EXCAVATION OF GREEN ANT AND ECHIDNA SHELTERS, CAPE YORK PENINSULA

J. FLOOD

Australian Heritage Commission
Canberra

N. HORSFALL

Behavioural Sciences
James Cook University

INTRODUCTION

This paper presents the results of archaeological excavations at Green Ant and Echidna Shelters on the Koolburra Plateau, northwest of Laura in Cape York Peninsula, north Queensland. The work was undertaken as part of a multi-attribute approach to the prehistory of the region. Such an approach to regional prehistory is exemplified by the work of Morwood in the Central Queensland Highlands who used two principal types of evidence in his study, excavated assemblages and rock art, on the basis that "as two strands in the web of evidence documenting the workings of a cultural system, a combined study of art and stone seemed to offer potential for yielding a more detailed account of the processes by which archaeological observations relate to their cultural context" (1981:1). A similar approach seemed well suited to the Koolburra Plateau, which is also extremely rich in rock art sites (Flood 1983b, 1983c).

The project involved two field seasons in the winters of 1981 and 1982, which totalled 11 weeks. Presentation of the results of the whole project is beyond the scope of this paper, which will focus primarily on Green Ant and Echidna Shelters, the two major sites excavated.

THE SETTING

The Koolburra Plateau lies between latitudes 15° 30′ and 15° 35′S and longitudes 144° 01′and 144° 05′ E. As the crow flies, Koolburra is about 50km WNW of Laura near the base of Cape York Peninsula (Figure 1). The Peninsula is almost 1000km long and about 450km wide at the base, which lies at approximately latitude 16° 20′ S, on a line from near the Gilbert River on the west to just north of Cairns (Anderson, 1984:11). In general, the central spine of the peninsula is characterised by undulating wooded hills or low sandstone escarpments. In the

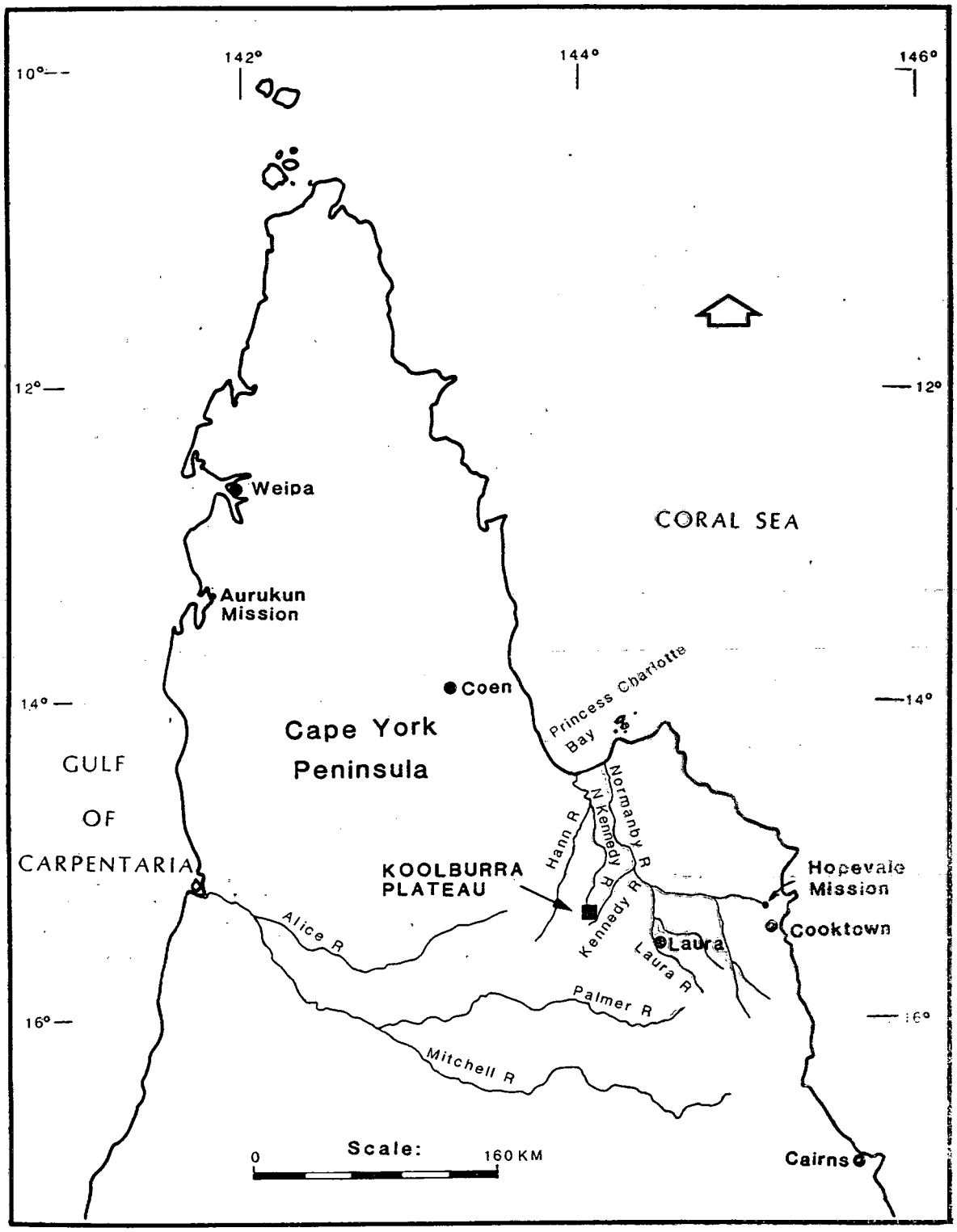


Figure 1. Map of Cape York Peninsula, northeast Queensland showing the location of the Koolburra Plateau study area.

Laura region there is a tract of sandstone extending over some 10,000km^2 which is listed in the Register of the National Estate under the name Quinkan Country, Quinkan being the Aboriginal name for malevolent spirits which are vividly portrayed in rock paintings of the region. This great belt of Cretaceous and Jurassic sandstone extends from the coast near Cooktown to the Hann River in the west, and from near Princess Charlotte Bay to the Palmer River from north to south (Figure 1). Aboriginal painting sites in this sandstone tract number many thousands.

The area of greatest relief is in the east and south where the sandstone plateau rises to 1700m ASL and is deeply incised by the Laura and Normanby Rivers. Further north and west lie undulating plainlands of less than 250m, where the most characteristic vegetation is open forest dominated by stringybark, Eucalyptus tetrodonta. In the Koolburra region the soils are generally red podzols, and the vegetation mainly dry sclerophyll woodland. Bloodwood-box woodland is characteristic of the valley floors, with a more stunted woodland on the plateau and upper slopes. Dispersed stands occur of grass trees (Xanthorrhoea australis) and fruit trees such as the nonda (Parinari nonda). In wetter areas species such as Pandanus, Melaleuca and Casuarina occur with occasional rainforest species.

