and Nyami (Nabangardi)

These three sisters and the rest of their family are the traditional owners of Estate Two in the study area (fig 3.2). Linda was the oldest sister but unfortunately I had little to do with her after her husband died (Jimi's brother). Bye Bye, her younger sister is Sunfly's second wife, and was an excellent informant. She was both thoughtful and patient and had a very detailed memory of her country and economic activities. Nyami, her younger sister, is married to Jimi and although a very enthusiastic informant was a bit young (about 14) when she left the desert. She has since learnt a lot about women's work at Balgo but her knowledge of the country is not as detailed as other informants.

Mission records reveal Bye Bye was born in 1939 and entered the mission in 1948. This is incorrect as her younger sister, Nyami, is recorded as being born before her. Their inaccurate records reveal Nyami was born in 1938 as well as 1932 and claim she entered the mission in 1951. The family in fact came to Balgo together and were one of the last families to leave the desert. They must have got to Balgo in the early 1950's.

Bye Bye's mother saw her first white people when she was a little girl (?1920's). Her family was camped near Mindirr (23) and saw three men on camels travelling north up the Stansmore Range. She recalls the man in charge was called Sam. This could have been Sam Hazlett, who Terry (1937:245) said had "done a great deal of publicly unnoticed

travelling in the Big Paddock (? Great Sandy Desert). These Europeans were quite friendly and gave tobacco to the Aborigines although a "second lot" came through hunting people and after women. When Bye Bye was a little girl her family made two trips to the station near Gregory Salt Lake to steal bullocks. On the last trip they were caught, chained to a tree and given poisoned food to eat. Apparently some Aboriginal stockmen talked the station owners into releasing them. When released her family took off and walked to Ngandalarra(6), 200km away, without stopping. After this they were very frightened of white people and did not go near them until the mission started. Even when her family decided to go to the mission they were very unsure and travelled to Emily Springs (Nyili) where they camped for about a year before making the big step.

Even before direct contact with Europeans, western items were being traded into the study area. Bye Bye and Nyami both recall their parents obtaining thumb sized packages of mixed tea and sugar and we found two steel axes and one sheet of steel that was thought to have belonged to their father. Carnegie recorded traded articles in the general area as early as 1896. He saw a family with an "old iron tent peg, the lid of a tin match box,and a part of the ironwork of a saddle" and suposed, on the best authority of the day, that these were from Leichhardt's expedition (Caregie 1898:244-5).

Arthur and Bill Lari (Djabanangga)

Arthur and Bill are brothers from Pintubi/Gugadja country south of Lake Hazlett. Both can recall mounted parties of white people from the station at Gregory Salt Lake, coming into their region to shoot

Aborigines. When people began to leave the region (to Yuendemu before going to Balgo) Arthur and a few others stayed on to police and protect the region from intruders. Arthur was a renowned fighter and has many scars to prove it. This policing party was met by Donald Thomson in 1957, who thought he was the first white man they had seen. Thomson was impressed by Arthur and described him as follows

> I was able to establish a special friendship with a man of considerable intelligence and magnificent physique, Tjabanangka. He had broad powerful shoulders and arms, and a heavy beard which was intensely black and more or less bifid in form...Tjabananjka was indisputably the dominant man in this group ... by virture of his personality and leadership. During the period that we lived and hunted with them I never saw anyone,man or woman, question his lightest word. Yet there was nothing in his behaviour of dominance or exploitation. In all the years I have lived in the field among Aborigines I have known only two men who exercised great authority. These were Wongo of Caledon Bay and Tjabanangka ...Tjabanangka carried more authority ... it was he who; in the partition and distribution of food saw to it that everyone had his share (1975:83-84).

I found Arthur to possess these qualities. He was also a very good hunter and had an excellent memory. He was perhaps the most traditionally oriented man I worked with but unfortunately his command of English was very poor.

Jambu (Djabananga)

Jambu is a Gugadja man belonging to the country between his classificatory brothers Arthur and Bill to the north east and Jimi Djambidjin to the south west. The mission records he was born in 1925 and entered the mission in 1945. He told me he entered the mission

when he was about my age (27 at the time) and was taken to Alice Springs as a stockman. He is an articulate and artistic man, although people complained about the quality of his hunting.

