Overview of Archaeological Resource on Forests: A Discussion Paper

A report undertaken for the NSW CRA/RFA Steering Committee

[May 1998]

OVERVIEW OF ARCHAEOLOGICAL RESOURCE ON FORESTS: A DISCUSSION PAPER

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A report undertaken for the NSW CRA/RFA Steering Committee project number NA16/EH

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Report Status

This report has been prepared as a working paper for the NSW CRA/RFA Steering Committee under the direction of the Environment and Heritage Technical Committee. It is recognised that it may contain errors that require correction but it is released to be consistent with the principle that information related to the comprehensive regional assessment process in New South Wales will be made publicly available.

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This project has been jointly funded by the New South Wales and Commonwealth Governments. The work undertaken within this project has been managed by the joint NSW / Commonwealth CRA/RFA Steering Committee which includes representatives from the NSW and Commonwealth Governments and stakeholder groups.

The project has been overseen and the methodology has been developed through the Environment and Heritage Technical Committee which includes representatives from the NSW and Commonwealth Governments and stakeholder groups.

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1. EXECUTIVE SUMMARY

This report has been prepared for the joint Commonwealth/State Steering Committee which oversees the comprehensive regional assessments of forests in New South Wales.

The comprehensive regional assessments (CRAs) provide the scientific basis on which the State and Commonwealth governments will sign regional forest agreements (RFAs) for the major forests of New South Wales. These agreements will determine the future of the State's forests, providing a balance between conservation and ecologically sustainable use of forest resources.

This report was undertaken to present an overview of the archaeological resource on New South Wales' forests and its management requirements as a context for technical discussions regarding management options for archaeological values in the CRA/RFAs.

To set the scene, a brief overview of cultural heritage policy in relation to archaeological research is presented. This is followed by an overview of archaeological research in New South Wales' forests.

The forest archaeological resource is described in terms of the relative occurrence of different archaeological sites in addition to a more technical discussion about the problems of defining and interpreting the more intractable surface archaeological record (stone artefacts).

This report discusses the ongoing natural landscape and taphonomic process affecting the resource, in addition to prehistoric, historic and contemporary cultural impacts, to provide a context for assessing the relative significance of future impacts on the resource.

As a prelude to considering current management requirements, there is a discussion of archaeological significance. In particular, the spatial aspect of the resource is emphasised as a conceptual key for both understanding the resource and its management.

Following this, approaches used to 'model' the forest archaeological resource for management purposes, in addition to other current forest management practices in relation to archaeological sites, are discussed. Finally, some recommendations are provided for a strategic program of management and research in light of the issues raised in this discussion paper.

1. INTRODUCTION

In the context of Aboriginal heritage it is important to distinguish cultural values, particularly those held by Aboriginal people, from scientific values established by archaeologists. While there may be some degree of overlap and interdependence between the two value systems, they nevertheless form discrete systems of belief, each requiring quite different models of identification and management.

The issues discussed in this paper relate primarily to the archaeological or scientific values of Aboriginal archaeological sites mainly of the pre-contact era.While recognising that the orientation of this report is a consequence of the current legislation in NSW it should be noted that Aboriginal laws and customs continue to exist in relation to the appropriate custodianship, use, control and management of Aboriginal cultural heritage. Aboriginal people continue to be bound by these laws and customs regardless of whether they are formally recognised by non-Indigenous laws and policies. Therefore, the setting of government research and management agendas related to Aboriginal heritage must involve advice being sought from and negotiation with the relevant Aboriginal people or communities who consider themselves the primary custodians and interpretors of their cultures. Accordingly, the report should be seen only as one possible component of the broader discussion and negotiations that must surround the setting of research and management priorities.

Non-Indigenous archaeological sites are not covered in this report and are subject to different legislation, management regimes and prescriptions.

This discussion paper raises a number of issues that need to be considered in future decisions regarding the management and research requirements for the forest archaeological resource in the context of Comprehensive Regional Assessments / Regional Forest Agreements (CRA/RFAs).

The paper has two main objectives: to give a clear indication of the nature of the forest archaeological resource and to stimulate discussion between natural resource and cultural heritage managers on archaeological identification and management issues for the CRA/RFAs.

In describing the forest archaeological resource the focus is on providing an appreciation of what further benefits archaeological research can realistically deliver in the context of the CRA/RFAs. Also, the limitations of particular methods of identification and approaches to management are discussed.

The report highlights the need for agreed and clearly defined conservation objectives.

1.1 THE FOREST ESTATE

This study refers to forests within the five New South Wales CRA Regions: Upper North East, Lower North East, Sydney Basin, Southern and Eden. Together, these areas encompass the bulk of the forests of the Great Dividing Range and coastal hinterland of eastern New South Wales.

The current forest estate is a subset of the pre - 1788 forests of New South Wales. At a very general level, the forest estate is differentiated from the broader pre -1788 forest coverage on the basis of forested areas characterised by both lower soil fertility and more rugged terrain.

Most of the forests are encompassed in national parks or State forests, although there are some that are leasehold and a smaller proportion that are private. This report largely discusses the results of surveys undertaken on State forests for Environmental Impact Assessment (EIA) work and to a lesser extent national parks where there has not been the same development generated impetus to survey. Over the period in which most systematic surveys have been undertaken (the last 20 years), land tenure has shifted substantially

from Crown-timber lands to national parks, a process that is continuing. Given this, and the considerable overlap of broad forest types and contiguity between different land tenures, we are fairly safe in taking survey results to date as broadly indicative of forest in general rather than specific tenures.

2. CULTURAL HERITAGE CONSERVATION POLICY - 1970s -1990s

This overview is not intended to be comprehensive but to indicate the path of forest heritage conservation policy in relation to archaeological sites over the last twenty years in New South Wales.

By the mid 1970s, the then Forestry Commission of NSW (FCNSW) and the National Parks and Wildlife Service (NPWS) had started compiling inventories of Aboriginal sites as a result of the inception of the *National Parks & Wildlife Act 1974.* It was generally thought by the Commission that there were relatively few sites in forests. The Commission did not then perceive that it had a broader role beyond reporting sites chanced upon in the course of its operations and avoiding impacts on those it knew about. Broader management consideration and the need to survey for unknown sites was generally considered the purview of NPWS.

A raised awareness of other issues relating to the Aboriginal heritage and the archaeological resource on forests arose as a result of the New South Wales Government investigation into wood chipping of the south coast forests. The Ashton report recommended that survey be undertaken to identify Aboriginal ‘relics’ and areas sacred to local Aboriginal people. Archaeological (Hughes and Sullivan 1978) and anthropological (Egloff 1979) studies were undertaken that identified a range of archaeological and Aboriginal sites and confirmed a strong Aboriginal attachment to the south coast forest area generally. The results of Egloff's study, in addition to the passage of the *Environmental Planning and Assessment Act 1979,* further alerted the Commission to the need for cultural heritage assessments and increased its responsibilities in this regard.

In addition to these early forest studies, NPWS instigated a statewide project to record sites of Aboriginal significance. The project known as the ‘Sacred Sites Survey’ was undertaken by Ray Kelly and Howard Creamer and documented many hundreds of sites including a significant number in the north coast forests (Creamer 1980).

In response to the growing appreciation of the extent of the Aboriginal cultural heritage resource on land that it managed, FCNSW commissioned an overview of the cultural heritage resource on Crown-timber lands of New South Wales including an assessment of associated management issues. The work was undertaken by Sandra Bowdler (1983), who recommended that a program of surveys be undertaken to locate sites and that a management regime be instigated for each site based on its significance (Bowdler 1983). She also recommended that Commission staff be trained in aspects of the management and identification of cultural resources, and that an archaeologist and Aboriginal liaison officers be appointed by the Commission to assist in further refining and implementing these recommendations.

There was not a clear overall response to Bowdler's report in the short term, although some of Bowdler's priority areas for survey and recommendations regarding specific sites management procedures were adopted during the 1980s. Of particular note in this regard is the study of rainforests, Bowdler's highest priority for survey (Byrne 1987). Bowdler's (1983)

recommendations for training and for the employment of an archaeologist and Aboriginal Site Officers (in a kind of parallel structure to NPWS) were not implemented until eight to ten years after the publication of her report, in the context of increased EIA responsibilities arising from court cases following forestry environmental disputes.

Denis Byrne was the Commissions next principal consultant after Bowdler and worked on a number of projects including assessments of the heritage values of NSW rainforests (Byrne 1987).

Byrne was to raise a number of key management issues (Byrne & Smith 1988). Central to his concerns was the need to conserve a 'representative' sample of sites ideally from undisturbed environmental contexts. He also advocated the need to conserve a sample of the unknown resource, that is sites that were predicted to occur but were as yet documented or unverified. He also recommended that conservation strategies for the protection of cultural values be enmeshed in forest operation planning. These ideas were germane to his later discussion of forest management principles (Byrne 1991) where he advocated the need for a more strategic management approach centred on assessing the potential of the existing reserve system for protecting relatively intact archaeological landscapes.

In 1990, the Commission commenced an extensive EIS program covering many of its Management Areas, particularly on the north coast. In 1991, an archaeologist was employed by State Forests of New South Wales (SFNSW) Northern Region to produce and coordinate the cultural heritage components of some 13 Environmental Impact Statements (EIS) for the North Coast forests.

Expectations varied within the Commission, however, there was a general assumption that the site inventories produced for the EIS program would be definitive and would provide for all the future cultural heritage management requirements. According to Gollan, this was an understandable expectation because there had not yet been sufficient investigation in the northern forests to indicate the extent of the resource nor did conservation models from NPWS at the time significantly enlighten that view (Gollan 1992).

During the course of the EIS program, it became increasingly obvious that the extent of the resource was such that it defied definitive treatment in an EIS. The focus of consultants recommendations related more to the need for various measures relating to ongoing identification of the resource than management of the sites identified. Various approaches were recommended by different consultants and developed by SFNSW' archaeologist. These are discussed later in this report.

Once SFNSW, through the EIS program, was fully engaged in identifying sites and then having to actively manage them, they were in effect committed indefinitely to providing resources to sustain this effort. The archaeologist's position on the north coast has become permanent and four Aboriginal Cultural Heritage Officers have been employed in the north east of the State.

The policy situation is less clear in the southern part of the State, but nevertheless, a considerable commitment to Aboriginal cultural heritage management has been maintained through the EIS program and requirements to manage known sites.