The climate is of the dry monsoonal type, with a very marked seasonal rainfall. There is a long dry season which lasts from May to October. The wet season lasts from November to April, with average annual rainfall in the range of 800-1200mm. In the dry season water becomes scarce, although major watercourses such as the Kennedy River keep flowing. The region also boasts a number of permanent lagoons, which are an excellent source of lily roots and other plant foods. The temperature regime is tropical, with average monthly temperature around 27^{o}C.

Remarkably little fauna was seen in the course of our work in the Koolburra area. This relative paucity is surprising in a region where European settlement and exploitation is comparatively recent and of low intensity. However, it correlates with the paucity observed by John Winter in the Laura area (Rosenfeld et al 1981:45-49). Local tradition, according to Percy Trezise (Laura, pers. comm. 1981), suggests that the fauna was already depleted before European impact. It is also interesting to note how little game explorer Edmund Kennedy encountered on his disastrous expedition through the area (Beale 1970b). More recently, poison baits laid for dingoes have apparently had little effect on their population but considerable impact on other fauna. The environment is also being seriously degraded by the foraging of numerous wild pigs.

ETHNOGRAPHY

In his work on the Kuku-Yalanji from the Bloomfield area at the base of Cape York Peninsula, Anderson (1984) has provided a useful overview of the ethnography of the region. Whilst there is much local diversity, especially on the west coast of the peninsula, there is apparently a common genetic heritage among Aboriginal people of Cape York Peninsula (Kirk 1973). All languages appear to be "recent descendants of a common ancestral language now termed Proto Paman" (Sutton 1976). There likewise seems to be an underlying uniformity in social organisation, including kinship and marriage (McConnel 1939-40) and

local organisation, patrilineal clans and totemism (Sharp 1939). The traditional economies of the west and east coasts of the peninsula have been analysed by Lawrence (1968), who also found much similarity.

Peterson (1976:66) divides Cape York Peninsula into two culture areas (West Cape York and East Cape York) based on drainage divisions. The Koolburra Plateau, situated as it is on the spine of the Great Dividing Range, is on the boundary between the two.

Unfortunately, there is extremely little ethnographic data about the Koolburra and Laura region, which was inaccessible to researchers until the construction of the Cape York Developmental Road in the 1960's. Our knowledge of the area is therefore gleaned from anthropologists, linguists and others carrying out research at coastal settlements such as Aurukun, Hopevale, Bloomfield River and Princess Charlotte Bay, and from information that Trezise (1971) was able to gather from local Aboriginal elders at Laura in the 1960's.

Among ethnographers, the main sources of comparative data include the studies of Roth (1897, 1901-1910) on north Queensland Aborigines, the work of McConnel (1939-40), Thomson (1933, 1972), Sharp (1939), von Sturmer (1978), Sutton (1976) and others on the west coast, Haviland (1979) at Hopevale, Anderson (1979, 1984) at Bloomfield, Hale and Tindale (1933-4) and Chase (1975) in the Princess Charlotte Bay area. There has been almost no ethnographic work in the lower central part of Cape York Peninsula, apart from that by Brady et al (1980) in the Palmer River Valley to the south of the Laura-Koolburra region.

The traditional way of life of Aboriginal people occupying the spine of the peninsula was therefore never recorded, except in a few fragmentary references. In 1974 some fieldwork was carried out in the Laura area by Harris (1976) concerning traditional patterns of plant food procurement, but this project was never completed. The following preliminary account, however, gives an overview.

> In the open-canopy woodlands that extend over the greater part of the interior of the Peninsula, most staple plant foods were obtained from localised habitats or micro-environments within the woodland ecosystem. Stream channels and freshwater swamps, which support food plants such as palms, pandanus, sedges, and water-lilies through the long dry season, were the most important of these micro-environments. They yielded starch-rich vegetable foods in abundance, which were complemented by animal proteins and fats obtained from terrestrial animals, fish and birds. Staple plant foods were also obtained from scarps and other steep or irregular slopes where pockets of deeper, damper soil accumulate around rock outcrops and favour the growth of yams and other tuberous plants. Such micro-environments are sometimes associated with freshwater springs and with rock shelters, as in the Laura area (Rosenfeld, A.I.A.S. Newsletter n.s. no. 3, January 1975), so that their attraction as living areas is greatly enhanced. Drier and more exposed slopes also functioned as foci of plant-food procurement because they often support stands of cycads (Cycas spp.). These palm-like plants produce starchy but poisonous seeds in large, easily harvested quantities, and, being highly resistant to burning, are differentially favoured by the fires

> that sweep through the woodlands in the dry season. A detailed study of these plants was made. Their attraction as a food source lay in their abundant yield of large seeds, in the ease of harvest, in the possibility of storage, and in their occurrence in concentrated stands (Harris 1976:22).

According to Tindale (1974:176), the Koolburra plateau and the Laura area both lie in the tribal territory of the Kokojawa, their boundaries running from south-east of the Morehead River west of the Hann River to Laura, south to the North Palmer River and the Great Dividing Range, and including the Upper Mosman and Kennedy Rivers. Tindale's data and map are primarily based on information from Roth (1897 and 1901-10) and his own expedition to the Princess Charlotte Bay area (Hale and Tindale 1933). Trezise (1971:7) disagrees with Tindale, and, arguing on the basis of information collected from local Aboriginal elders in the 1960's that the sandstone area around Laura was the country of the Gugu-Minni people (alternative renditions of these names are Koko-, Kuku- or Gogo-jawa and Koko-, Kuku, or Gogo-minni or -mini). The Koko-mini, according to Tindale (1974:176-7) occupied the middle Palmer and Mitchell Rivers west to about their junction, east to Mt. Mulgrave and Palmerville. A variety of tribal maps exist for the region (Thomson 1972; Roth 1910; Haviland 1979; Brady, et al 1980; Rigsby 1980). There is considerable variation amongst these authorities concerning the names and locations of tribes, but one common feature is that the Koko-mini are always placed further to the west than the Koko-jawa or Koko-warra.

The Koko-warra occupied an area inland from Princess Charlotte Bay. According to Hale and Tindale (1933: 69-70):

> The Koko-warra tribe of Roth was known by contact to member of the Koko-Lamalama, with whom we conversed at Bathurst Heads. They were said to live on the upper waters of the Normanby River and to extend as far as Laura. Their main camp was at a place called "Daidan", which the authors have since recognised as being the Deighton River. This is probably the "Laura-Deighton" tribe, whose brass "king plate" was accidentally kicked up out of the sand by one of us on a beach at Flinders Island.

The Deighton River lies between the Normanby River and Laura, so this group, the Koko-warra, would seem to have occupied at least the eastern portion of the Laura sandstone region. To their west the country would seem to have belonged to the koko-jawa, also called the koko-ramul (Tindale 1974:176,284). These people were described by Roth (1910:18) as belonging to the Morehead River, which lies just west of the Hann River, well to the west of Laura. Roth in his ethnographic bulletin (no. 14) on transport and trade (1910:18) described their trade with neighbours as follows:

> At Princess Charlotte Bay, the Koko-ramul of the Morehead River give the Koko-warra (whose 'country' extends along the course of the Normanby and Deighton Rivers) reed-spears, iron-scraps, European tomahawks etcetera, getting in return melo shell, grass-reed-spears, nautilus-shell necklaces, stingaree spears and fishing nets. The Endeavour and Bloomfield River Blacks travel up in the direction of the Laura River, and supply the koko-warra with red-ochre, white-clay, grass-tree

spears etcetera, which are paid for with the same articles as are supplied to the Koko-ramul.