APPENDIX 2.1 Results of chi-square analysis for inter-site comparisons of unretouched flakes

	1	2	3	4	6	8	10	17	18	19	22	23	25	26	27	28	29
2	11.21[5]																
3	17.77[5]	1.09															
4	.78	5.90[3]	11.26[5]														
6	13.01[5]	3.04[1]	1.29	9.55													
8	43.84[5]	4.41[2]	2.23	11.81[5]	.08												
10	9.88[4]	.25	.12	5.89[3]	1.65	2.62											
17	104.26[5]	.86	.01	10.55[4]	1.46	2.45	.06										
18	10.84[5]	.93	.04	7.05[3]	.74	1.40	.21	.09									
19	.72	3.86[2]	7.70[3]	.01	8.13[4]	10.11[4]	4.43[2]	7.71[3]	5.53[3]								
22	15.54[5]	52.13[5]	62.85[5]	22.90[5]	37.75[5]	42.20[5]	41.09[5]	61.50[5]	39.38[5]	18.22[5]							
23	28.91[5]	58.22[5]	67.43[5]	27.07[5]	56.04[5]	60.91[5]	53.80[5]	66.28[5]	54.26[5]	32.28[5]	7.23[4]						
25	.99	10.30[4]	14.77[5]	2.50	14.25[5]	16.58[5]	9.97[5]	14.19[5]	11.64[5]	2.36	3.08[1]	13.91[5]					
26	39.43[5]	16.42[5]	10.74[4]	31.94[5]	1.32	1.19	8.41[4]	11.34[5]	6.93[4]	26.41[5]	85.77[5]	97.79[5]	34.20[5]				
27	88.33[5]	49.38[5]	37.75[5]	75.93[5]	12.61[5]	10.23[4]	24.46[5]	39.00[5]	25.75[5]	62.53[5]	158.51[5]	156.11[5]	68.79[5]	6.82[4]			
28	1.25	15.73[5]	22.21[5]	3.49[1]	17.13[5]	19.95[5]	14.22[5]	21.38[5]	15.10[5]	3.04[1]	5.46[3]	18.22[5]	.77	44.26[5]	90.65[5]		
29	.35	3.79[1]	7.23[4]	.01	8.13[4]	10.03[5]	4.35[2]	6.77[4]	5.52[3]	.03	13.91[5]	28.22[5]	1.74	24.99[5]	57.99[5]	2.10	
30	3.44[1]	28.32[5]	34.00[5]	16.12[5]	32.38[5]	45.44[5]	27.88[5]	33.28[5]	29.21[5]	15.27[5]	2.15	.38	6.18[3]	56.81[5]	94.27[5]	7.72[4]	13.54[5]
31	56.76[5]	114.32[5]	128.74[5]	99.52[5]	84.32[5]	91.53[5]	94.50[5]	126.00[5]	90.14[5]	58.22[5]	13.75[5]	.80	21.93[5]	159.72[5]	260.80[5]	32.76[5]	48.31[5]

KEY [1]P ≤ 0.1 [2]P ≤ 0.05 [3]P ≤ 0.02 [4]P ≤ 0.01 [5]P ≤ 0.001

APPENDIX 2.2 Results of chi-square analysis for inter-site comparisons of scrapers

