1. Defining Research Questions in Northern Australian Lithic Studies

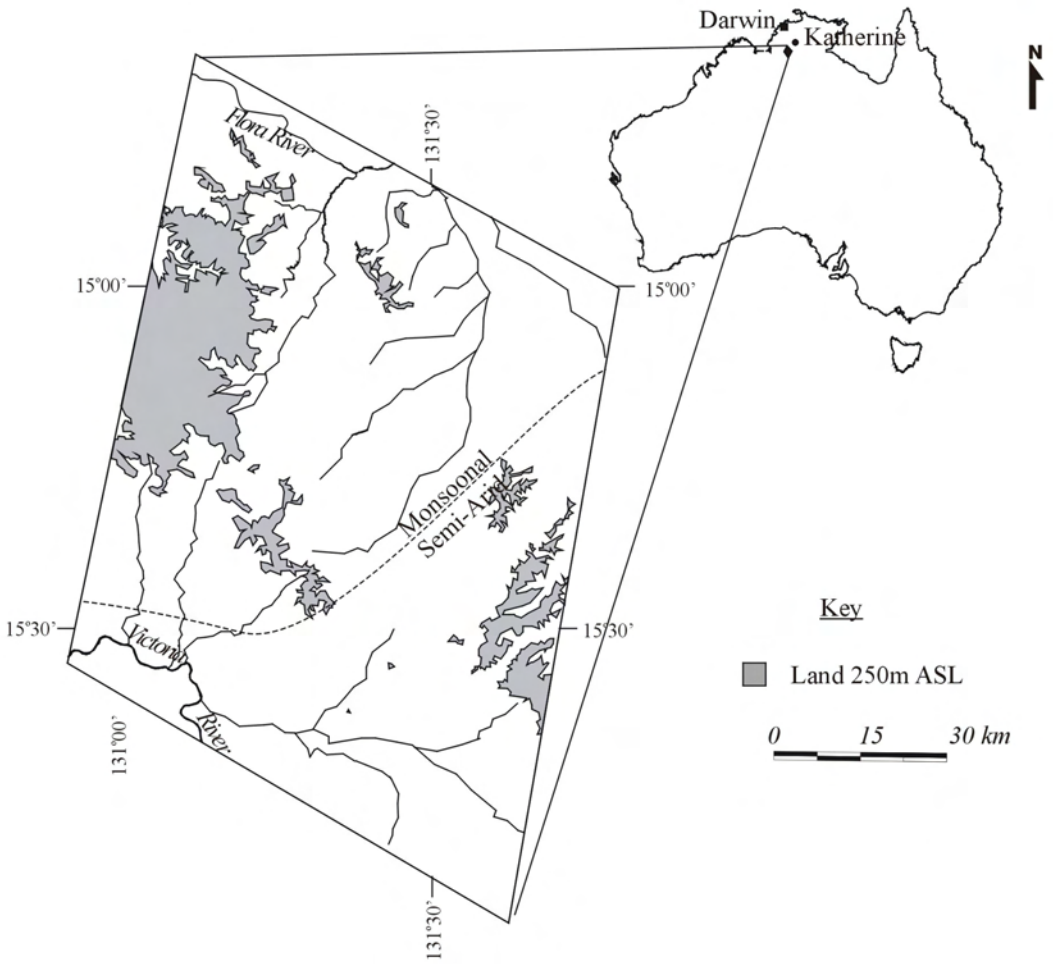
Archaeologists have long sought the meaning of variation and patterning in the stone artefact assemblages strewn across the landscape and buried in the ground. Foraging theory and theory stipulating the strategic role of lithic technology in hunter-gatherer societies suggests that much of this variation could reflect responses to different settlement and subsistence practices as well as responses to varying levels of risk and uncertainty. This monograph explores whether temporal variation in stone artefact assemblages from four rockshelters in one region of the Northern Territory could reflect changes in such factors over the last 15,000 years. The study provides a detailed exploration of changing stone implement manufacture as well as alterations to technological provisioning strategies – or the strategic organisation of stone artefact manufacture, transport, use-life and discard – as climate and resource structure fluctuated in this region since the end of the Last Glacial Maximum.