The Koko-minni, according to Roth, (1910) had their home around the middle Palmer River, and were at Maytown with their main camp at the head of the King River (a tributary of the Palmer River). "They wander between these, Laura and Palmerville" and "the Koko-minni form the means of communication between natives on the gulf and east coasts" (Roth 1910:94-95). Roth's map of the Koko-minni's movements showed arrows to both west, east towards Laura and north-east towards Koolburra Creek. This implies that the Koko-minni did not actually occupy the Koolburra Plateau, but did visit there, presumably for trade among other reasons.

From this rather lengthy discussion, we conclude that the Koolburra Plateau was the country of the Koko-jawa (=Kokoramul) people. Their territory, according to Tindale (1974:176), was about 7800km^2 in area, and was centered on coordinates 144^o 10' E and 15^o 30' S (this is exactly the same latitude but about 5 minutes of longitude to the east of Koolburra Plateau). Koko-jawa territory seems to have extended as far east as the Laura River but, to the east of Laura, the Koko-warra people occupied the Deighton and Normanby.

Although almost nothing is known of these groups, it is important to note that the Koolburra Plateau and much of the Laura area seem to fall within the same tribal territory, especially in view of the fact that their rock art is stylistically very different (discussion below).

Population movement in the last century and the early part of this century has made it virtually impossible to find descendants of the pre-European groups who have knowledge of the region. Thus, there exists no ethnographic information directly relating to the area. Indirect evidence is in the form of impact on Aborigines by explorers and miners. The first white explorers to venture near the Laura district were members of the ill-fated Kennedy expedition of 1848 (Beale 1970a, 1970b), who passed about 10km to the west of the Koolburra Plateau (Figure 2). Next were the Jardine brothers in 1864, overlanding cattle to Somerset at the tip of Cape York. Their route was even further to the west of the Laura district (Bolton 1970, Robinson 1983). William Hann's party, exploring Cape York Peninsula in 1872 for the Queensland Government, was the first to actually pass through the Laura district (Hann 1873). His route took the party through the centre of the sandstone country, past numerous painted rock shelters which they apparently did not sight, and close to the southern end of the Koolburra Plateau. Hann's party was the first to find traces of gold on the Palmer River, and started the Palmer River gold rush in the following year (Mulligan 1904).

The initial track from Cooktown to the Palmer River was very circuitous and, like Hann's route, passed close to the Koolburra Plateau. It is not surprising that local Aboriginal groups reacted with hostility to the coming of the Europeans. In country that may not have been well stocked with game in the first place (Trezise 1973:27), the presence of thousands of miners would have irreversibly upset the ecology. The diggings were essentially abandoned by 1883, but those 10 years had had a major impact on the indigenous inhabitants. The combination of loss of their land, the economic and spiritual base of the society, a decade of violent conflict, social disruption and introduced diseases reduced the population of the Kuku-mini and Kuku-Yalanji in the Palmer River

area to a handful of individuals and family groups. Aboriginal people from further north towards Laura were similarly affected, and moved to fringe camps around former gold centres such as Maytown. It is therefore possible that Koolburra Plateau Aboriginal sites have not been occupied since the 1880's. In contrast to the Laura area, no European subjects appear in the Koolburra rock art and, unlike the sites of Early Man Shelter and Mushroom Rock, no historic artefacts were found on open campsites or in rockshelter deposits in rockshelters.

In more recent times the Koolburra area has been a cattle property run by the Gostelow family. However, as the cattle do not venture far up into the escarpment country, they have had little or no impact on the environment surrounding the rockshelters. There has likewise been little impact from tourism or mining. There were very few visitors to the area until the construction of the developmental road in the 1960s, and the Koolburra Plateau lies some 13km west of this road (Figure 3). Some mineral exploration has taken place and the track into Green Ant Shelter owes its origin to this activity.

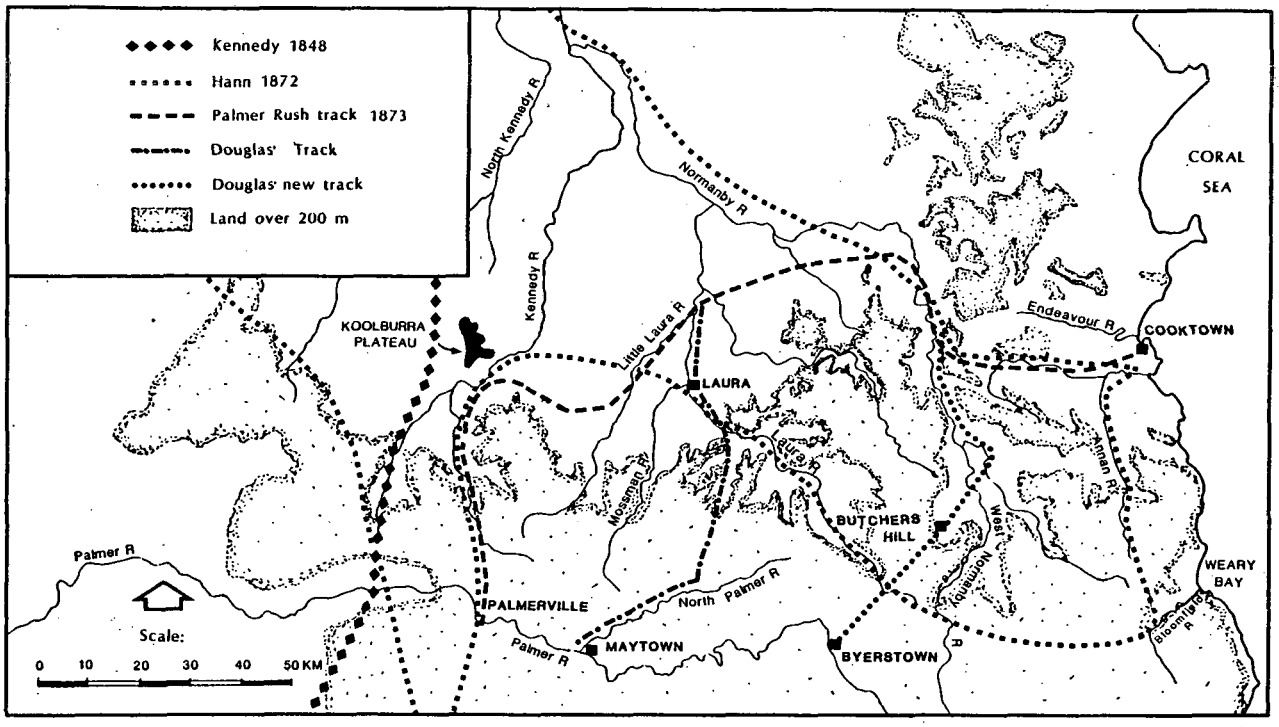


Figure 2. Routes of explorers and gold miners in the 19th century.