	1	2	3	4	6	8	10	17	18	19	22	23	25	26	27	28	29	30
2	5.68[3]																	
3	4.62[2]	18.50[5]																
4	2.45	.67	12.51[5]															
6	.09	.76	1.58	.20														
8	.41	3.72[1]	.16	2.12	.49													
10	.10	2.30	3.35[1]	.75	.01	.60												
17	10.73[4]	19.49[5]	1.19	21.85[5]	3.14[1]	.87	7.08[4]											
18	6.46[3]	.73	3.76[1]	.09	.03	1.01	.14	6.86[4]										
19	13.00	3.36[1]	25.30[5]	6.02[3]	4.25[3]	9.70[4]	8.35[4]	34.37[5]	4.96[2]									
22	41.89[5]	17.71[5]	67.99[5]	24.90[5]	14.34[5]	26.85[5]	27.81[5]	86.90[5]	18.17[5]	2.88[1]								
23	25.39[5]	12.67[5]	39.68[5]	16.58[5]	14.05[5]	23.31[5]	20.19[5]	49.56[5]	15.28[5]	3.75[1]	.49							
25	25.50[5]	.00	8.32[4]	.30	.06	2.69	1.31	13.07[5]	.47	2.31	11.79[5]	10.60[4]						
26	1.89	.05	5.45[3]	.40	.67	2.43	1.20	8.21[4]	.56	1.02	6.17[3]	7.11[4]	.04					
27	.76	5.50[2]	.12[3]	3.27[1]	6.69[4]	.01	.96	.94	1.46	12.58[5]	34.49[5]	27.06[5]	3.67	3.07[1]				
28	8.34[4]	.78	20.14[5]	2.50	1.90	5.85[3]	4.48[2]	29.38[5]	2.12	.95	8.91[4]	7.95[4]	.48	.10	8.07[4]			
29	10.27[4]	2.70[1]	19.96[5]	4.79[2]	3.81[1]	8.55[4]	6.92[4]	27.07[5]	4.25[2]	.00	2.44	3.45[1]	1.98	.92	10.81[5]	.79		
30	8.31[4]	3.38[1]	14.30[5]	4.86[2]	4.82[2]	8.72[4]	6.65[4]	18.55[5]	4.90[2]	.50	.20	.67	2.69	1.94	10.04[4]	1.79	.46	
31	24.46[5]	5.99[3]	47.02[5]	10.91[5]	5.42[3]	12.80[5]	13.12[5]	64.46[5]	7.07[4]	.00	3.96[2]	4.30[2]	3.33[1]	1.29	17.73[5]	1.52	.00	.54

KEY [1]P ≤ 0.1 [2]P ≤ 0.05 [3]P ≤ 0.02 [4]P ≤ 0.01 [5]P ≤ 0.001

APPENDIX 2.3 Results of chi-square analysis for inter-site comparison of engravers

	1	2	3	4	6	8	10	17	18	19	22	25	26	27	28	29
2	.02															
3	.51	.06														
4	.27	.14	.17													
6	1.93	1.32	.32	.77												
8	1.72	1.39	.35	.82	.00											
10	.06	.02	.19	.02	.72	.76										
17	.75	.52	.00	.14	.35	.38	.17									
18	2.31	1.85	.45	1.13	.00	.00	.89	.49								
19	.00	.02	.58	.20	1.34	.37	.06	.13	1.69							
22	1.01	1.17	.00	.24	.33	1.41	.23	.54	.50	.68						
25	3.52[1]	2.87[1]	.90	1.96	.01	.01	1.34	.96	.03	2.40	1.06					
26	.94	.72	.08	.34	.05	.05	.36	.10	.05	.79	.08	.14				
27	.98	.76	.09	.37	.04	.05	.38	.11	.04	.82	.09	.12	.00			
28	.99	.71	.01	.26	.24	.27	.26	.20	.34	.70	.01	.71	.05	.06		
29	.04	.01	.25	.40	.82	.87	.00	.22	1.02	.04	.30	1.51	.43	.45	.33	
31	.03	.10	1.25	.45	2.17	2.77[1]	.16	1.18	3.08[1]	.01	1.55	4.60[2]	1.32	1.37	1.48	.12