The study is set within Wardaman Country, a region located around 120km southwest of Katherine in the eastern Victoria River region (Figure 1.1). It is neatly positioned between the semi-arid zone to the south and the wet tropics to the north, and is therefore well located to explore the effects of climate change on past human land use practices. Wardaman Country is also an ideal setting for a study of long-term technological and social change because it has been a focus of archaeological research since the 1930s. Wardaman Country has also played an important role in defining key research questions in northern Australian prehistory, beginning with Davidson's (1935) seminal work on the origins and spread of cultural practices across northern Australia. This was followed by Mulvaney's (1969) definition of the northern Australian industrial sequence at Ingaladdi, and then by Cundy's (1990) doctoral thesis on technological change at Ingaladdi. Flood, David and others have more recently investigated the antiquity of Wardaman rock art, and this has resulted in a number of excavations at impressive rock art sites throughout the region (Attenbrow *et al*. 1995; David 1991; David *et al*. 1992; David *et al*. 1990; David *et al*. 1994; McNiven 1992). A number of other theses concerned with industrial change and typological variability have also demonstrated the suitability of these sites and assemblages to addressing detailed questions about landuse and industrial variability (Gregory 1998; Sanders 1975). This research history, and the recovery of many thousands of stone artefacts from well-dated sites spanning the last 15,000 years, makes this area particularly attractive for investigating long-term cultural and technological changes in northern Australia.

Problems in North Australian Prehistory

Stone artefacts and rock art have taken centre stage in past constructions of northern Australian prehistory. Whereas rock art studies have tended to emphasize the dynamics of inter-regional connections, rapid and major change and social differentiation over time (Chippindale and Taçon 2000; David and Lourandos 1998; David *et al*. 1994; Morwood 2002; Mulvaney and Kamminga 1999), interpretations of stone artefacts are usually conservative and emphasize stasis over long periods (Holdaway 1995:787). Examples of the view that stone artefacts offer only limited information about the past are not difficult to find in the recent literature. For instance, Chippendale and Taçon (2000:90) comment: "the long-term archaeological record… is overwhelmingly a story of lithics, which is not easy to interpret in human terms. It is not unfair to say that in Arnhem Land, the archaeology tends to offer 'chronology without information'". Similarly, Morwood (2002:xi) writes "in the past, archaeologists have generally relied on 'hard' evidence, such as stone artefacts… in their reconstructions of the past. However, these do not tell us much – if anything – about many important developments in Aboriginal ideology, territoriality, resource use and social organization". Mulvaney and Kamminga (1999:39) also comment on the diminishing importance of stone in comparison to rock art: "there is now better understanding of other material remains, including the remarkable chronological, pictorial and cognitive record provided by rock art, so that stone artefacts play a less significant role in current interpretations of prehistoric chronology".