THE KOOLBURRA PLATEAU

The Koolburra plateau (Figure 3) is separated from the Laura area by the Kennedy River and some 40km of plains. The topography is more gentle than that around Laura. It forms the extreme northwestern part of the Laura sandstone area; to the west of Koolburra rolling plains extend to the west coast of Cape York Peninsula. The rocky plateau is about 15km long and up to 7km wide, occupying an area of about 45km^2. It is surrounded by a plain elevated between 100m and 130m ASL clothed with dry sclerophyll woodland dotted with occasional lagoons. The plateau rises from 140m ASL to a maximum of 282m ASL. Immediately to

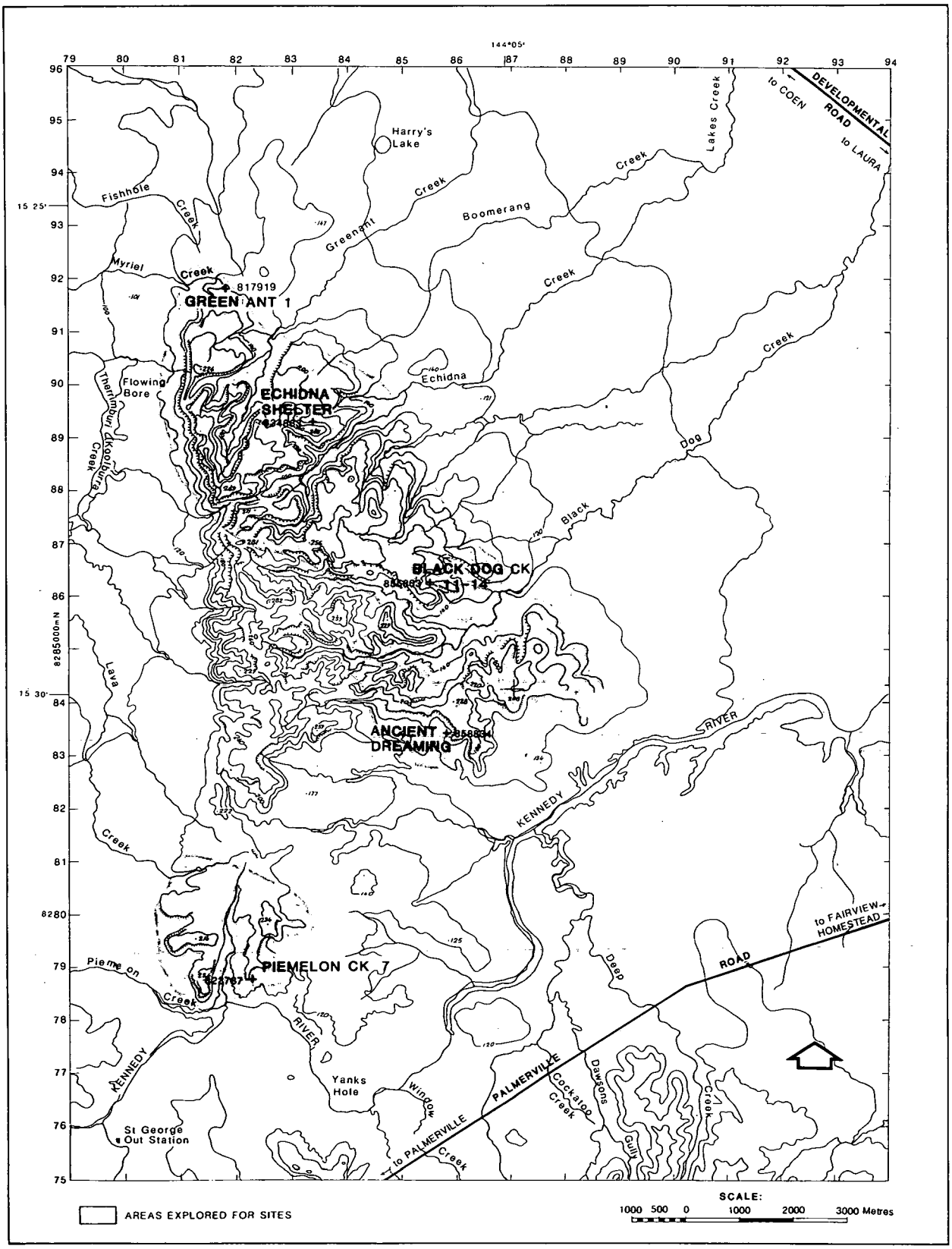


Figure 3. Detailed map of the Koolburra Plateau showing locations of major sites and archaeologically explored areas.

the south lies the Kennedy River which is a permanent source of water. Most other rivers and creeks in the area dry up in winter, but four fairly large creeks flowing eastwards from the Koolburra Plateau retain pools of water even at the height of the dry season. A low escarpment running almost due north-south forms the western boundary of the plateau, but on the east side the ground is more broken and a series of valleys lead into the heart of the plateau.

RESEARCH AIMS

The Koolburra project focussed attention on an area in Cape York Peninsula where archaeological work had not previously been carried out. Because of its location on the spine of the Great Dividing Range, the Koolburra region is a potentially important link between west and east Cape York. It is also on the easiest natural route southwards into the Australian Continent from the tip of Cape York. Cape York Peninsula is one of the most likely entry points for Pleistocene voyagers into Australia, and previous research by Rosefeld et al (1981) established human presence in the Laura area by 13,000 B.P. Excavations of Mushroom Rock by Wright (1971) likewise suggested considerable antiquity for human occupation of the Peninsula.

The project was a multi-attribute regional survey, with the following aims:

1) to obtain one or two archaeological cultural sequences by excavation, in order to establish an age bracket for the art, to reach a fuller understanding of the prehistoric culture and technology of the region and of changes over time and space, and to make comparisons with the cultural systems of adjacent regions;

2) to further investigate certain questions raised by previous archaeological work in the Laura region, such as the possibility that there was a warmer, wetter phase between about 9000 and 3000 B.P. (Rosenfeld et al 1981:13-14; Kershaw 1975);

3) to carry out an intensive archaeological survey of a sample of the study area, recording every site within it, in order to elucidate the prehistory of the region, inter-site patterning and the relationship between different types of sites;

4) to record as many art sites as possible in the region, in order to combine this evidence with that of archaeological excavation to document the workings of the regional cultural system, to study factors causing variability in the rock art and to compare the Koolburra art with that of adjacent regions in order to illuminate the prehistory and cultural systems of Cape York Peninsula. This study involved analysis of the inter-regional distribution of motifs, styles, techniques and superimpositions in a sample of sites from the north, centre and south of the plateau, and a comprehensive site survey to record all art sites in two smaller selected areas in the vicinity of the excavated rockshelters;

5) to study factors causing damage or deterioration to the art and occupation sites and to make recommendations for their conservation and management. A particular study was made of damage by termites.

This paper relates to the first and second aims above, and the third is addressed by Lilley (1986 - this volume). Description of the rock art study, in which 165 sites were recorded, will be published separately. Two rockshelter deposits were selected for excavation; Green Ant Shelter in 1981 and Echidna Shelter in 1982. Both appeared to have great research potential, and the rest of this paper is devoted to a description of these two excavations.