In 1992, Gollan undertook an analysis of Aboriginal cultural heritage policy development in relation to forests, with regard to the practices of NPWS, SFNSW, and heritage experts/bodies, including the Australian Heritage Commission (AHC). He looked at the methods employed to identify and characterise the cultural resource on forests. Gollan argued for critical reappraisal of the existing policy which had at its centre the 'site' as the principal focus for management and greater consideration given to area based management to preserve the environmental and spatial context of the archaeological resource (Gollan 1992:17). In support of this view he cited Byrne's then recent paper which argued similarly for a more considered conservation strategy based on reserve selection to ensure that representative areas of archaeological variability are maintained which will enable future researchers to examine both systemic and symbolic aspects of human action (Byrne 1991:386).

The basic weakness of the assumption [that is, site based management], as conservation policy, is that it does not allow for the consideration of the systemic values of cultural information, that is, archaeology in environmental context, and that the archaeological information system is dynamic with changing impacts and threats (Gollan 1992:17).

Generally speaking he was critical of what he perceived to be SFNSW' failure to proactively manage for cultural resource values and at the

same time, NPWS's failure to provide more viable conservation models rather than concentrating on site inventorying as part of EISs. He argued that NPWS's position was too focused on its regulatory function rather than the provision of programmatic direction that would provide conservation alternatives to agencies such as SFNSW (Gollan 1992:13).

Perhaps NPWS's legislation provides little impetus to produce conservation strategies beyond the level of site protection and identification given that all sites are lawfully protected regardless of their significance. While operational guidelines exist in relation to licensing activities and issues of Aboriginal involvement they are rarely articulated within the context of an overarching conservation strategy (Zone Team Accountabilities and Operating Guidelines 1995). However pragmatic decisions are and will continue to be made on the basis of 'significance' and the process for this would be greatly enhanced if the context for decision making was broader than the confines of a specific EIA project.

While NPWS's conservation agenda may not have been operationalised beyond the immediate problems of identifying and managing sites, there is evidence that for some time it has included consideration of the need to *preserve and protect a representative sample of all sites types within a particular environmental region, in addition to any sites of particular Aboriginal and scientific significance* (Ross 1986:61).

The need to provide conservation leadership is recognised by NPWS's efforts in the early 1990s to produce 'Cultural Area Plans' or standing research designs for specific NPWS regions. Unfortunately, the initial enthusiasm for these plans has waned and they still await completion.

Again, NPWS willingness to develop innovative approaches to management is evidenced in their overview of the archaeological resource of the Natural Resources Audit Council (NRAC) northeast forest area (James & Conyers 1995). The study provided a detailed summary description of Aboriginal archaeological site types in public land in the study area, identified gaps in the current information base, and provided recommendations for future management. The report concluded with a broad range of management recommendations, including the need to formulate and test deductive predictive models based on 'human decision making' and to adopt 'representative' landscape based units in favour of 'sites' for management purposes. However, while the document articulates a conservation strategy, it gives no indication how deductive predictive models may be formulated or tested or their relationship to representative areas for the purposes of conservation.

3. MAJOR STUDIES IN FOREST ARCHAEOLOGY

3.1 OVERVIEW OF MAJOR STUDIES

To give the reader an appreciation of the amount of forest survey that has been undertaken, a brief outline of some of the larger regional scale forest surveys and/or regional synthesis is discussed. However, not included are the numerous site specific and the earlier smaller scale surveys or anthropological studies undertaken.

3.1.1 State-wide

Statewide studies of forest archaeological values include Byrne's (1987) rainforest study and Bowdler's (1983) overview of archaeological sites in Crown-timber lands.

3.1.2 Upper North East, Lower North East and Sydney Basin CRA Regions

The Upper North East and Lower North East CRA Regions have had the most systematic survey coverage of any of the NSW CRA areas. Unlike other CRA regions, much of the forest data was recorded under a single program and recorded to a standard format. This program recorded over 500 sites in the far north coast area alone.

In Upper North East and Lower North East CRA Regions there has been two regional studies encompassing forest areas. These are McBryde's (1974) pioneering regional prehistory of the New England Region and Godwin's (1990) PhD thesis of the New England Tablelands and escarpment forests. In addition to these academic studies, there has been archaeological surveys undertaken of each of SFNSW' north coast management areas. These include studies of the Dorrigo (Comber 1991), Glen Innes (Hall 1992a; Lomax & Fife in prep.), Grafton (Hall & Lomax 1993a), Tenterfield (Byrne 1995), Urbenville (Smith 1993), Dorrigo Three Year EIS (Kuskie 1994), Coffs Harbour/Urunga (Davies & Stewart-Zerba 1995), and Walcha/Nundle and Styx River (Davies et al 1995; Lomax 1995) Management Areas. Surveys have also been taken of SFNSW' Casino District (Hall & Lomax 1993b), Duck Creek forestry EIS Area (Collins 1991) and compartments within the Chaelundi forests (Collins 1991).

In addition to these regional forest surveys, there has been a program of open site excavation in the Dorrigo Three Year EIS Area (Sullivan *et al* 1996) and a desk top data audit of archaeological sites on public lands of the NRAC north-east study area (James & Conyers 1995). Currently Hall and Lomax (1996a) are synthesising some of the results of the north coast work (this is discussed in detail below).

Areas within the Lower North East and Sydney Basin CRA Regions have been intensively investigated by both ground survey and excavation, particularly parts of the Hunter Valley and the Sydney region sandstone plateaux. A wealth of comprehensive archaeological data including several thousand 'sandstone sites' are recorded within or in close proximity to State forests or other forested lands (see Kinhill 1995 for comprehensive review of this work).

Recent archaeological surveys undertaken on State forests in the Lower North East CRA Region include regional surveys of Wingham (Collins & Morwood 1991), Kempsey/Wauchope (Packard 1992), Gloucester/Chichester (Byrne 1992), and Morisset (Kinhill 1995) Management Areas.

Detailed systematic surveys have also been undertaken of McPherson State Forest (McDonald 1988) and Yarrahapinni and Way Way State Forests (Morwood & Collins 1991) in addition to a regional survey of the forests of the Newnes Plateau area (Gollan 1987).

Recently open site excavation in forest uplands was undertaken in SFNSW' Kempsey Management Area (Lomax 1994).

3.1.3 Southern and Eden CRA Regions

Some of the earliest systematic forest surveys were undertaken in the forests of the Southern and Eden CRA Regions with reasonable survey coverage for a range of environmental contexts, particularly in SFNSW' Eden Management Area.

Regional scale academic research undertaken in forested areas of this region include Flood's (1980) southern highlands prehistory, and recently, research on coastal forest rockshelter and open sites (Boot 1993). A large number of Australian National University (ANU) student surveys have also been undertaken on low altitude forests of the mid south coast recording literally thousands of sites within a relatively small area of a few hundred square kilometres. The results of these studies were recently compiled by ANU graduate student Tom Knight (1996).

Regional surveys undertaken on State forests and national parks in Southern and Eden CRA Regions include surveys of Wandella-Dampier (Byrne 1983a), Five Forests (Sullivan & Hughes 1978; Byrne 1993b), Duea and Wadbilliga National Park (Byrne 1983c & d), Eden Woodchip Agreement Area (Byrne & Smith 1987; Byrne 1990) and SFNSW' Queanbeyan and Badja Management Areas (Grinberg Knight & Associates 1995).

Extensive field surveys of forests were also undertaken in the early 1990s for NPWS and SFNSW' South East Forests Projects (Packard 1991; Packard in prep). Extensive and systematic survey coverage was achieved, unfortunately there has been no report produced on the results of this work, although the results have been summarised in the Eden EIS (SFNSW 1994). A total of 173 artefact scatters were located at a density of 1.3 sites per km of survey transect. Artefact scatters were located in all environmental contexts surveyed and correlations noted between site location and terrain characteristics (Packard, P., NSW NPWS, pers. comm., 1997)

NPWS is currently undertaking a regional scale program of research and field survey of land systems in the Eden CRA Region. This work will include the data compiled from the South East Forests Project (Heffernen, K., NSW NPWS, pers. comm., 1997).

In addition to forest surveys, a desk top overview of Aboriginal sites for NPWS south-east regions was undertaken by Byrne & Smith (1988).

Regional scale survey of Victorian forested uplands bordering the Eden CRA Region include the Lower Snowy River (Geering 1981), Snowy River Management Unit (Hall 1990) and Far East Gippsland (Hall 1991) areas.

3.2 METHOD

Most of the archaeological surveys of forested environments in New South Wales have been undertaken in the last 20 years. Over this period there are a number of discernible trends both in the method employed in undertaking field surveys, general aims of studies, data interpretation and in the style of management recommendations provided.

A significant proportion of forest survey in New South Wales has been undertaken as a result of EIA on crown timber lands. Much of the work has been regional in scale and has focused on developing predictive models from sample survey data and characterising the relative archaeological sensitivities of different environmental components in terms of artefact and/or site densities.

Noted trends include an increased attention in recording variation in archaeological visibility constraints and relatively fine grained environmental and taphonomic data pertinent to examine correlations between site locations and formally defined landscape characteristics. In addition, early attempts to utilise formal statistically based sampling frameworks have been abandoned in favour of more 'opportunistic' non-probablistic approaches.

One of the earliest systematic forest survey was undertaken in the early 1980s in the southern forests of New South Wales by Denis Byrne and Brian Egloff. Of central concern to this early work was establishing formal sampling frameworks and the need to devise means to overcome problems of access and varying site visibility conditions. One method devised to overcome these problems in forested upland areas was to locate survey transects along ridgeline toposequences (Byrne 1984).

Formal landscape definitions were not utilised for the early survey work and site location was described in terms of composite topographic

elements such as ridgelines. While this level of recording was perfectly adequate for characterising general site location, later researchers have favoured the use of more formal definitions to permit a greater level of comparative analysis and more detailed predictions of site locations.

The results of the early forest work added considerably to the then little known archaeology of the New South Wales' coastal hinterland, indicating a strong correlation between landscape characteristics and site location. The relationship between terrain characteristics and constraints on human movement in upland coastal forests was noted and characterised in terms of a 'ridgeline model' of movement (Byrne 1984:70).