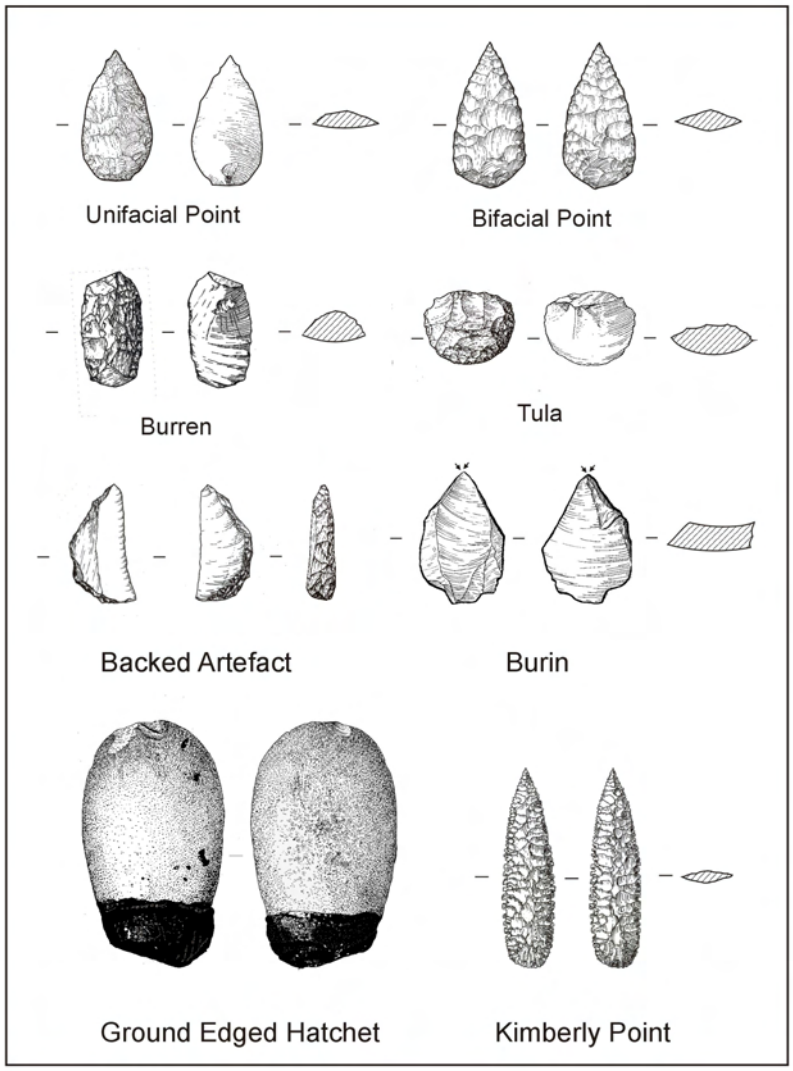
Figure 1.1. The location of the study region in relation to major physiographic features and the edge of the semi-arid zone.



While these assessments are undoubtedly overly negative, it must nevertheless be conceded that most archaeologists recognise only a single technological change taking place somewhere between 6,000 and 3,000 years ago in the northern Australian archaeological record (Bowdler and O'Conner 1991; Holdaway 1995). This single division hardly contributes to a sense of dynamism in Australian stone artefact studies. This change involved the superposition of a later industry, in which a suite of new and morphologically regular implements including tulas, bifacial points, unifacial points, burins and burrens appear for the first time (Figure 1.2), over an earlier industry in which core and flake production was dominant and relatively few typologically regular retouched flakes are to be found. Against this single sudden change, there is often seen to be an element of technological continuity involving the continued production of edge ground axes, 'scrapers' and 'core tools' from Pleistocene times (Jones and Johnson 1985; Morwood and Hobbs 1995a; Mulvaney 1969; Schrire 1982).

It now seems apparent that the timing of this major industrial change is not coeval across the continent, nor even throughout northern Australia, and temporal lags of up to several millennia clearly preceded the appearance of the new types in different regions (Attenbrow *et al*. 1995; Bowdler and O'Conner 1991; Clarkson and David 1995; Flood 1995; Hiscock 1993b; Smith and Cundy 1985). Despite a common understanding that these changes were sudden, there is also mounting evidence that aspects of this transition were gradual and took place over several thousand years. Yet archaeologists have rarely examined the nature of this transition in detail, and this has greatly diminished our ability to understand the mechanisms driving such changes.

Figure 1.2. Common implement types discussed in the text (backed artefact reproduced from Hiscock and Attenbrow (2005a) with permission).