KEY [1]P ≤ 0.1 [2]P ≤ 0.05 [3]P ≤ 0.02 [4]P ≤ 0.01 [5]P ≤ 0.001

APPENDIX 2.4 Results of chi-square analysis for inter-site comparisons of blades

	1	2	3	4	10	17	18	19	23	25	26	27	28	29
2	4.85[2]													
3	7.26[4]	.74												
4	5.66[3]	.02	.57											
10	2.34	.00	.56	.02										
17	1.01	9.13[4]	11.51[5]	10.31[4]	4.49[2]									
18	.66	6.60[3]	9.70[4]	7.44[4]	3.85[2]	.01								
19	4.84	.24	.09	.15	.20	8.11[4]	6.86[4]							
23	8.00[4]	2.00	.52	1.78	1.77	11.65[5]	11.04[5]	.92						
25	1.61	.06	.89	.12	.03	3.38[1]	2.29	.39	2.24					
26	1.53	.06	.08	.03	.06	2.64	2.55	.01	.72	.14				
27	1.46	.05	.09	.02	.05	2.55	2.47	.01	.75	.12	.00			
28	10.29[4]	2.80[1]	.86	2.51	2.46	14.78[5]	14.00[5]	1.38	.02	3.05[1]	1.10	1.10		
29	5.93[3]	1.30	.25	1.14	1.16	8.79[4]	8.35[4]	.53	.03	1.51	.45	.45	.10	
31	18.64[5]	4.67[2]	1.26	4.19[1]	3.71[1]	26.72[5]	23.67[5]	2.05	.02	4.60[2]	1.37	1.37	.00	.12

KEY [1]P ≤ 0.1 [4]P ≤ 0.01

[2]P ≤ 0.05 [5]P ≤ 0.001

[3]P ≤ 0.002

APPENDIX 2.5 Results of chi-square analysis for inter-site comparisons for cores

	1	2	3	4	6	8	10	17	19	22	23	25	26	27	28	30
2	4.64[2]															
3	5.12[2]	15.50[5]														
4	.36	6.84[4]	2.81[1]													
6	.86	8.33[4]	.11	.32												
8	11.33[5]	32.04[5]	2.18	7.97[4]	1.56											
10	7.65[4]	20.18[5]	.43	4.91[2]	.46	.80										
17	2.26	11.10[5]	.49	.55	.00	3.96[1]	1.62									
19	1.72	10.25[4]	.53	.58	.01	3.87[2]	1.60	.01								
22	.00	4.82[2]	5.28[2]	.34	.84	11.52[5]	7.87[4]	2.29	1.72							
23	.20	2.58	4.41	.81	1.35	10.42	6.57[3]	2.48	2.09	.23						
25	.10	2.47	2.91[1]	.48	1.00	7.44[4]	4.39[2]	1.51	1.36	.11	.00					
26	1.65	10.83[4]	.03	6.75[4]	.02	1.52	.35	.06	.09	1.63	2.18	1.58				
27	14.14[5]	32.69[5]	2.91[1]	10.17[4]	1.77	.00	1.07	5.14[2]	4.88[2]	14.55[5]	12.00[5]	8.35[4]	1.79			
28	6.07[3]	16.91[5]	.04	3.59[1]	.19	1.73	.21	.08	.83	6.28[3]	5.18[2]	3.36[1]	.10	2.33		
30	2.58	12.68[5]	.02	1.25	.04	1.82	.41	.10	.18	2.58	2.96[1]	2.04	.00	2.24	.09	
31	.38	2.94[1]	8.75[4]	1.53	1.81	16.48[5]	11.97[5]	3.63[1]	3.71[1]	.45	.00	.01	3.15[1]	21.35[5]	10.03[4]	4.74[2]

KEY [1]P ≤ 0.1 [4]P ≤ 0.01
[2]P ≤ 0.05 [5]P ≤ 0.001
[3]P ≤ 0.002

APPENDIX 2.6 Results of chi-square analysis for inter-site comparisons of hammers

	1	2	3	4	8	17	19	23	26	27	29	30
2	1.14											
3	3.72^{1}	.59										
4	11.77^{5}	5.33^{3}	1.98									
8	.93	.05	.03	.64								
17	.00	1.19	2.96^{1}	8.79^{4}	.90							
19	.64	.07	.80	4.38^{2}	.14	.58						
23	.13	1.50	3.04^{1}	7.51^{4}	1.31	.10	.92					
26	.41	.01	.02	1.39	.06	.41	.01	.72				
27	26.92^{5}	11.42^{5}	6.37^{3}	2.28	2.33	15.62^{5}	8.87^{4}	14.98^{5}	3.84^{2}			
29	.02	.93	2.09	5.55^{3}	.87	.01	.53	.03	.43	11.40^{5}		
30	3.20^{1}	.58	.02	.68	.06	2.71^{1}	.80	2.03	.31	3.28^{1}	2.12	
31	1.41	5.43^{3}	9.28^{4}	20.11^{5}	4.26^{2}	1.10	3.39^{1}	.43	2.77^{1}	37.52^{5}	.68	8.99^{4}