Subsequent regional scale field investigation undertaken in East Gippsland, Victoria by Hall (1991; 1992b) gave greater attention to a more fine scale plotting of the occurrence of archaeological materials in terms of a range of environmental and taphonomic parameters. This was undertaken to more carefully characterise factors critical in determining site location. Unlike previous approaches, the site concept was abandoned and replaced with the artefact as the minimal analytical unit. This was undertaken principally to enable the comparison of archaeological materials between sampling strata at a range of spatial scales.

The survey strategy employed by Hall (1991, 1992b) entailed quantifying areas of ground surface exposure within each sampling strata and recording the presence/absence of archaeological material in terms of a range of environmental and taphonomic considerations. This 'controlled non-random' sampling approach was later further formalised by Packard (1991) for the New South Wales' south east forests and used in a suite of subsequent forestry EIA studies (Byrne 1992; Byrne 1995; Davies *et al* 1995; Davies & Stewart - Zerba 1995; Grinberg Knight & Associates 1995; Hall & Lomax 1993 a & b; Kinhill 1995; Kuskie 1994; Packard 1992; Smith 1993).

There have been various arguments for and against probabilistic and non-probabilisitic sampling designs such as that outlined above (Bird 1993). On a regional scale the former is costly and unproductive in terms of producing sufficient locational data for modelling purposes. Also, in practice the actual field survey is restricted to areas of high visibility within a given sampling unit, a bias which is not generally adequately accounted for in the interpretative framework.

Non-probabilistic sampling designs focus on 'windows' of archaeological visibility and have been characterised as non-representative and at worst circular (Bird 1993). However, the approach is particularly useful in forest EIA surveys as it facilitates high site capture rates by focusing on areas of visibility and at the same time permits quantitative assessments of sample biases inherent in such a data collection strategy.

In 1991, as part of their EIS program, SFNSW commenced a program of systematic archaeological survey and research (most of these studies are referred to above). This program was undertaken over a five year period and involved regional scale survey, intensive localised surveys and limited open site excavation.

The regional scale archaeological surveys were undertaken according to a standardised recording system based on that initially developed by Hall (1991). As a result, a considerable amount of comparable and detailed site locational data was recorded.

Management recommendations for the archaeological resource have also evolved as our knowledge of the resource has increased. In particular, the increasing recognition of the almost continuous distribution of archaeological surface materials throughout the forest environment challenges the logic of the automatic legal protection afforded to the often highly disturbed examples of these sites identified during forest surveys. For this reason recommendations increasingly advocate strategies to protect the 'unknown resource', that is, sites predicted to occur but as yet unverified.

Recommendations for how this is achieved are generally couched in terms of the need to maintain a 'representative sample' but varies according to whether the analytical potential of the resource is seen principally in terms of its spatial or 'systemic' nature, or alternatively, whether significance is associated with individual sites. Advocates of the former view tend to see management in terms of defining representative 'landscape areas' on the basis of environmental parameters, while advocates of the latter prefer a more circuitous path and emphasise the need to direct efforts to further refine predictive models to identify archaeologically sensitive areas.

3.3 DATA COVERAGE

The forested areas under investigation cover hundreds of thousands of hectares. In terms of area surveyed, coverage is minuscule. However, the work to date can be considered a reasonable starting point for formulating an understanding of the resource as a basis for its management. Firstly, our existing knowledge of the resource indicates that there are broad regularities in the record (this is discussed further below). Much of the work that has recently been undertaken is now producing redundant data in this respect (ie similar patterning noted in respect to correlations between site location/ artefact density and landscape characteristics etc.). Also, through forestry EIA work, much of the data has been compiled in a way that is relevant to providing regional overviews - (use of comparative data collection technique and regional research designs). Further regional survey work, if undertaken within the context of the CRA, is unlikely to add significantly to the existing corpus of survey data and would need justification beyond that of a 'gap' filling exercise.

An additional factor is that, aside from the systematic surveys of the last 20 years, there has been a good deal of informal 'surveys' of forested areas through the work of NPWS, private or university researchers and forestry workers over the years (reflected in the NPWS and SFNSW databases). These researchers would have tapped into local knowledge regarding the presence of the more 'spectacular' sites, so we can assume coverage for these rare site types, although unmeasurable, is much greater than the coverage provided by systematic surveys to date.

3.4 SITE TYPES AND DISTRIBUTION

This section will give a very general description of the forest archaeological resource in terms of site type and occurrence.

A wide range of archaeological site types have been recorded in forested areas. These include rockshelter occupation and art sites, quarries, axe grinding grooves, scarred and carved trees, stone arrangements, bora rings, rock engravings, burials and artefact scatters. Sites types other than stone artefact scatters are generally rare in forests, most extremely rare. The main exceptions to this are rockshelter occupation/art sites and grooves/engravings associated with sandstone formations in the Sydney Basin, Lower North East and Upper North East CRA Regions.

Site types such as burial grounds, scarred trees and bora grounds are generally located in those areas which were the primary focus of Aboriginal exploitation, that is productive riverine areas and coastal and estuarine resource areas, rather than the more marginal areas occupied by present day commercial forests. Bora and burial grounds in particular are often associated with riverine landforms. In addition, these sites are highly vulnerable to processes of natural and humanly induced attrition and the surviving sample of such sites will be relatively small.

The impacts of fire, vegetation removal, grazing and timber harvesting would account for the rarity of vulnerable site types such as stone arrangements and carved trees. Recently, a number of stone arrangements have been recorded in the forests of SFNSW' Glen Innes Management Area (Lomax & Fife in prep.). However, these sites are located in precipitous and rocky terrain on the edge of the New England Tablelands escarpment and are likely to have undergone only minimal disturbance - and are unlikely to be exposed to any future disturbance. While forests were undoubtably used for ceremonial activities, particularly mountains and prominent topographic features, archaeological evidence of these activities is rare.

The occurrence of rockshelter occupation, art sites and axe grinding grooves is in a large part determined by the presence of suitable rock outcrops or shelters for occupation. These site types most commonly occur where suitable sandstone formation is present and in association with basalt tors (Byrne 1995; Lomax & Fife in prep.).

Recorded stone quarry sites in forests are rare. While surveys have been undertaken in areas where suitable rock outcrops are common, few quarry sites have been located (Hall & Lomax 1993; Kuskie 1994). The use of specific rock outcrops as quarries appears to be extremely selective and it is anticipated that rarity of such site types is a real reflection of their occurrence. Other factors which may account for the rarity of stone quarry sites is the use of pebble shingle beds as sources of stone raw materials. The examination of stone artefact assemblages from open site excavations in forests suggest that pebble shingle beds are likely to have been a significant source of stone raw materials even in locations where

suitable stone sources are known to occur (Sullivan et al 1996; Lomax 1994).

In contrast, archaeological evidence in the form of stone artefact scatters is present in all forest types and in many, if not most areas, occurs more or less continuously across the landscape at an average density of one to two artefact occurrences per kilometre of survey transect (Hall & Lomax 1996:35). There have been thousands of such sites now recorded in forests, mostly through the forestry EIA work described above. The presence of these stone artefact occurrences throughout forested areas is not surprising given that they potentially represent the accumulated debris of many thousands of years of occupation.

3.5 METHODOLOGICAL ISSUES FOR IDENTIFICATION AND MANAGEMENT

There is now a large amount of forest archaeological work that has been undertaken in New South Wales. While the views of agencies and practitioners on identification and management have so far been divergent, it seems we are now in a position to define some essential characteristics of the archaeological record that should provide a common baseline for future work. These relate to recognising the extent and formation history of the record, and realistically addressing these factors in terms of research programs, significance assessment and approaches to management.

4. THE NATURE OF THE FOREST ARCHAEOLOGICAL RECORD

4.1 OVERVIEW OF THE 'FORMATION' OF THE RECORD

It has been established that the archaeological resource on forests is present in all forest types and in many areas occurs more or less continuously across the landscape. Generally speaking, what are termed sites merely reflect 'windows' of archaeological visibility. These 'sites' are generally characterised by small shallow deposits of stone artefacts.

At the same time, forest research has demonstrated the connections between landscape configuration and landscape scale and the formation of such archaeological deposits. In forested uplands in particular, site location can be predicted principally on the basis of terrain characteristics. This is a direct reflection of the topographic constraints imposed on human movement, where movement is constrained to specific pathways such as ridges.

Due to the lessening of constraints on movement, conversely the less dissected a region is, there is a corresponding weakening of the tendency for archaeological materials to cluster on linear landforms away from water sources, such as ridgelines. In these landscapes the focus may move more to areas adjacent to waterways and swamps, or other resource considerations. For example, in the north coast forests on the coastal plains and tablelands, where planar landforms dominate, there is little landform focus for site formation and it is correspondingly more difficult to intersect sites by surveys.

Any interpretations of regional patterning in areas of the Great Dividing Range needs to be understood firstly in terms of the opportunities and constraints imposed by the physical configuration of the regional landscape. This requires considering the 'connectivity' of the landscape - that is how patterns of movement in one area are influenced by the channelling of movement by landscape constraints imposed in all other areas (*cf.* Byrne 1991).

While landscape configuration and terrain effectively constrains the range of options for the spatial deposition of materials in a landscape, land form stability determines the possibility for, and temporal scale of deposition. Generally speaking, landforms in forested environments of the Great Dividing Range are fairly stable with the notable exception of areas associated with drainage lines and colluvial wasting associated with some steeply dissected areas.

Stable landscapes typically result in the long term accumulation of cultural remains. In landscape areas where there is both the long term accumulation of materials and constraints on spatial deposition, the expectation is that archaeological variability will be characteristically coarse grained (*cf.* Binford 1980).

Recently, data from detailed site surveys (Kuskie 1994) and open site excavations in the north east of New South Wales (Sullivan *et al* 1996; Lomax 1994) in eastern Chaelundi State Forest and Nulla

Five Day Forest were examined specifically to determine how landscape variation and surface processes affect the spatial and temporal scale of archaeological variability (Hall & Lomax 1996a). Most of the local area and site specific data examined related to eastern Chaelundi State Forest (Sullivan *et al* 1996). This study area was a good starting point for obtaining a baseline understanding of these issues, as it is designated old growth and therefore had been subject to minimal disturbance from logging.

Looking at the Chaelundi data, and a range of other regional survey and excavation data, Hall and Lomax (1996a) argued (on the basis of comparison between five excavated site assemblages) that there was limited subregional variation between assemblages, in terms of the proportion representation of either raw material or artefact categories other than that related directly to variation in local geology. In addition, they argued that variation noted between sites, in terms of spatial structure and artefact density, was not related to functional considerations, but proximity to stone raw material source and variation in local and micro-topography (Hall & Lomax 1996a).