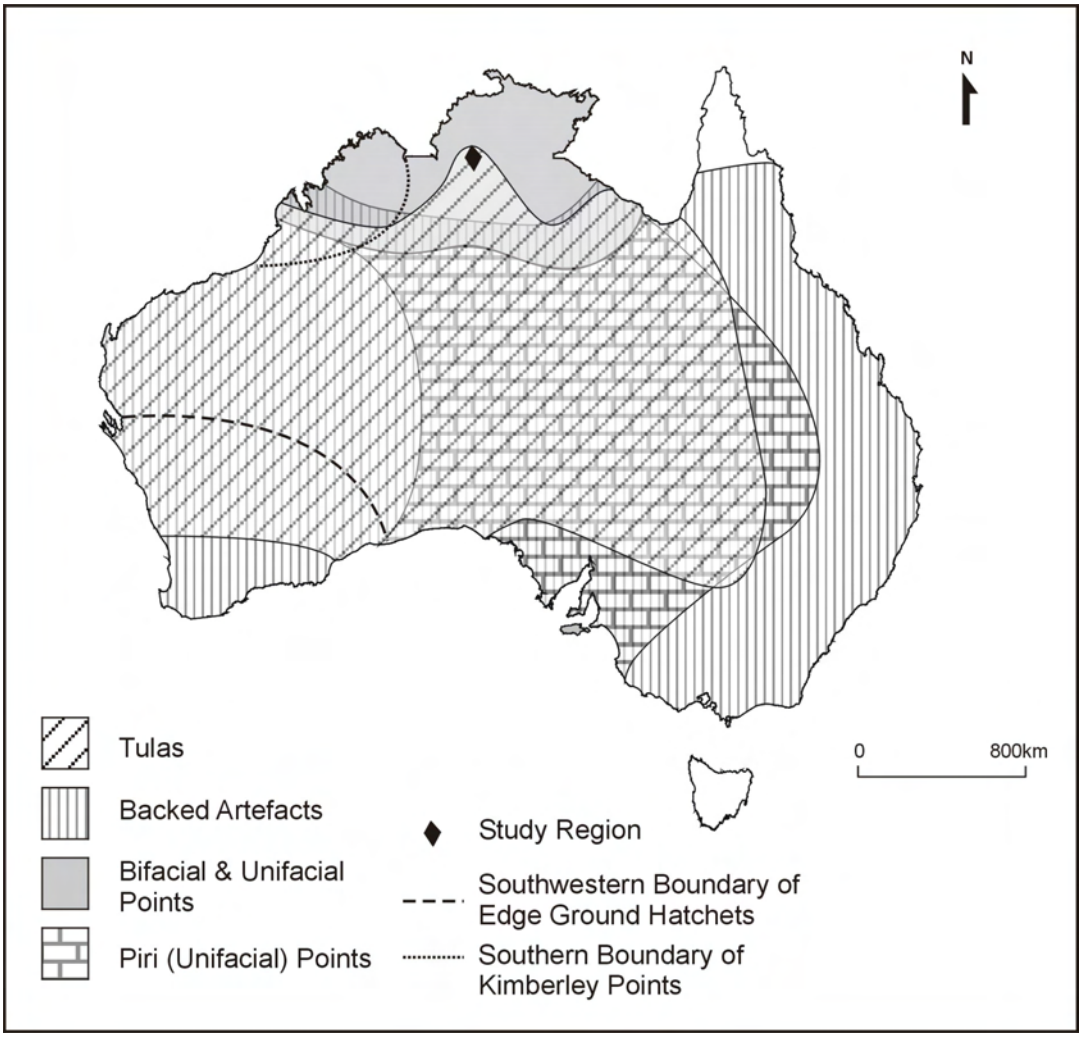


The problem of the classification of Australian retouched implement forms has been a focus of archaeological inquiry since archaeology began in this country, and this is no less the case in northern Australia. For instance, the relationship of unifacial and bifacial points to one another has occupied much attention in the literature with various archaeologists arguing for or against a continuum in these implement forms (Allen and Barton n.d.; Flood 1970; Hiscock 1994a; Jones and Johnson 1985; Roddam 1997; Schrire 1982). Their relationship to the pressure flaked Kimberley points of northwestern Australia and to the pressure and percussion flaked 'pirri' points of South Australia has also remained ambiguous (Akerman and Bindon 1995; Elkin 1948; Tindale 1985). The relationships of retouched flakes such as 'scrapers', 'burrens', 'burins' and other miscellaneous 'adze-like' flakes to similar forms found in other regions also remains unresolved. Indeed, it is difficult to see how these problems can be adequately resolved without first undertaking detailed studies of artefact production and the effects of raw material availability and resharpening on implement morphology in a number of key regions.