GREEN ANT SHELTER

Green Ant Shelter is at the base of the northern tip of the Koolburra Plateau (Figure 3). It is located at AMG point 817919 on the 1:50,000 Lakes Creek map sheet 7767-III (latitude 15° 26′ S, longitude 144° 02′ E) and lies at an elevation of 170m ASL. There is a permanent soak in a small creek bed some 200m to the west, and a small permanent creek about 1km west of the site. Some 4km away to the northeast across the wooded plain is a lagoon, Harry's Lake. This would have been an excellent source of food such as lily roots. The site was discovered in 1978 by Percy Trezise who noted unusual engravings there. He named it Green Ant Shelter, after the ubiquitous small green ants which weave their nests in every bush and lie in wait to sting the unwary passer-by.

The site is a sandstone rockshelter which faces north and measures approximately 12m in length and 3.5m in width (Figure 4). Its maximum height inside the dripline is about 3m, but the roof at the western end of the shelter is much lower. The earth floor is fairly level. The shelter faces out on to a grassy area surrounded by other large sandstone boulders forming a sort of amphitheatre. On the south side of the shelter the hill rises up to the plateau and there is a certain amount of slopewash into the shelter at both ends.

An initial inspection of the site by Flood and Trezise in 1979 revealed an occupation deposit being exposed by erosion at the dripline and a few stone artefacts lying on the surface. The back wall of the shelter is covered with a mass of engravings and a few paintings. At the west end a huge mound of the termite Coptotermes acinaciformis covered a considerable amount of this wall. This colony was removed before excavation commenced in 1981, revealing intact engravings and traces of paintings destroyed by the termites. The engravings at Green Ant Shelter consist of pecked mazes, pits, macropod tracks, bird tracks, human hands and feet and other motifs. Some are light in colour and appear relatively fresh, others are deeply weathered and seem to have considerable antiquity. Some engravings clearly extend below the present ground surface.

The Excavation

Excavation of Green Ant Shelter was carried out by Earthwatch volunteers under the direction of Flood, Horsfall, Cubis and Lilley, for 5 weeks in July-August 1981 and for 2 weeks in July 1982. Approximately 350 person-days were spent on the excavation. At the same time the shelter's rock art was recorded by tracing and photogrammetry and casts were made of the below-ground engravings.

Excavation was by 5cm spits and natural layers. Horizontally, the

excavation unit was a 1m x 1m square, except for square 018 which was excavated in 50cm x 50cm quadrants. However, data from these quadrants have been combined in the present analysis. Finds were recorded in three-dimensionally in situ wherever possible, using a survey level. All material was sieved through 2mm, 5mm and 9mm sieves. The provenance of artefacts which came from the sieves could be established within one square metre horizontally and within 5cm vertically (except in 018). In 1981 flotation was applied to a sample of the majority of spits in squares N20, S20 and R20 and this procedure recovered a number of small organic remains (see below). Excavation continued until bed rock was reached or until no impact could be made on the decomposed rocky matrix in spite of repeated efforts with a pick. Approximately one sixth of the site's $30m^2$ of earth floor and potential occupation deposit was excavated. This involved excavation of about $5m^3$ of deposit.

One of our objectives was to uncover part of the back wall of the shelter in the hope of revealing engravings which extended to a considerable depth. The area initially excavated was $2m^2$ along the wall in the low, western end of the shelter, where it was very clear that engravings extended below the present ground level. These pits were designated R20 and S20 according to an alpha-numeric grid system laid over the site composed of 1m x 1m squares. It soon emerged that the wall in this vicinity was steeply undercut, so these squares were extended southwards into R21 and S21 (Figure 4). These pits did not produce a very satisfactory cultural sequence, however, since artefacts were relatively few in number and the deposit was disturbed by slabs of rockfall.

The second stage of the excavation involved opening up another 1m x 1m square (N21) against the back wall, this time in the centre of the shelter where there was better headroom, and where engravings also extended below the ground surface. This was later extended outwards to N20. Finally, in 1982 a further square (018) was excavated in the centre of the shelter just inside the dripline. This pit yielded the greatest number of artefacts, least disturbance by rock fall and the oldest occupation. Thus, the cultural sequence described for Green Ant Shelter is largely based on evidence from 018. However, this area also produced problems, as described below in relation to dating, probably because of its proximity to the dripline and consequent possible truncation of the deposit.

Stratigraphy

The matrix was fairly homogeneous and distinct horizons were not discernible. The main stratigraphic change was a gradual one from the upper layers of sand in varying shades of brown and degrees of compaction to the lower rubble deposits.

There was no obvious disturbance from animals but remains of termite mounds occurred in the deposit. There was also considerable roof fall in the area adjacent to the back wall. The maximum depth of excavated deposit was approximately 1m. Seven main layers could be distinguished in section (Table 1 and Figure 5A,B). Visual impressions of the colours of layers at the time of excavation were followed later by the Munsell colour identifications on dry samples in the laboratory. The soil pH was consistently between 3.5 and 4.5 throughout the deposit.