Geomorphic examination of sediments at a number of the Chaelundi ridge crest sites confirmed a high degree of stability to the depositional matrix of sites, indicating that these landform surfaces, and presumably others like them, throughout the east coast of New South Wales have retained complete records of stone artefact discard (Sullivan et al 1996).

These results generally reinforce the view (in respect to archaeological variability) that there is, overall, a fairly low level of spatial and temporal resolution to the archaeological record in forests. More specifically, occurrences are generally not amenable to interpretation as discrete behavioural entities. Rather they reflect patterns of movement about the landscape and to a large extent their formation is determined by broad scale regularities and patterning of the physical environment (*cf.* Stafford & Hajic 1990:142).

4.2 NATURAL FORMATION PROCESSES

Archaeologists often refer to sites as being undisturbed or '*in situ*'. Generally, by this they mean that sites have not been disturbed by cultural processes or impacts that might alter their spatial 'integrity'. In reality, however, there are a range of natural and cultural processes which alter the spatial arrangement of archaeological material from the time they are discarded. How rapidly this process happens and how significant the affects are depends on the nature of the landscape/sediment units in which the material is deposited.

To understand the effect of natural formation process on the structure of the archaeological record, it is useful to consider cultural materials in terms of their landscape/sediment assemblage matrix. Such units are useful for ordering and characterising cultural materials, as they have measurable spatial and temporal boundaries, that reflect relatively long term processes, especially where vegetation and climate have limited applicability to the past.

In forests, soil bioturbation and tree growth are natural processes which will have had significant impacts on the spatial integrity of cultural materials. Even where soils are very stable and there is no lateral movement soil bioturbation will relatively rapidly rework top soils. For this reason there is generally no temporal ordering of materials (Mitchell 1995; Sullivan et al 1996).

Tree growth also ensures that over time the entirety of the forest floor will have undergone some level of disturbance. As Gollan (1992: 44) has suggested, even a simple linear analysis of tree growth indicates that in forests of 100 trees per hectare, the time taken for every part of the forest floor to have been effected by just trees is about 2 500 years, that is there is arguably no site older than that (excluding sites on rock platforms) which retains depositional integrity.

There are a range of taphonomic factors effecting not only the formation of archaeological sites, but also our ability to detect archaeological materials on contemporary landsurfaces. The extent to which geomorphic processes affect this aspect of the resource is often under-estimated by archaeologists, when they attempt to draw relationships between the intensity and pattern of human occupation on the basis of relative amounts of archaeological materials located by surface survey.

Except where there is extensive deflation or erosional land surfaces present, the surface expression of archaeological open sites is likely to be only a fraction of the existing resource. Conditions for the exposure of archaeological materials in forests vary significantly between

different landform/sediment matrices and extreme caution should be exercised in drawing conclusions about human occupation on the basis of correlation data. At one extreme are the conditions presented by forest environments with skeletal soils where materials are conflated within a very thin matrix of sediments and therefore manifest as high density 'sites'. Conversely materials in wet forest environments are extremely difficult to locate, regardless of the intensity of their deposition. This is because materials deposited within a significantly greater soil volume site tend to fall below the threshold of archaeological visibility (Hall & Lomax 1993 a & b).

4.3 ABORIGINALLY INDUCED GEOMORPHIC PROCESSES

In 1969, Rhys Jones coined the phrase 'fire stick farming' (Jones 1969). A radical suggestion at the time as it challenged the view that there was such a thing as a wholly natural ecosystem in Australia (Flannery 1995:223). However, there is ample evidence to suggest that the early explorer did not enter a continent with pristine, stable landscapes. Rather, the landsurface was being continuously and rapidly moulded by the effects of bushfires, a process probably intensified by Aboriginal burning (Hughes & Sullivan 1981a).

It has been hypothesised on the basis of geo-archaeological investigations undertaken in eastern Australia, that Aboriginal firing regimes led to episodic erosion and depositional rates which greatly exceeded those under natural firing (Hughes & Sullivan 1981 b: 277). Hughes and Sullivan argue that Aboriginal burning practices removed the ground cover of grasses, shrubs and protective leaf litter exposing soils to accelerated rainwash, sheetwash and rill erosion, especially following high intensity rainfall events. In particular, areas where soils have low clay content, such as those formed from sandstone and basalt, would have higher rates of instability (Hughes and Sullivan 1986:129). Conversely, soils with higher clay and organic content are less likely to have been eroded.

4.4 POST-CONTACT PROCESSES

Disturbance as a result of human agency is likely to have occurred in most forested areas since post-contact. In particular, areas of less marginal and relatively accessible terrain are likely to have undergone a range of impacts and vulnerable archaeological sites in such areas will have undergone a high degree of disturbance.

Early grazing runs either side of the Great Dividing Range were extensive. The initial presence of cattle and sheep is likely to have initiated the deflation of delicate topsoils even before any purposeful vegetation clearance commenced. The extent of the impact of grazing which has continued to the present day, and soil loss and modification of soil structure through trampling stock, will have conflated extensive areas of the surface archaeological record. In particular, sodic duplex soils of south eastern Australian uplands are highly susceptible to sheet wash, gully and tunnel erosion, and deterioration of landsurfaces in these areas was widespread by the 1840-50s (Jenkin 1986:136).

As a result of mining activities associated with the gold rushes of the 1850s, slopes were stripped of soils, and alluvium in valleys completely reworked. People generally think of these impacts as being contained to fairly discrete areas, but changes to hydrological regimes and downstream effects were often considerable (Jenkin 1986:139).

The 1860s was the era of the Free Selection Acts, designed to put working people on the land. During this period extensive deforestation occurred as families began to effect obligatory 'improvements'. The extent of vegetation clearance and wastage of timber resources through ring barking was so dramatic that a Royal Commission was initiated in the early 1900s to investigate the future of New South Wales' timber reserves (Curby 1993:5). Generally, areas considered to be 'poor country' or unworthy of agriculture, were the areas from which New South Wales' first timber reserves were recognised.

Former and current Crown-timber lands have been harvested in most management areas for at least 150 years. The forests have been logged and, in some areas, several logging operations have occurred over time as demand for different timber products arose and sawmilling techniques and logging equipment improved. In particular, technological advancements in mechanisation in the late 1930s permitted harvesting of previously inaccessible terrain (Byrne 1992:28).

Past harvesting has clearly caused soil erosion, principally gully and sheet wash, and modifications to hydrological regimes in terms of increased run off and infiltration. However, the

extent of past impacts depends largely on the intensity of harvesting and the forest type in question. Traditional forestry practices involving selective logging or long rotations have probably had only small impacts on soils (Lamb 1986:440). Snigging tracks and forest roads have the most potential to cause significant soil erosion, but damage is generally avoided through providing ample water dispersing drainage (Lamb 1986:423).

Fire management and forest fuel reduction are essential to minimise the risk and spread of severe wildfires. This is achieved on public lands by the maintenance of an extensive network of fire trails and in addition to grazing on Crown-timber lands. These activities continue to impact the archaeological resource on forests, however accelerated erosion through high intensity fire has a significantly greater negative impact (Lyons, K., SFNSW, pers. comm., 1997.) .

Recreation and tourism is an important activity in many of the more accessible areas of public forest and has the potential to impact more obtrusive archaeological site types through curiosity and vandalism.

Given the long history of processes affecting the depositional integrity of the surface archaeological record, it is reasonable to question the efficacy of site survey as a process to mitigate further impacts in areas other than those that have undergone 'minimal' disturbance.

4.5 FUTURE IMPACTS IN TERMS OF SPECIFIC ARCHAEOLOGICAL SITE TYPES IN FORESTRY AREAS

Archaeological sites can be regarded as having two dimensions from which their value derives. Their physical elements and their structure. Some site types are more vulnerable to disturbance than others. For example, sites with large physical elements (i.e. scarred trees and stone arrangements) are likely to be destroyed by a single impact, whereas stone artefact sites which are less vulnerable to disturbance, may withstand a number of impacts before they are completely destroyed (Byrne 1992; Hall & Lomax 1993 a & b).

4.5.1 Stone arrangements and bora grounds

These sites are vulnerable to processes of natural attrition such as tree growth, however sites formed in the recent past may still be detected as cultural formations. With the exception of stone arrangements located on rock platforms/ledges, extant sites are likely to have been impacted by post-contact land use.

4.5.2 Scarred and carved trees

These are relatively uncommon site types away from major valleys and riverine areas and are vulnerable to high intensity fire, vegetation clearance and relatively rapid natural attrition.

Remnant trees may be present in timber production forests as a result of their poor timber quality or because they are non-commercial species. While the trees may not directly be targeted in future harvesting activities due to their likely low commercial values, they could be inadvertently affected through forestry operations.

4.5.3 Rockshelter sites

These sites are likely to be relatively common in forests in areas where sandstone shelter formation or granite tors are present.

It is often assumed by archaeologists that rockshelter sites have the potential to be impacted from run off as a result of vegetation clearance or harvesting activities. However, the detailed examination of rockshelter sites in the Upper Mangrove Creek catchment, which has been periodically logged, failed to report any damage to shelters that could be specifically attributed to logging (Kinhill 1995:105).

Perhaps the greatest threat to rockshelter sites is through direct human disturbance in popular recreation areas or if roading was to be undertaken in close vicinity.

4.5.4 Rock engravings and axe grinding grooves

These are relatively rare in forests with the exception of sandstone areas.

Timber harvesting is unlikely to have a direct impact on these sites on steeper slopes, including cliff lines with rock outcrops and rock shelters. Nor should it affect sites in or adjacent to creek lines given the requirements to maintain buffer zones along creek lines. Indirect impacts to these sites as a result of sediment wash is likely to be mitigated by current soil management prescriptions (Kinhill 1995:106).

For sites located in the open, contexts damage could be caused any where that heavy machinery is used.

4.5.5 Stone quarry sites

Stone quarry sites in general comprise areas of artefact debitage and loose rock floaters that are susceptible to ground surface impacts from forestry activities. Larger quarry sites associated with extensive rock outcrops are extremely rare. Generally, it can be expected that these sites will be located in areas of low timber site quality, given that their existence depends on large concentrations of rock. For this reason, they are unlikely to be impacted directly from harvesting operations but may be impacted by gravel extraction or roading (Collins & Morwood 1991:56).