Another important problem in northern Australian lithic studies is the explanation of distinct geographic boundaries in the distribution of each implement type. For instance, an intriguing question for many Australian archaeologists is the apparent division between the distributions of bifacial points and backed artefacts. Bifacial points are found only in the central northern tip of the continent while backed artefacts are found only in the southern two thirds (Figure 1.3), with little geographic overlap

between the two types. Interestingly, Dortch (1977) and O'Connor (1999) have suggested that a distinctive form of 'backed point' found in the Pilbara region is evidence of an overlap between these northern and southern industries, but few other such potential overlaps are documented (Dortch 1977; Hiscock 1988; Hiscock and Hughes 1980; O'Connor 1999; Smith and Cundy 1985).

Figure 1.3. Distribution map of common retouched implement forms in Australia (modified from Hiscock 1994b).



Some archaeologists have seen such discontinuities in the geographic and temporal occurrence of stone technologies as indicating an incursion of new populations into Australia, equipped with new technologies and perhaps even responsible for the introduction of the dingo (Dortch 1977; Glover 1973; Mulvaney 1969). Others have treated geographic boundaries in stone artefact types as a convenient framework on which to pin models of socio-linguistic and/or internal demographic readjustment in the mid- to late Holocene. For example, McConvell (1990; 1996) sees this north-south technological discontinuity as likely linked to the spread of a set of very homogeneous and therefore quite recent Pama-Nyungan (PN) languages across most of southern Australia, leaving an isolated pocket of more diverse and therefore possibly much older non-Pama-Nyungan (NPN) languages in the northwestern third of the continent. It is often noted that the distribution of this NPN grouping corresponds very well with the distribution of bifacial points (Clendon 2006; Evans and Jones 1997; McConvell 1990, 1996). The PN language spread is attributed by McConvell to the migration of peoples outward from a homeland somewhere near the Gulf of Carpentaria where the greatest diversity in PN languages occurs (McConvell 1990, 1996). Likewise, Evans and Jones (1997) support a socio-linguistic model of technological diffusion, but believe such a spread could have taken place without migration through the diffusion of socio-cultural practices and ethnic affiliations. In their view, this would have

involved the spread of a package of new cultural practices that presented opportunities for new connubial alliances and included a suite of new technologies. Clearly, the issue of origins, language and technology of northern Aboriginal Australians remains at the heart of current archaeological debate, and there is much room for new models and reappraisals of the evidence at this time.

The problem with these techno-linguistic models stems from the common typo-genetic view that specific implement morphologies are linked to discrete groups of people, such that the appearance of new forms must necessarily imply the arrival or spread of new people or new ethnic identities. It is difficult to see, however, how the complex distributional configuration of technologies shown in Figure 1.3 in any way supports such models. For instance, the distribution of tulas does not conform to a single spread zone, nor does that of unifacial piri points or bifacial points. A model that advanced multiple, but not necessarily simultaneous diffusions of new technologies might go further toward explaining such a pattern, but no such model has been proposed in recent years.

Growing dissatisfaction with diffusionist/techno-linguistic explanations has given rise to a third theory concerning the origins and emergence of new lithic technologies in northern Australia. This model views the complex and overlapping distribution of retouched technologies as representing independent emergence and spread of curated implement forms in multiple locations that formed part of a broader technological response to increased economic risk in the mid-Holocene as climatic variability increased and effective precipitation decreased. The new technologies are argued to have provided a solution to the increasing problem of maintaining a supply of tools in the face of increased mobility and/or unpredictable access to raw materials (Clarkson 2002a; Clarkson and Wallis 2003; Hiscock 1994b, 2002, 2005). These new standardized retouched 'toolkits' are seen to have increased economic success in times of greater hardship in three ways: first, by extending the use-life of stone tools so that reprovisioning need not interfere with critical and time-stressed activities such as procuring food and water in highly variable environments; second, by serving as light-weight multifunctional tools that could be easily interchanged and replaced without requiring regular and time-consuming reworking of the haft; and third, by enhancing the performance characteristics of tools by standardizing those features that are most important for tool function (i.e. tulas are highly effective tools for adzing hard woods, points increase penetration power, backed artefacts likely increase killing power and effectiveness by adding multiple barbs to a spear, etc.). It should be stated, however, that the functional properties so often attributed to these Australian stone artefact types are highly conjectural, and few if any studies have conclusively demonstrated any link between particular forms and enhanced performance.