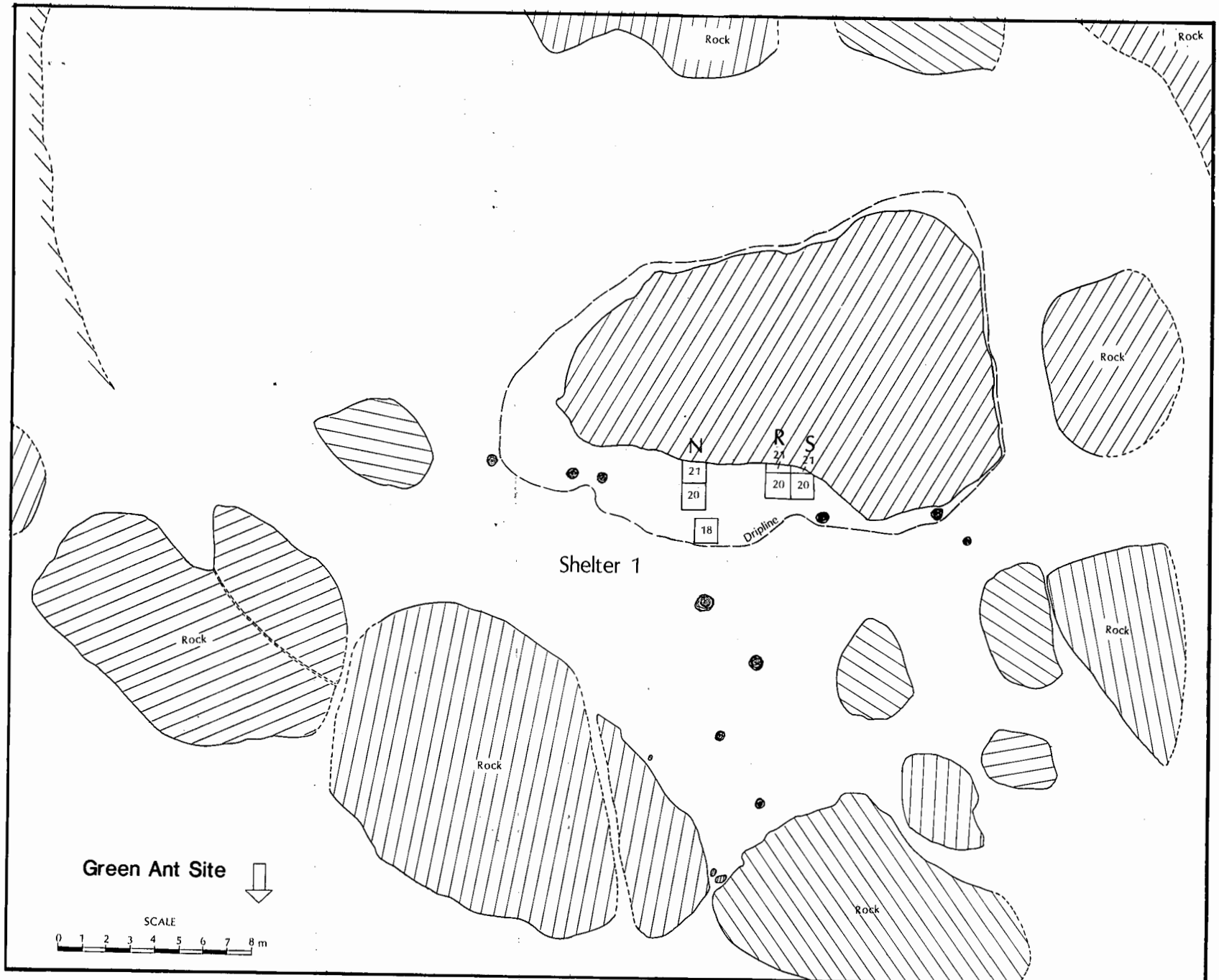


Figure 4. Plan of Green Ant Shelter showing excavated squares.

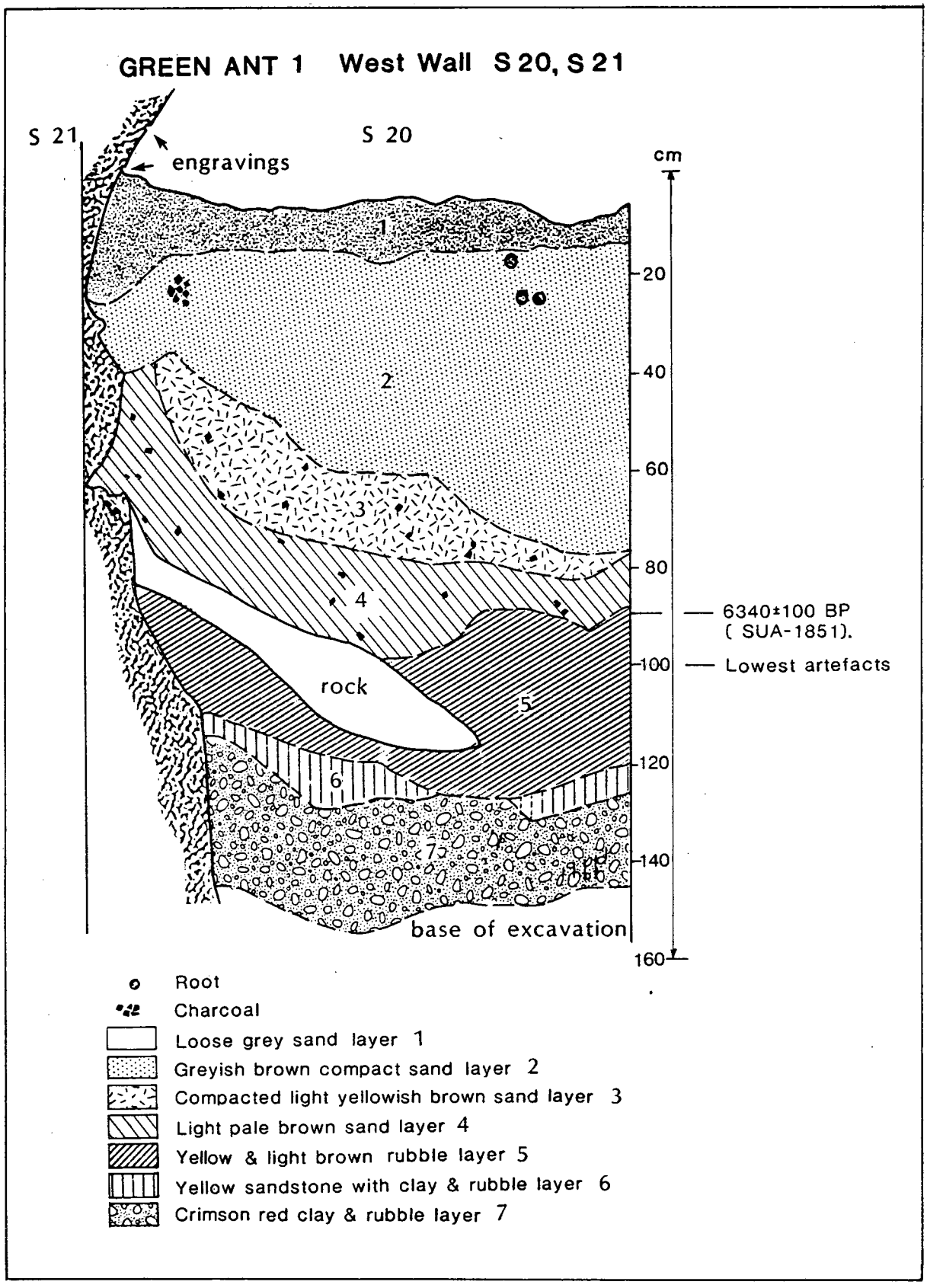


Figure 5a. Stratigraphic section of west wall of Square S20, Green Ant Shelter.