KEY $^{1}P \leq 0.1$ $^{4}P \leq 0.01$

$^{2}P \leq 0.05$ $^{5}P \leq 0.001$

$^{3}P \leq 0.002$

APPENDIX 2.7 Results of chi-square analysis for inter-site comparisons of grinding slabs

	1	2	3	4	6	8	10	17	18	19	22	23	25	26	27	28	29
2	65.83[5]																
3	3.52[1]	31.21[5]															
4	2.37	45.50[5]	.19														
6	34.65[5]	.01	14.98[5]	20.05[5]													
8	26.43[5]	.10	10.68[4]	14.42[5]	.10												
10	11.02[5]	10.35[4]	2.14	3.85[2]	5.37[2]	3.42[1]											
17	.98	39.81[5]	.65	.19	20.97[5]	15.59[5]	4.82[2]										
18	44.18[5]	.01	19.49[5]	27.05[5]	.02	.04	6.65[4]	26.54[5]									
19	18.67[5]	9.61[4]	5.06[1]	8.35[4]	4.07[2]	2.32	1.09	9.11[4]	5.21[3]								
22	7.36[5]	37.30[5]	.37	1.34	13.58[5]	9.18[4]	1.15	2.18	19.26[5]	3.82[1]							
23	.08	34.78[5]	1.60	.92	22.09[5]	17.13[5]	6.16[3]	.31	25.94[5]	10.09[5]	3.41[1]						
25	2.89[1]	15.88[5]	.02	.42	9.89[4]	7.19[4]	1.15	.65	11.56[5]	2.66	.10	1.50					
26	81.42[5]	4.47[2]	42.08[5]	55.81[5]	1.79	2.65	18.98[5]	52.57[5]	3.23[1]	18.17[5]	44.83[5]	48.87[5]	25.66[5]				
27	1.14	9.24[4]	.01	.02	7.15[4]	5.44[3]	1.03	.16	7.61[4]	1.97	.20	.61	.04	16.43[5]			
28	6.23[3]	80.88[5]	.34	1.12	11.22[5]	7.72[4]	.89	1.89	14.66[5]	2.75[1]	.00	3.10[1]	.11	34.34[5]	.20		
29	47.64[5]	.18	20.99[5]	29.99	.11	.00	6.60[3]	28.33[5]	.05	5.30[2]	21.88[5]	26.70[5]	11.66[5]	4.80[2]	7.34[4]	15.73[5]	
31	14.02[5]	120.00[5]	28.99[5]	25.37[5]	108.41[5]	94.07[5]	47.92[5]	21.04[5]	108.32[5]	58.90[5]	36.01[5]	15.30[5]	29.00[5]	174.09[5]	22.76[5]	35.47[5]	105.10[5]

KEY [1]P ≤ 0.1 [2]P ≤ 0.05 [3]P ≤ 0.02 [4]P ≤ 0.01 [5]P ≤ 0.001

APPENDIX 2.8 Results of chi-square analysis for inter-site comparisons of ochre

	1	3	4	6	10	17	18	19	22	27
3	.87									
4	2.93^{1}	.50								
6	24.74^{5}	12.29^{5}	9.15							
10	20.44^{5}	10.56^{4}	9.21^{4}	.25						
17	.07	.36	1.64	16.74^{5}	13.70^{5}					
18	1.15	.70	.06	5.07^{2}	3.88^{3}	.59				
19	4.59^{2}	1.27	.29	5.20^{2}	4.34^{2}	2.78^{1}	.33			
22	3.12	1.57	.00	10.17^{4}	9.93^{4}	1.76	.08	.27		
27	2.21	.39	.02	2.83^{1}	2.02	1.28	.10	.03	.02	
28	.11	.26	1.35	14.90^{5}	12.15^{5}	.01	.46	2.37	1.45	1.08

KEY $^{1}P \leq 0.1$ $^{4}P \leq 0.01$

$^{2}P \leq 0.05$ $^{5}P \leq 0.001$

$^{3}P \leq 0.002$