This last explanation for the appearance of new stone artefact types begins to incorporate explicit modelling of the ways in which technology might articulate with broader economic systems and constraints. This approach reflects the fact that archaeologists are increasingly looking to human behavioural ecology as a theoretical umbrella under which to unite propositions about the organizational and functional roles of technology with ideas about appropriate human responses to foraging in different contexts, as modelled from optimal foraging theory.

While behavioural ecology has sometimes been treated with suspicion in anthropology for its use of simple mathematical models formulated from observations of non-human organisms, as well as its reliance on optimization theory, it nevertheless serves a useful purpose in providing testable hypotheses that make the operation of complex systems such as human culture more accessible or tractable (Winterhalder 2002). It is therefore their simplicity and elegance that makes formal models attractive to archaeologists trying to understand the causes of behavioural and material patterning. Of course, optimality studies have been around for a long time, and have formed a major if implicit component of behavioural and processual explanation. Unlike those employed in human behavioural ecology, however, earlier optimality models lacked formal expression and sometimes left open the definition of actors, constraints and currencies. This monograph aims to further develop and test ecological models that relate technological strategies to changing economic circumstances in later northern Australian prehistory.

Defining the Aims of the Research

Australian prehistory has been largely built on the record of lithic industrial change, but has made interpretive use of stone artefacts in unsophisticated ways that fail to incorporate an understanding of the factors giving rise to assemblage variability. Consequently, northern Australian prehistory is filled with theoretical, methodological and empirical problems of the sort that may only be effectively bridged by detailed regional studies of stone technology from multiple sites spanning comparable time periods. At present, very few studies of this sort exist.

From this brief overview it is possible to identify several important shortcomings in northern Australian Prehistory. These are:

- a poor grasp of temporal changes in stone artefact production systems, leading to overly static impressions of long-term change;
- poor understanding of the manufacture and transformation of stone artefacts, and hence systemic problems encountered when interpreting typological variation;
- failure to explore the nature of transitions between apparently distinctive phenomena, forcing gradual changes into the background, while bringing sudden transformational change to the foreground; and
- the use of underdeveloped models specifying the interaction of key economic, environmental and technological variables and their likely effects on assemblage variation.

Redressing these problems will be a major long-term undertaking in Australian archaeology, but this monograph takes one small step in this direction by exploring four interconnected issues that may potentially be addressed through the study of assemblage variation in Wardaman Country.

The Nature of Technological Change in Wardaman Country over the last 15,000 years

If we are to look to the stone artefactual record for evidence of the ways in which the lives of people occupying Wardaman Country have changed over time, it is essential that an accurate description of technological change is developed. As argued above, this requires greater attention to the temporal and spatial distributions of major stone reduction technologies, and closer examination of the nature of the transition between earlier and later assemblages to see whether this is sudden or gradual. To meet this objective, a detailed analysis of the stone artefacts from four rockshelters located throughout Wardaman Country will be undertaken, focussing on describing the timing, nature and tempo of changes in lithic technology.

Typological Variation, Implement Manufacture and Morphological Continuums

North Australian prehistory is largely built on stone typologies, yet the relationships between the various implement forms is poorly understood, as is the sequence of manufacturing actions involved in their production or the changes in morphology they undergo throughout their use-life. Studying past manufacturing systems requires an understanding of the technological features preserved on artefacts that are indicative of specific knapping behaviour. It also requires that the sequence of knapping actions be time-ordered, such that each artefact can be ranked in order of reduction so that transformations in the technological and morphological features of artefacts can be tracked as reduction intensity varies. Ranking reduction in this way also can help determine discard thresholds by identifying combinations of characteristics that led to the discontinuation of use. Addressing this issue involves formulating *reduction sequence models* that track morphological changes in stone artefact morphology from initial production through to final discard, and in so doing, identifies the morphological continuums that underlie conventional type boundaries. Common northern Australian typologies are employed here as a preliminary basis from which to explore implement manufacture, although this is not meant to support the notion that types represent real and discrete kinds. In fact, many of the analyses presented will expose the non-reality of discrete types and lend support to recent

suggestions that new classifications are needed to better link individual artefacts to the technological processes that created them (Hiscock 2001a; Hiscock and Clarkson 2000).