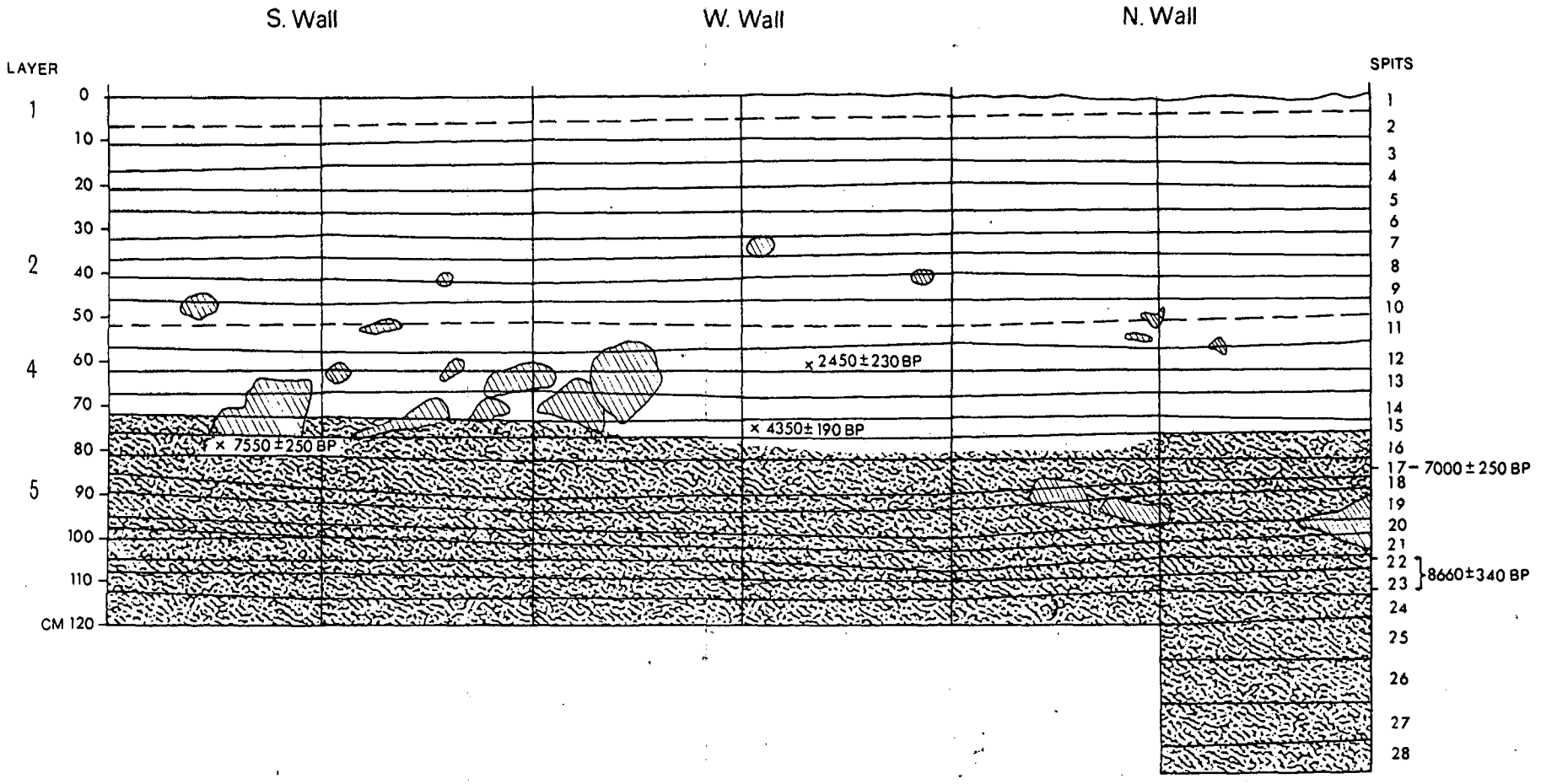


Figure 5b. Stratigraphic section of south, west and north walls of Square 018, Green Ant Shelter, showing spits and dates (note that Layer 3 does not occur in this square)

Table 1. Stratigraphy of Green Ant Shelter.

LAYER NO.	DESCRIPTION	MUNSELL COLOUR
1	Fine brown sand with scattered charcoal; loose to firm compaction	10YR 4/2 -"grayish brown"
2	Fine grayish brown sand with scattered charcoal (an increase from layer 1); firm to hard compaction	10YR 3/2 - "dark grayish brown"
3	Fine light yellowish-brown sand with scattered charcoal. Hard and compact; only found adjacent to back wall.	10YR 5/3 -"grayish brown"
4	Fine pale brown sand with 'pinkish' cast; very few scattered pieces of charcoal.	7-5R 4/1 -"grayish brown"
5	Yellowish-brown rubble/gravel layer. The little charcoal was generally close to boundary with Layer 4. Rocks were present and matrix was compact but not hard.	7-5YR 5/4 - "yellowish brown"
6	Yellowish sandstone, clay and rubble (not present in all squares).	7.5YR 6/4 -"light brown"
7	Reddish clay and rubble layer (not present in all squares).	5YR 5/4 -"reddish brown"

Dating

Eight charcoal samples were submitted for C14 dating and the results are shown in Table 2. The S20 and N20 dates were obtained at the end of the 1981 excavation, when it was not intended to continue digging. The S20 samples from Layer 5 were submitted to date the lowest used ochre and charcoal and proved identical (although separated vertically by >5cm). The N20 samples were intended to date the lowest engravings and to give some indication of the rate of accumulation of the deposit. They indicate a rate of approximately 9cm per 850 years or 10.5cm per 1000 years.

Table 2. Radiocarbon Dates from Green Ant Shelter

SQUARE & QUADRANT	SPIT	DEPTH (CM)	DATE B.P.	LAB.NO.	SAMPLE	ASSOCIATION
018 N.W.	12	61	2450±230	ARL-148	Charcoal	Artefacts
018 N.W.	15	75	4350±190	ARL-149	Charcoal	Artefacts
018 S.E.	16	79	7550±250	ARL-224	Charcoal	Artefacts
018	17	82-86	7000±250	ARL-150	Charcoal	Artefacts
018	22/23	105-114	8660±340	ARL-151	Charcoal	Lowest artefacts
N20	5	17-20	720±50	Beta-3776	Charcoal	Artefacts
N20	7	25-30	1570±60	Beta-3777	Charcoal	Lowest engravings
S20	20B	84-88	6340±70	Beta-3778	Charcoal	Lowest used ochre
S20	23	92-98	6340±100	SUA-1851	Charcoal	10cm above lowest artefacts

In 1982, when preliminary excavation of Echidna Shelter showed Green Ant Shelter to be the deeper and more productive site, it was decided to try to obtain a better cultural sequence from Green Ant Shelter by excavating a square in the centre, away from the back wall but inside the dripline. Cultural deposits in this square (018) extended to a depth of about 115cm. Initially, four 14C dates were obtained from 018 (ARL 148-151), and an age-depth curve was drawn (Figure 6A). The rates at which the deposits have accumulated are variable. The rate is about 25cm/1000 years in the upper horizon of 018 (spits 1-12), about 5cm/1000 years in the middle layer (spits 13-17), and about 16cm/1000 years in the lower horizon (spits 18-23).

In view of the very long time which apparently elapsed between spit 15 (75cm) and spit 17 (82-86cm) and the fact that the ARL-150 sample was collected from over the whole square, a further date (ARL-224) was obtained on a piece of charcoal collected *in situ* and precisely located in spit 16 between the 4350 ± 190 BP (ARL-149) and 7000 ± 250 BP (ARL-150) dates from spits 15 and 17 respectively. This gave an age of 7550 ± 250 BP. An age-depth curve incorporating ARL-224 rather than ARL-150 (see Figure 6B) might therefore be expected to be more accurate. In fact it accentuates the variation in accumulation rates.

On the whole, the integrity of the deposit seems quite good. There are 15 sets of conjoined artefacts (Figure 7), and most are from the same or adjacent spits. One set of three conjoins (#1254, #1306 and #1329) spans spits 15, 16 and 17 in 018, possibly suggesting some kind of disturbance at this level. A paired conjoin, also in 018 (#1168 and #1280) is displaced 29cm, but this probably represents curation at least in part. Number 1280 is a flake removed from number 1168, and the latter has been retouched on the flake scar.