4.5.6 Surface archaeological record

Apart from what can be determined on the basis of logical argument, it would be difficult to objectively measure the effects of different impacts of harvesting on the resource. This is because the resource has continuously undergone transformation (according to the above formation processes) at varying rates and there is no obvious condition against wish to measure disturbance.

General predictions about the likely condition of the surface archaeological resource could be made on the basis of disturbance history and by reference to the stability of different soil types and landforms. As a general rule of thumb, we can assume that the surface record will have undergone a high degree of disturbance in areas that have had high intensity harvesting operations, particularly those undertaken in areas where soils have low clay content and/or are inherently unstable following ground surface disturbance.

Impacts to sites can be of two kinds, the effects on artefact themselves and secondly the effects on site structure.

Damage to artefacts occurs mainly as a result of direct pressure from machine tracks or tyres on tracks, especially on compact surfaces such as gravel where they could potentially be crushed. Off tracks this will generally only apply to a relatively small part of each operation, although the effect will be cumulative with each subsequent harvesting operation (Byrne 1992).

The movement of artefacts is the most pervasive cause of degradation to sites. Apart from natural processes of disturbance, the dislocation of artefacts resulting from roading is a new order of disturbance which virtually destroys the spatial patterning of sites (Byrne 1992). It is axiomatic that forestry activities in unlogged areas have a higher potential to disturb sites than the same activities in previously logged areas (Packard 1992).

The actual processes associated with harvesting which disturb the structure of the surface record are ground churning, compaction and subsequent soil erosion. This will occur most intensively in association with snigging tracks, log dumps and during road construction. However, the intensity of potential impacts will vary with terrain. In areas of dissected terrain, logging operations will be most intensive on the upper parts of toposequences. Most of these areas have relatively high archaeological sensitivity and the impacts of operations is potentially high. In areas where planar landforms dominate, archaeological materials will tend to be more dispersed. In these areas there will be less direct correspondence between operations and site locations and impacts will be correspondingly lower (Hall & Lomax 1993 a & b).

The effect of this on the archaeological resource will have been cumulative degradation, rather than the complete destruction of the resource. Each cutting cycle leaves some areas intact or only partially degraded. This degradation will increase until a hypothetical end point is reached, the maximum possible disturbance of all areas (Byrne 1992).

Even though there has been a long history of disturbance to sites in forests, large numbers of ‘intact’ or partially intact sites will remain (Hall & Lomax 1993b:83). In addition, the lateral displacement of artefacts will not have affected all potential information associated with surface sites. For example, the ratio of different artefact categories and raw materials at site assemblages is unlikely to be significantly affected.

5. SIGNIFICANCE OF THE RESOURCE

5.1 BACKGROUND

Our understanding of the significance of archaeological sites is fundamental in shaping our approach to identification and management.

Significance, of course, has many different dimensions: scientific, social and aesthetic. As discussed previously, this paper is primarily concerned with archaeological or scientific aspects, although there is some congruence with how archaeologists rank scientific significance and other codes of significance. Notably, sites considered by archaeologists to be to highly significant for their rarity, such as stone arrangements, would invariably be ranked as highly significant on other grounds, for example, public, and Aboriginal. On a more general level, it is worth noting that given archaeology is concerned with defining empirical phenomena, it provides a good basis for assessing other forms of significance that derive from physical remains.

In assessing scientific significance, archaeologists give primacy to research or information potential. This is largely based on our understanding of how the archaeological record manifests behavioural meaning, both spatially and on a site by site basis.

5.2 BEHAVIOURAL MEANING OF SITES

The archaeological record is often perceived by cultural heritage practitioners in terms of the ethnographic present, that is occurrences of archaeological debris are often referred to as ‘campsites’ or ‘occupation’ sites.

The archaeological record is often conceived of as a large number of discrete localities of behavioural relevance (‘sites’), separated by spaces that have no archaeological content. Obviously, in relation to the forest archaeological resource, this view is at odds with what we now know to be the empirical nature of the resource. That is, it is largely spatially continuous, and its contemporary surface manifestation is the result of a range of non-behavioural landscape and taphonomic process operating at a range of spatial scales. Trying to manage for this spatial aspect of the resource on the basis of disparate ‘sites’ presents a number of practical problems.

The need to challenge the ontological status of sites in relation to forest archaeological resource is not new (Byrne 1991, Gollan 1992). It is generally appreciated, even by the most strongly committed to the site notion that the archaeological record is a contemporary phenomena (Binford 1968:271). Consequently, the continuous distributions of archaeological debris that are taken to demark sites are contemporary patterns and are not *a priori* behaviourally relevant units. This is evidenced by the results of formation studies (Schiffer 1987) and taphonomic studies (Foley 1981) generally that make it clear that sites, as they are observed by archaeologists, are created by the act of observation at a particular point in time. In addition, materials are added, removed and rearranged continuously in the archaeological record.

The danger in the uncritical use of the site concept in resource management leads to systematic exclusions of segments of the archaeological record and limited understanding of the context of the included segment (Byrne 1991). At worst, it leads to a highly skewed managed record (Dunnell 1992:33).

The challenge, therefore, is not to identify sites for management, but to define and identify archaeologically relevant spatial aggregates. The key to defining and identifying these units, must

take into account the characteristics of the resource, in particular the scale of its variability, and to appreciate its formation as a largely sedimentary process (*cf*. Schiffer 1987).

5.3 SCIENTIFIC SIGNIFICANCE

Historically, significance assessment for research and management purposes has focused on the individual site, particularly large and complex sites (see papers in Sullivan and Bowdler 1984).

In relation to open sites, the wisdom that larger and/or complex sites have inherently more information potential is rarely questioned. However, in reality density or size does not relate directly to intensity of behaviour, or site function, but may reflect the stability of landforms, spatial constraints on human behaviour and the connectivity of the landscape. For example, sites located in xeric forests on narrow ridge line toposequences are the densest most extensive sites located thus far in forests, however, in terms of human behaviour, they do not reflect a different level or type of occupation but merely represent the long term accumulation of low level discard events. In terms of their information potential, they are time averaged palimpsests with no temporal patterning. In short, they may be bigger, but they do not necessarily have more information content.

Generally speaking, however, the resource is characterised by low density surface scatters of material, which according to the generally applied principles of significance assessment for scientific values, are individually of low significance. On an individual basis, apart from their locations, there may not be a lot more potential information that can be derived from these sites in isolation (Byrne 1983b).

However, collectively these sites have the ability to provide information on the human response to the forested environment in terms of the movement of people and materials about the landscape. Their information potential lies largely in their interrelationship with other sites and landscape characteristics at a range of spatial levels. Therefore, the problem becomes how to identify and manage areas 'representative' of this patterning (Hall & Lomax 1996b).

This is not to say that we need to know the precise location of sites to define such areas. Due to their close association with landscape characteristics, the problem becomes one of choosing representative components of the landscape (Byrne 1991; Gollan 1992).

While there is some reluctance for archaeologists to conceive variability in terms of environmental characteristics, lest they be accused of 'environmental determinism', it is pertinent to note two points. Firstly, recognising the opportunities and constraints presented by landscape variability do not negate the process of socially defined decision making, it is relevant to establish what these constraints are (Ingold 1981). Secondly, regardless of the behaviour that in part formed the contemporary surface archaeological record, it is largely a product of past and ongoing landscape processes, so, in order to establish behavioural variability, these other formation processes must first be understood.

Stratified open sites with a degree of temporal resolution would automatically be accorded a high degree of scientific significance. However, these are likely to be very rare in forests and are most likely to occur near water ways/swamps or in rockshelters. It can generally be assumed that the protection of such sites is catered for by the existing reserve system and measures applied to manage a range of natural environmental values.

Other rare, obtrusive kinds of sites, such as those mentioned above, are generally considered to have high scientific significance and would need to be specially catered for in any management strategy.

6. CURRENT APPROACHES TO MANAGEMENT AND IDENTIFICATION

This section of the document will examine some of the approaches that are currently advocated for 'modelling' the forest archaeological resource, in addition to current forest management practices. This is undertaken as a basis for providing recommendations for a more strategic identification and management of the resource in the final section of the report.

In particular, this chapter will examine the recent use of 'predictive modelling' and discuss its limitations for determining land use decisions for Aboriginal archaeological sites. In particular, whether more resources and the application of more sophisticated mapping technology will greatly advance our understanding of the resource past first principles.

Expanding on this discussion, current forest management and identification practices with reference to Forestry Tasmania and SFNSW and the recently instigated South East Forests Regional Advisory Committee (SEFRAC) archaeological project in New South Wales will be examined.

6.1 PREDICTIVE OR CORRELATION MODELLING

Predictive or correlation modelling in archaeology is an inductive process based on the recognition of composite patterns of uniformities that are detected by empirical observations. Patterns are generally described in a way that can provide expectations concerning the archaeological characteristics of unknown areas (Warren 1990:91).

All recent regional scale EIA forest archaeological surveys involve some form of predictive modelling with recommendations for further survey to 'test/refine' the 'preliminary' models. However, the question of what level of generality or specificity is adequate is rarely addressed. Perhaps, more importantly, is the recognition that correlation models, because of their very nature, are probably untestable in any formal sense (Norton & Williams in Lewis 1996:19).

All stakeholders need to have a realistic appreciation of archaeological data and its limitations for predictive modelling. The North American literature is worth examining in this regard. Such models have been used much longer there, and have gone through similar stages of development as in Australia, so there are important lessons. In particular, the North American example described below indicates the problems inherent in seeing predictive modelling as an end in itself.

There is a long history of predictive modelling and more recently the application of Geographic Information Systems (GIS) to modelling site locations in cultural resource management in North America. Great fervour and extensive resources have been devoted to probabilistic-based surveys aimed at elucidating patterns of settlement (Altschul 1990:227).

Faced with the problem of how to manage large numbers of often poorly documented resources and resources whose locations were not even known, North American Federal archaeologists and land managers of the 1970s seized upon the

potential of these studies. However, by the 1980s the popularity of these models had significantly waned. Why their popularity failed was not to do with their failure necessarily to predict site locations but was related to the changing face of cultural resource management (Altschul 1990:227).

In the late 1970s, the site data bases of many North American regions was very meagre, however, regional scale surveys undertaken to rectify this situation had produced hundreds, if not thousands of sites. Generally speaking, the survey effort had produced enough data to predict the broad patterns of site locations (Altschul 1990: 227).