Technological Change and Landuse

A primary goal of lithic analysis is to develop an understanding of the causal factors that brought about technological change. This issue involves developing an understanding of the relationships between various models of land use and the sorts of technological responses we might expect in certain circumstances. By approaching assemblage variability in terms of the ordering and location of stone procurement, tool design, raw material reduction, and discard in the landscape, and matching these observations to ideas about the various advantages offered by different design alternatives in different contexts, I seek to explore the ways in which people organized their use of the landscape in terms of frequency of use, levels of mobility, the size of foraging territories, the levels of uncertainty in resource acquisition, and the degree of forward planning exercised in exploiting various areas. Addressing this question involves developing a set of predictions derived from optimal foraging theory (particularly patch choice, settlement and mobility patterns and time allocation) that relate the changing availability of critical resources to optimal modes of land use through time. These predictions will then be tested against changing assemblage composition through time. The aim is to identify patterned behaviour in the way sites are provisioned with raw materials and different kinds of toolkits through time. This will include a study of the distances traveled, the form and quantity of materials imported, the degree to which they are reduced and conserved, and the diversity of manufacturing and other tasks performed through time. Changes in provisioning and landuse can be inferred from these results with implications for the way societies were structured at the time.

Wardaman Country in Broader Context

While gaining an understanding of changing patterns of stone artefact manufacture is interesting and rewarding in itself, the ultimate value of regional studies of this kind lies in their contribution to answering the 'big questions' in Australian archaeology. A further objective of this study therefore is to consider how changes in one region may help interpret similar changes in other nearby regions, and what these may mean for socio-demographic change in northern Australia more generally. This last issue therefore involves consideration of multiple lines of evidence, including archaeological, linguistic, environmental, skeletal and genetic data at regional and continental scales to build an interpretive model of later prehistoric changes in Aboriginal society.

There are a number of reasons for drawing together so many lines of evidence. The first is a matter of strengthening the argument. By drawing together multiple supporting interpretive strands, it is possible to build a stronger and more interconnected argument (Wylie 1989). Secondly, taking a broad view of long-term socio-demographic processes at regional and continental scales makes it possible to examine key elements of the social and environmental context in which long-term technological changes took place in any specific region. In this way, the study of stone artefact assemblages has the potential to contribute a vital and unique perspective on the past, because it provides a tangible record of human behaviour intimately linked to the means by which people extracted a living from their environment.

Chapter Outline

Naturally, the themes discussed in this book develop as a series of chapters, and it is usually helpful to signpost at the outset where the various kinds of information to be presented can be found.

Chapter 2 examines a number of optimal foraging models and develops predictions about the kinds of technological strategies that should be appropriate in particular foraging contexts. This chapter also examines the role of risk in hunter-gatherer economies and technologies as a constraint on human action and a potential catalyst for technological innovation. Chapter 3 details the various techniques employed to reconstruct stone artefact production patterns and to describe change and variation in stone artefact manufacture. A review of the physiography of the area is presented in Chapter 4, along with predictions about the effects that climate change should have on technological provisioning

strategies over time. Chapter 5 provides summaries of the excavation procedures, stratigraphy, dating and cultural materials recovered from each of the four rockshelters. Chapter 6 constructs reduction sequences for cores, flakes and the various retouched implement forms found in Wardaman Country. Documenting reduction sequences allows reconsideration of typological diversity and evaluation of the use-lives of various implement forms helpful in identifying the changing performance characteristics of toolkits over time. Chapter 7 presents data on the sequence of technological changes in the region over the last 15,000 years, and determines whether technological changes are consistent with those predicted in Chapter 4. Chapter 8 draws together each of the analyses presented to build a picture of major changes in Aboriginal society since the end of the LGM. The chapter concludes with a discussion of the implications of broad economic and technological changes for our understanding of social processes, ontology and inter-regional connections.