Apparently the models had done their job, but had they? While they provided a broad indication of archaeological sensitivity, they did not provide any context for assessing the relative significance of sites located as a result of compliance surveys. As one American Federal archaeologist remarked - she did not need another model that told her where sites were but rather a framework for assessing the relative values of some forty seemingly identical lithic scatters (Altschul 1990:227). This scenario is undoubtably familiar to our own forest planners who need in addition to models that predict the unknown, frameworks that bring some order and direction to the increasingly large data bases that are being amassed.

To explicate some of the limitations and problems with predictive modelling, recent approaches to modelling archaeological site locations in forests in Australia will be briefly discussed.

When considering the merits of various approaches, it is important to keep in mind some of the constraints imposed by the characteristics of the forest archaeological record. In particular, attention needs to be drawn to the circularity of correlation modelling resulting from the inherently skewed sample data produced by surface survey in forests. In addition, correlation models (as generally devised by cultural resource management archaeologists) fail to recognise that landscape configuration, scale and processes affect site location at a range of different spatial scales.

6.2 GIS MODELS (EAST GIPPSLAND EXAMPLE)

It is often assumed that GIS models of site location will have greater accuracy than non - GIS models. While GIS offers superior mapping capabilities and quantitative and qualitative analysis, it is only as good as the data that is entered into it and possibly sometimes worse. Collecting archaeological data with sufficient rigour for GIS modelling is a very expensive and time consuming task. Because of the vagaries influencing archaeological observations, we need to think critically whether GIS is likely to produce a level of accuracy significantly greater than current modelling strategies, or in fact leads to increased levels of unacceptable error.

A pilot assessment was undertaken to examine the utility of GIS for modelling archaeological site locations in the forests of East Gippsland, Victoria (Lewis 1996).The project was commissioned by the Australian Heritage Commission as part of the National Estate cultural heritage assessment of the East Gippsland RFA.

A number of lessons can be learned from this project. Perhaps most important is a recognition of the gulf between data requirements for GIS modelling and the sample biases inherent in data collected from surface surveys in forests.

As has been discussed previously, the locational data generated by archaeological surface survey reflects a range of formational and site detection limiting factors. Variable ground surface conditions, problems associated with assessing archaeological visibility and difficulties of access introduce a range of factors which greatly reduce the accuracy and the nature of behavioural inferences that can be made from the data.

This above point is similarly noted by Lewis (1996:34) who raises the likelihood that the patterns revealed by modelling based on archaeological point location data sets are only artefacts of their sampling methodology (Lewis 1996: 34). In concluding he suggests the results of his study highlighted those environmental variables not that influence site location, but which influence survey accessibility: topographic attributes and values related to slope and wetness (Lewis 1996: 35).

In recording data for GIS it is important that accurate data is recorded for both site locations and null observations. However, because of the range of factors determining and obscuring the observation of archaeological surface materials, determining the status of null observations is inherently problematic. For example, although formulaic approaches have been developed to estimate archaeological visibility conditions, the underlying factors affecting visibility conditions

are often poorly understood and a significant margin of error can be assumed.

Even if full sets of data including null observations could be systematically recorded, the presence of bias in the sampling method remains a potential problem. Solutions to these problems, such as formal probabilistic sampling strategies, are well known (Shennan 1988), however, in practice they are impractical and often fail to avoid the problems they were designed to overcome. This is because in forested environments observation will always be limited to a sub-set of topographic features that provide ground surface visibility and access, regardless of survey transect location.

Furthermore, interpolation from current GIS derived variables also raises questions of locational accuracy and scale. This is particularly relevant for some of the fine scaled variables which are fundamental to specifying archaeological site location. Variables such as local scale terrain strongly correlate with site locations, however small errors in this variable can take the observer from the lowest to highest values observed (ie from a ridge crest to a steeply sloping ridge side slope). Obviously errors of this nature will have a profound affect on the accuracy of site location predictions.

6.3 TASMANIAN MANAGEMENT PRACTICES FOR IDENTIFICATION

Management for cultural heritage values is outlined in Forestry Tasmania's Forest Practices Code (1993). The code formalises procedures for cultural heritage management in terms of a program for preoperational site identification, recording and assessment in addition to consultation with special interest groups.

More recently Forestry Tasmania has devised a statewide predictive model of archaeological sensitivity known as the Archaeological Potential Zoning (APZ) system (McConnell 1995). The zoning system is designed to improve site capture rates for archaeological sites, with an eye to enhancing the protection of significant archaeological sites. It is predicted that the system will operate for the next two years, after which the system will be reviewed (Gaughwin, D., Forestry Tasmania pers. comm., 1997).

Under the zoning system, the landscape is divided into zones of archaeological sensitivity each with specific requirements in terms of intensity of survey coverage and survey strategy.

Preoperational and in some cases postoperational surveys are required. This year alone (June, 1997) 300 archaeological surveys were undertaken as a result of the zoning system.

The model is formulated on the basis of a range of disparate environmental variables selected on the basis of ‘expert opinion’. The model is primarily based on the notion that there is a direct relationship between past human behaviour and the contemporary archaeological record and does not address the overarching complexities of site formation and detection.

Unlike recent work in Victoria and New South Wales, Tasmanian field recording methods have not systematically recorded data for factors affecting site detection and negative site location. These factors are further compounded by the poor ground surface visibility conditions experienced by surveyors in Tasmanian forests. In terms of examining aspects of site formation much of the data has limited potential. Interpretative frameworks have also focused on defining Aboriginal settlements patterns.

A program of surface survey was recently undertaken for Forestry Tasmania by Sim (1996) to test the predictive potential of the model. Given the absence of a formal sampling framework to test the model, the results were as would be expected, inconclusive. While more sites were located in areas predicted to have high archaeological potential, the model was not consistent and in some survey areas no sites were located in areas of high sensitivity. In addition, more sites were located in areas of low sensitivity than those of medium sensitivity.

In wet forest types ground surface visibility conditions restricted the utility of surface survey and it was concluded that the zoning system could only be applied to dry sclerophyll forests where ground surface visibility conditions permitted the detection of archaeological surface materials.

The results of the test not only indicated the limited utility of surface survey for locating archaeological surface materials in Tasmanian forests, in particular wetter forest types, it also indicated a conceptual weakness with the zoning system. That is, the model does not recognise the extent to which the archaeological record reflects a range of formational and site detection limiting factors.

The model continues to be used in Tasmania, where its success is seen largely as a formal tool for compliance. While the system will be effective in mitigating impacts to a narrow range of sites, that is those sites which are easily located by surface survey, it offers no management for sites which are not predicted to occur, or for those areas where surface survey is a particularly ineffective method for specifying site location. Furthermore, the absence of a coherent environmental framework means that it is very difficult to determine the broad parameters of the data captured through the survey process.

6.4 SOUTH EAST FOREST ARCHAEOLOGICAL RESEARCH PROJECT

The South East Forests Archaeological Research Project was developed by NPWS in 1994 and is funded by SEFRAC. The project is designed to formulate an archaeological zoning system for the South East Forests along the lines of that instigated by Forestry Tasmania.

The aims of the project, as described by the current project brief, are as follows. The overall objective of the project is to ensure that the most significant sites in the South East Forests study area are recognised and appropriately protected, while developing processes for salvage or protection of Aboriginal cultural heritage sites and landscapes within timber production forests. Prescriptions for archaeological sites and archaeologically sensitive land units are to be used to determine requirements for pre-logging surveys and survey techniques to be employed. Processes are to be developed for the determination of when Section 90 Consents (*National Parks and Wildlife Act 1974*) may be required to allow timber harvesting to proceed.

Work on the SEFRAC archaeological project commenced in 1997. The initial stage of the project has been concerned with the collation of existing archaeological site location data. A high degree of error in recorded sites has meant that the project archaeologist's time has been spent on data correction. The data has been entered into NPWS Windows version Environmental Resource Mapping System (WinERMs) data base with the intention of using data layers to provide environmental correlates for site locations (Heffernen, K., NSW NPWS, pers. comm., 1997). However, the low level of spatial resolution for environmental data layers suggest that this may further increase uncertainty in determining environmental correlates for site locations.

Personal computer based ERMs programs used so far in Australia for cultural resource management generally do not have fine enough spatial resolution to map most individual landforms or landscape features. As site location appears from all previous research to be related to landforms, these must be identifiable in the systems to be used for predictive modelling (Sullivan & Hiscock 1992:85). Given the absence of this level of environmental information, it seems likely that WinERMS will be extremely limited as a tool for identifying archaeological sensitivity and probably less reliable than that which could be established on the basis of first principles.

The second stage of the project, which will commence in the near future, is a program of archaeological survey. The survey will be undertaken to produce systematic data to formulate a ‘predictive model’.

6.5 SFNSW (NORTHERN REGION)

This section of the paper will outline SFNSW (Northern Region) system of management for Aboriginal archaeological values. Northern Region have formalised their management systems for cultural heritage in the document ‘SFNSW Northern Region Policies and Procedures for Cultural Heritage Management (draft)’. These guidelines were developed specifically for Northern Region in consultation with NPWS, however some of the practices in them have been adopted by SFNSW Central and Southern Regions (note: this refers to SFNSW regional structure - 1992-97).

The draft guidelines articulate policies and procedures for managing cultural values including archaeological values. The document outlines guidelines for the identification, assessment and management of both the known and unknown resource. The underlying principal for managing archaeological values is the need to reserve a representative sample of the resource. In addition, Aboriginal heritage values are identified and maintained principally through on going consultation with Aboriginal communities at various stages of the planning process in addition to field assessment.

Known sites are managed in accordance with legislation. They are either protected from impacts, or if they are sites of low value, a Section 90

Consent may be sought from NPWS if supported by the relevant Local Aboriginal Land Council/s.

The strategy for managing the unknown resource is to develop and implement a strategy for identifying gaps in the reserve system (all tenures) for maintaining areas representative of the archaeological resource. The method for doing this is currently being trialed in the Glen Innes Management Area (Lomax & Fife in prep.).

For sites other than stone artefact scatters, preharvesting surveys are undertaken by SFNSW staff and/or local Aboriginal community representatives to ensure that sites are identified and protected. SFNSW staff are trained in site identification, consultation and site management procedures for this purpose.

The document also outlines guidelines for undertaking pre-roading surveys which were prescribed under some EIS determinations. However, the preferred position of SFNSW (Northern Region) is to undertake further survey within the context of those areas not adequately represented within the reserve system (as yet to be determined).

The procedures were developed largely to meet the requirements of Department of Urban Affairs & Planning (DUAP) EIS determinations and legislation (SFNSW Northern Region nd).

6.6 CONCLUSION

Correlation modelling has inherent limitations in terms of producing sound empirical results. More significant even than this weakness is that the systems described above are not explicitly linked to a conservation strategy with an effective methodology for reserve selection. While all of the above approaches to predictive modelling will, with varying degrees of success, indicate likely areas to locate sites, there is no broader frame of reference for assessment (other than the sites identified by the survey process itself) and the sample captured will be largely unspecified. In addition, there is no consideration given to the spatial dimension of the resource, or recognition that much of its analytical potential is derived from its examination at a range of spatial scales. As argued previously, site based management for the surface record fails not only to recognise the 'systematic' nature of the resource, but potentially leads to a highly skewed, albeit managed, record in that it protects only that small proportion of the archaeological record that can be detected on current landsurfaces.

Within the current SFNSW (Northern Region) guidelines, the need to reassess management for stone artefact scatters has been recognised. Establishing the ability of the reserve system (all tenures) to maintain areas representative of the surface archaeological record has been identified as a priority by SFNSW and has been raised a number of times by NPWS as a possible strategy. The current CRA process provides an opportunity to explore and develop strategic management options that give protection to its significant elements both in respect to its landscape representativeness and highly significant sites, wherever they occur.

Recommendations concerning the key elements in any future strategy for identification and management are presented in Chapter 7.

7. RECOMMENDATIONS

7.1 REQUIREMENTS FOR FURTHER SURVEY

Requirements for further regional scale forest archaeological surveys need to be critically examined in relation to the issues discussed in this paper. In particular, the extent to which further CRA survey work will add significantly to our ability to provide improved management advice for the RFA. One issue that needs to be critically examined is the extent to which further survey data will significantly add to the existing corpus of archaeological forest data, especially given the inherent limitations of surface survey as a means to comprehensively define the resource.

7.2 CONSERVATION STRATEGY

Objectives for management that give proper consideration to the spatial aspect of the resource and how to protect its significant elements, both in respect to its landscape representativeness and significant sites, need to be clearly articulated by an overarching conservation strategy. The strategy needs to clearly define those values that need management and to set criteria for conservation outcomes.

Less attention should be given to future management of identified open sites in working forests or future identification, especially in highly disturbed contexts, and instead ensuring adequate representation of such sites within the reserve system. This will necessitate a parallel development of a more strategic approach to the granting of Consents for previously identified sites.

A system of management is required to ensure that the spatial aspect of the forest archaeological resource (all tenures) is maintained. Given the fundamental effects of landscape characteristics and processes, identification and management should be within the context of 'representative' landscape areas.

The Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative (CAR) Reserve System for forests in Australia (Commonwealth of Australia 1997), state that the reserve system should sample the full range of forest communities and ecosystems across the landscape. The National Forest Policy Statement also defines the need for the CAR reserve system to protect old growth forest and forested values in the reserve system (Commonwealth of Australia 1992). The Scoping Agreement for NSW RFAs acknowledges that heritage issues are to be addressed.

Given that the CAR reserve system is to be established spatially across environmental units of forests, as well as in least disturbed areas (old growth and wilderness), it would seem valid to examine if such a system will allow the reservation of a 'comprehensive, adequate and representative' sample of the archaeological record across forested landscapes. This would be supplemented by off-reserve management techniques for site types other than stone artefact scatters and those landscape areas not adequately represented within the CAR system.

The methodology for undertaking this task would entail an examination of the reserve system including *defacto* reserve areas (defined by management prescription and zoning controls). The analysis would take into account disturbance history and the inherent stability of different landscape systems. Data requirements for this analysis are likely to be met by data layers created as a result of the current CRA assessment process. The scale of areas for selection and the environmental parameters utilised will need further consideration, however, the most relevant parameters will be those that characterise variation in landscape configuration, scale and form. Such as, in descending order of scale; regional landsystem, major geological group and dominant landform pattern. This should at least enable the setting of rational statewide and regional priorities

for further survey work/other management priorities.

Because the objective is to capture variability and spatial patterning rather than identifying 'sites', environmental data is considered to be the more efficient for this task than archaeological data. Rather considerations such as disturbance history, in particular the existence of minimally disturbed forest areas, are likely to be a major consideration in the identification of reserve adequacy.

7.3 PRE-HARVESTING SURVEYS AND MANAGEMENT FOR DIFFERENT SITE TYPES

Requirements for pre-harvesting survey for archaeological sites need to be critically assessed. The need for further work should also be assessed on the basis of a realistic appreciation of future potential threats taking into account the overall conservation strategy. This will need to be critically assessed in terms of both past cultural (prehistoric, historic and contemporary) disturbance and landform stability.

Given that site types other than stone artefact scatters are rare and therefore of relatively high regional significance, their identification and management need to be site specific orientated and this is best achieved as part of ongoing operational planning. The method adopted should entail a mix of measures depending on the degree of risk to significant elements and broader considerations of Aboriginal heritage (ie survey by operational staff, and/or Aboriginal community survey/ consultation, including consideration of post-contact sites and places). An example of such a strategy is put forward in the SFNSW (Northern Region) draft guidelines.

REFERENCES

Altschul, J. H. 1990, Red flag models: the use of modelling in management contexts. In K. M. S. Allen, S. W. Green & E. B. W. Zubrow. *Interpreting Space GIS and Archaeology*. Taylor & Francis, London. pp. 229-238.

Binford, L. R. 1968, Some Comments on Historical Versus Processual Archaeology, *Southwestern Journal of Anthropology* 24:267-275.

Binford, L. R. 1980, Willow Smoke and Dog's Tails: Hunter-gatherer Settlement Systems and Archaeological Site Formation, *American Antiquity* 45:4-20.

Bird, C. 1993, Desktop study of archaeology: Central Highlands. A report to the Australian Heritage Commission, Canberra.

Boot, P. 1993, Pleistocene Archaeological Excavations from the Hinterland of the New South Wales Coast. *Australian Archaeology*. 37. p. 59.

Bowdler, S. 1983, *Aboriginal Sites on the Crown-timber lands of New South Wales. Report to the Forestry Commission of New South Wales*.

Byrne, D. 1983a, Archaeological Survey of the Wandella-Dampier State Forests. *In Proposed Foothills Logging Operations, Wandella-Dampier, Narooma District*. Forestry Commission of New South Wales.

Byrne, D. 1983b, *The Five Forests: an Archaeological and Anthropological Investigation*. National Parks and Wildlife Service New South Wales, Sydney.

Byrne, D. 1983c, Aboriginal sites in Deua National Park. Unpublished report to the National Parks and Wildlife Service.

Byrne, D. 1983d, Aboriginal sites in Wadbilliga National Park. Unpublished report to the National Parks and Wildlife Service.

Byrne, D. 1984, A Survey Strategy for a Coastal Forest. In S. Sullivan & S. Bowdler (eds.*) Site Surveys and Significance Assessment in Archaeology*. Research School of Pacific Studies, Australian University, Canberra. pp. 61-70.

Byrne, D. 1987, *The Aboriginal and Archaeological Significance of the New South Wales Rainforests*. Forestry Commission of New South Wales, Sydney.

Byrne, D. 1990, Archaeological Survey of Proposed Forest Roads in Eden and Bombala Districts. A report to the Forestry Commission of New South Wales.

Byrne, D. 1991, Aboriginal archaeology in forests - circles around the past. In D. Lunney (ed.*) Conservation of Australia's Forest Fauna*. Royal Zoological Society of New South Wales, Sydney. pp. -385-92.

Byrne, D. 1992, An investigation of the Aboriginal archaeological record in the Gloucester-Chichester EIS Area. *Gloucester and Chichester Management Areas Environmental Impact Statement. Supporting Document No. 8*. State Forests of New South Wales, Sydney.

Byrne, D. 1995, An investigation of the Aboriginal archaeological record in the Tenterfield EIS Area. *Tenterfield Management Area EIS, Supporting Document No. 5*

Archaeology. State Forests of New South Wales, Sydney.

Byrne, D. & L. J Smith. 1987, Survey for Aboriginal archaeological sites in the State Forests of the Eden Area. A report to the Forestry Commission of New South Wales.

Byrne, D. & L. J Smith. 1988, Cultural resource overview: Aboriginal sites in the Southeast Region. Unpublished report to the National Parks and Wildlife Service and the Australian Heritage Commission.

Collins, J. 1991, Report on the archaeological survey at the Duck Creek environmental impact statement area, northern New South Wales. A report to the Forestry Commission of New South Wales.

Collins, J. & M. J. Morwood. 1991, An archaeological assessment of the forests of the Wingham Management Areas, New South Wales. *Environmental Impact Statement Wingham Management Areas Proposed Forest Management Supporting Report 5* - Archaeology Survey. Truyard. Pty. Ltd.

Comber, J. 1991, Archaeological assessment of the Dorrigo Management Area. A report to Sinclair Knight Pty. Ltd.

Commonwealth of Australia. 1992, National Forest Policy Statement. A New Focus for Australia's Forests.

Commonwealth of Australia. 1997, The Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative (CAR) Reserve System for forests in Australia. A Report by the joint ANZECC/MCFFA National Forest Policy Implementation Sub-committee.

Creamer, H. 1980, The Aboriginal Heritage in New South Wales. In C. Haigh & W. Goldstein (eds.*) The Aborigines of New South Wales*. National Parks and Wildlife Service, Sydney. pp. 88-93.

Curby, P. 1993, European Disturbance History of Mount Marsh & Billilimbra/Washpool State Forests . A report to State Forests of New South Wales.

Davies, S. & A. Stewart-Zerba. 1995, An Archaeological Assessment of State Forests of New South Wales' Coffs Harbour - Urunga Management Areas. A report to Gutteridge Haskins and Davey Pty. Ltd.

Davies, S. with A. Stewart-Zerba, S. Crangle, L. Lamb, J. Prangnell and M. Salmon. 1995, An Archaeological Assessment of the State Forest of New South Wales Walcha-Nundle and Styx River Management Areas. A report to Mitchell McCotter.

Dunnell, R. C. 1992, The Notion Site. In J. Rossignol & L. Wandsnider (eds.*) Space, Time and Archaeological Landscapes*. Plenum, New York.

Egloff, B. J. 1979, *Mumbulla mountain: an anthropological and archaeological investigation*. National Parks and Wildlife Service, Sydney.

Flannery, T. 1995, *Future Eaters: An ecological history of the Australasian lands and people*. Reed, Melbourne

Flood, J. 1980, *The Moth Hunters: Aboriginal Prehistory of the Australian Alps*. Australian Institute of Aboriginal Studies, Canberra.

Foley, R. 1981, Off-Site Archaeology and Human Adaption in Eastern Africa. *BAR International Series 97*, Oxford.

Forestry Commission of Tasmania. 1993, *Forest Practices Code*. Forestry Commission of Tasmania.

Geering, K. 1981, Lower Snowy River archaeological survey. A report to the National Parks and Wildlife Service of New South Wales, Sydney.

Godwin, L. 1990, Inside Information: Settlement and Alliance in the Late Holocene of Northeastern New South Wales. Unpublished Ph.D. thesis, University of New England.

Gollan, K. 1987, Archaeological Investigations on Newnes Plateau. A report to New South Wales National Parks and Wildlife Service.

Gollan, K. 1992, Aboriginal Cultural Heritage Study: North East Forests New South Wales. National Parks and Wildlife Service.

Grinberg Knight & Associates. 1995, An Archaeological Survey of the Queanbeyan & Badja Forest Management Areas. *Queanbeyan & Badja Management Areas EIS Supporting Document No: 6 Archaeological Survey*, State Forests of New South Wales, Sydney.

Hall, R. 1990, Archaeological survey of the Snowy River Management Unit. A report to the Department of Conservation and Environment, Melbourne.

Hall, R. 1991, Far East Gippsland Archaeological Survey. A report to the Victoria Archaeological Survey.

Hall, R. 1992a, A predictive archaeological assessment of crown-timber lands in the Glen Innes Management Area. In Mandis Roberts Consultants. *Glen Innes Forest Management Areas EIS*. Forestry Commission of New South Wales, Sydney.

Hall, R. 1992b, Artefact density patterns in areas of high relief: a case study form Far East Gippsland. In B. Scougall (ed.) *Cultural Heritage of the Australian Alps. Proceedings of the symposium held at Jindabyne, New South Wales* 16-18 October 1991. Australian Alps Liaison Committee, 1992.

Hall, R. & K. Lomax. 1993a, *Grafton Management Area EIS Supplementary Report (Archaeology).* State Forests of New South Wales, Sydney.

Hall, R. & K. Lomax. 1993b, *Casino District EIS Supplementary Report (Archaeology).* State Forests of New South Wales, Sydney.

Hall, R. & K. Lomax. 1996a, The formation of open sites in forests. Paper presented Australian Archaeological Association Conference 5 -7 December 1996, Normanville, South Australia.

Hall, R. & K. Lomax. 1996b, A Regional Landscape Approach to the Management of Stone Artefact Sites in Forested Uplands in Eastern Australia. *Australian Archaeology*. 42 pp.35-38.

Hughes, P. J. & M. E. Sullivan 1978, A preliminary archaeological survey of the Five Forests, South Coast New South Wales. A report to the National Parks and Wildlife Service.

Hughes, P. J. & M. E. Sullivan. 1981a, The impact of bushfires on soils and soil erosion. In P. Stanbury (ed.*) Bushfires: their effect on Australian life and landscape.* The Macleay Museum, University of Sydney.

Hughes, P. J. & M. E. Sullivan. 1981b, Aboriginal burning and Late Holocene geomorphic events in eastern new South Wales. *Search* 12:277-278.

Hughes, P. J. & M. E. Sullivan. 1986, Aboriginal landscape. In J. S. Russell & R. F. Isbell (eds.*) Australian Soils: the human Impact.* University of Queensland Press, St. Lucia.

Hunt, P. 1993, Hinterland forests of East Gippsland. An archaeological survey of the East Gippsland Forest Management Areas. Department of Conservation and Natural Resources, Victoria and the Australian Heritage Commission, Canberra.

Ingold, T. 1981, The hunter and his spear: notes on the cultural mediation of social and ecological systems. In A. Sheridan and G. N.

Bailey (eds.) *Economic Archaeology. Oxford, B.A.R. International Series* 96:119-130.

James. R. & B. Conyers. 1995, NPWS Northeast NSW Aboriginal Archaeological Sites Project for NRAC 1994. New South Wales National Parks and Wildlife Service.

Jenkin, J. J. 1986, Western Civilisation. In J. S. Russell & R. F. Isbell (eds.) *Australian Soils: the human Impact*. University of Queensland Press, St. Lucia.

Jones, R. 1969, 'Fire stick farming'. *Australian Natural History*. 16, pp. 224-8.

Kinhill Engineers Pty. Ltd. 1995, Morisset forestry Districts An Assessment of Aboriginal Archaeological Sites. *Morisset Forestry District Environmental Impact Statement. Supporting Document No. 8*. State Forests of New South Wales, Sydney.

Knight, T. 1996, The Batemans Bay forests Archaeological Project. Site Distribution Analysis. Department of Archaeology & Anthropology, Australian National University, Canberra.

Kuskie, P. 1994, An archaeological assessment within Dorrigo 3 Year EIS study area, north coast New South Wales. A report to Forestry Commission of New South Wales.

Lamb, D. 1986, Forestry. In J. S. Russell & R. F. Isbell (eds.) *Australian Soils: the human Impact*. University of Queensland Press, St. Lucia.

Lewis, A. 1996, Archaeological Survey Strata - Easy Gippsland Forest Management Area. Draft report GIS Unit Department of Conservation and Natural Resources (DCNR), Victoria.

Lomax, K. 1994, Comara Range (NPWS Site No. 21-5-0054) Excavation, Nulla Five Day State Forest, mid north coast, New South Wales. A report to State Forests of New South Wales.

Lomax, K. 1995, Supplementary Analysis of Archaeological Data for Walcha-Nundle and Styx River Management Areas. *Appendix 8, Walcha-Nundle and Styx River Management Area EIS*. State Forests of New South Wales, Sydney.

Lomax, K & R. Fife. in prep. Glen Innes Determination Aboriginal Archaeological Survey (Stage 2), State Forests of New South Wales, Northern Region.

McBryde, I. 1974, *Aboriginal Prehistory in New England*. Sydney University Press.

McConnell, A. 1995, *Archaeological Potential Zoning: A Strategy for the Protection of Aboriginal Archaeological Sites in Tasmanian State Forests*. Volume 1 - Background, Methods, Use & Discussion. Forestry Tasmania.

McDonald, J. 1988, The Proposed Warre Warren Aboriginal Place McPherson State Forests - Archaeological Investigation. National Estate Grant.

Mitchell, P. B. 1995, A review of the geomorphology and soil stratigraphy at RSI (45-5-982) Regentville. Implications for the archaeological significance of the sites, and recommendation for further investigation. A report to Transgrid.

Norton, T. W. & J. E. Williams. 1992, Habitat modelling and simulation for nature conservation: a need to deal systematically with uncertainty. *Mathematics and Computers in Simulation*. 33 pp.374-384.

Morwood, M. J. & J. Collins. 1991, An archaeological Assessment of the Yarrahapinni and Way Way State Forests, New South Wales. A report to the Forestry Commission of New South Wales.

Packard, P. 1991, Sites and sampling in the southeast forests: research design, sampling

methodologies and sample selection for a proposed site survey project. A report to National Parks and Wildlife Service and the Forestry Commission of New South Wales.

Packard, P. 1992, An archaeological assessment of state forests in the Kempsey and Wauchope forestry Management Areas. A report to the Forestry Commission of New South Wales.

Packard, P. (in prep). Aboriginal sites in the south-east forests of NSW: results of a site sampling and predictive modelling program. Report to Forestry Commission New South Wales and National Parks and Wildlife.

Ross, A. 1986 (ed.) *Planning for Aboriginal Site Management*. A Handbook for Local Government Planners. National Parks and Wildlife, Sydney.

Schiffer, M. B. 1987, *Formation Processes of the Archaeological Record*. University of New Mexico Press, Albuquerque.

Scoping Agreement for New South Wales Regional Forest Agreement between the Commonwealth of Australia and the State of New South Wales.

SFNSW. 1994, *Eden Management Areas EIS - Main Report A.* State Forests of New South Wales, Sydney.

SFNSW Northern Region. nd. Policies and Procedures for Cultural Heritage Management (draft).

Shennan, S. 1988, *Quantifying Archaeology*. Edinburgh University Press. Edinburgh.

Sim, R. 1996, *Archaeological Potential Zoning testing project*. Forestry Tasmania.

Smith, A. 1995, *Archaeological Survey Methods for Forested Environments - An Assessment*. A report to Forestry Tasmania and the Australian Heritage Commission.

Smith, C. 1993, An archaeological investigation of the Urbenville Management Area, north-eastern New South Wales. *Urbenville Management Area EIS. Supporting Documents No. 5*. State Forests of New South Wales, Sydney.

Stafford, C. E. & E. R. Hajic. 1992, Landscape Scale Geoenvironmental Approaches to Prehistoric Settlement Strategies. In J Rossignol & L Wandsnider (eds.) *Space, Time and Archaeological Landscapes*. Plenum, New York. pp. 137-161.

Sullivan, M. E. & P. Hiscock. 1992, A suggested cultural resource GIS for the Northern Territory. In C. C. Devonport, S. J. Riley & S. M. Ringrose (eds) *Proceedings of the GIS and Environmental Rehabilitation Workshop* 4-5 September 1992 Darwin. AGPS, Canberra.

Sullivan, M. E., P. J. Hughes & W. Shawcross. 1996, Northeast Forests Archaeology Investigations in Chaelundi State Forests. A report to National Parks and Wildlife Service and State Forests of New South Wales.

Sullivan. S. & S. Bowdler (eds.) 1984, *Site Surveys and Significance Assessment in Archaeology*. Research School of Pacific Studies, Australian University, Canberra. pp. 61-70.

Warren, R. E. 1990, Predictive modelling in archaeology a primer. In K. M. S. Allen, S. W. Green & E. B. W. Zubrow. *Interpreting Space GIS and Archaeology*. Taylor & Francis, London. pp. 91-111.

Zone Team Accountabilities and Operating Guidelines. 1995, National Parks and Wildlife Service (Internal Working Document).