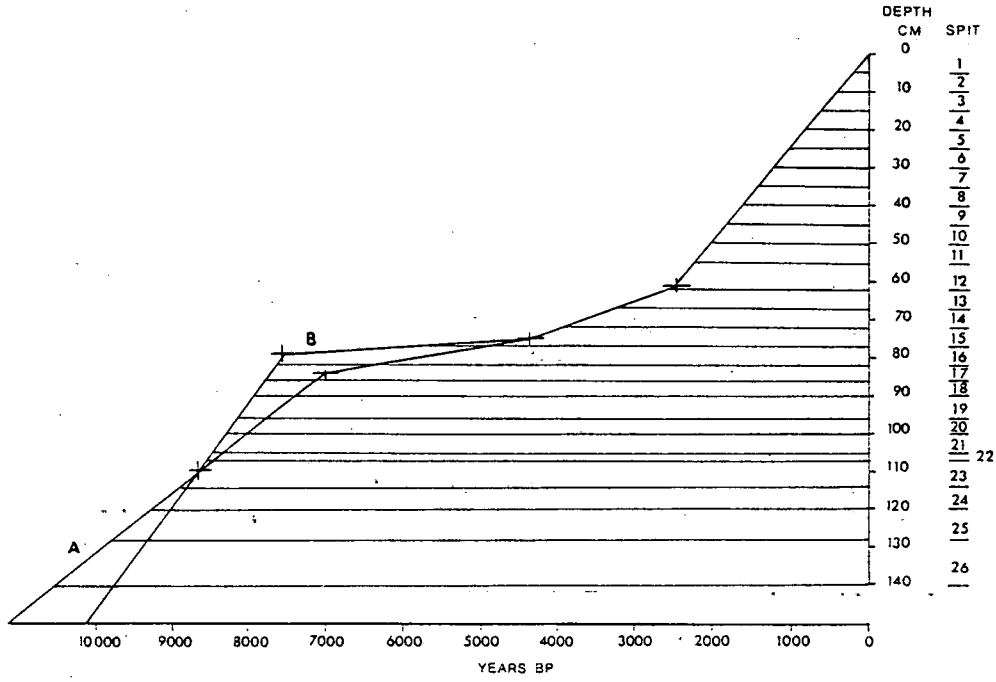
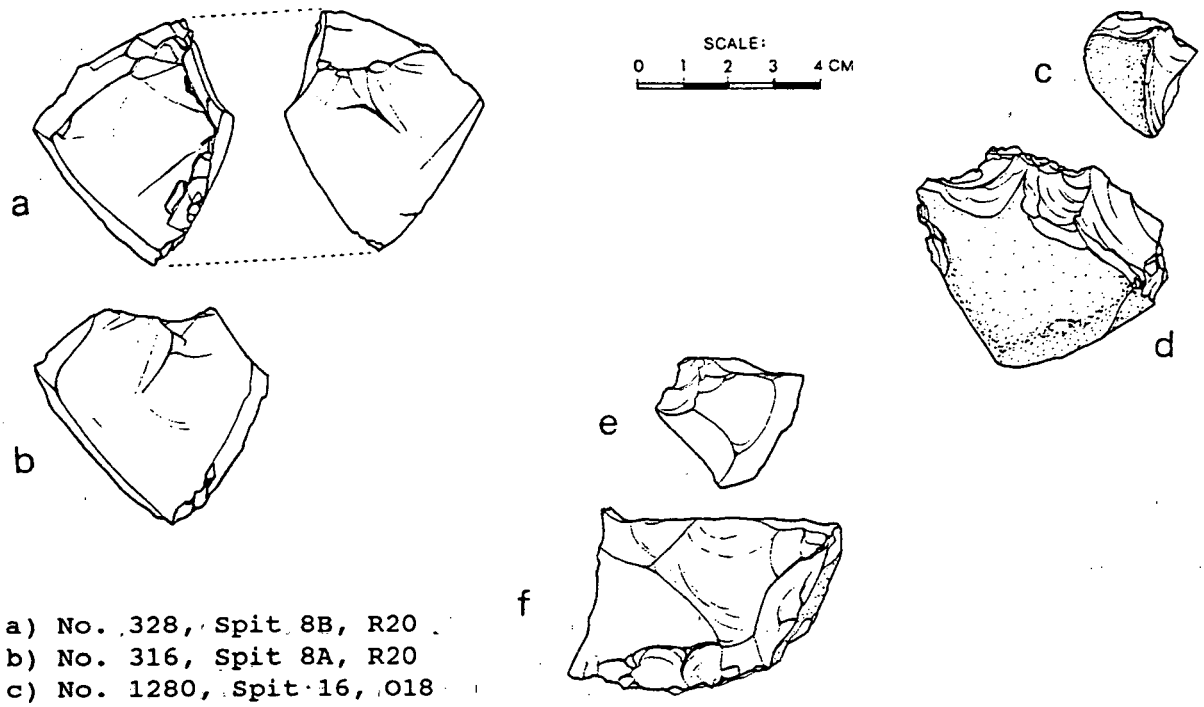


Figure 6. Age-depth curve for Green Ant Shelter (018).

A detailed analysis was made of all excavated material from square 018 (see Table 3). Data is presented by spits, but because spits are not representative of equivalent time spans, an averaged age-depth curve was used to calculate rate of deposition for certain categories of material. The rates of sediment accumulation (kg/100 years) are there seen to be markedly reduced in spits 13-17. The distribution of unmodified sandstone rocks showed that much greater quantities were present in spit 16 and below, with the transition occurring in spits 14 and 15. None of the rocks was very large and there were no large slabs of roof fall in square 018. (Fairly large blocks of roof fall were encountered in all other excavated square, particularly N20, R20 and S20.) A similar increase in the amount of rocks with increasing depth was found throughout the site. The amount of charcoal in the deposit, however, decreased with depth (Table 3), which is often characteristic of sandstone rockshelters.

The artefact discard rate is variable (Figure 8), but noticeably lower for spits 13-15. This corresponds with the low sediment accumulation rate for about the same time span. The data regarding sediment accumulation and artefact discard rate were analysed for each quadrant in square 018 as well as for the square as a whole, as shown in Table 4. In each spit of each quadrant comparisons were made between the absolute number of artefacts (greater than 20mm), their percentage vertical distribution, the number of patinated artefacts present, the colour, texture and nature of the sediments, and the number of artefacts per kilogram of sediment. Whilst the latter is not as meaningful a measure of artefact discard rate as number of artefacts per 100 years, it is a useful means of comparison of relative artefact densities between excavation units in this type of comparative analysis. Artefacts of less than 20mm were omitted from the analysis by quadrants in case they represented tool manufacturing waste and therefore skewed the results in favour of times when tool manufacturing was being carried out in the shelter.



a) No. 328, Spit 8B, R20
b) No. 316, Spit 8A, R20
c) No. 1280, Spit 16, O18
d) No. 1168, Spit 10, O18
e) No. 962, Spit 17, N20
f) No. 871A, Spit 17, N2

Figure 7. Conjoined artefacts from Green Ant Shelter.

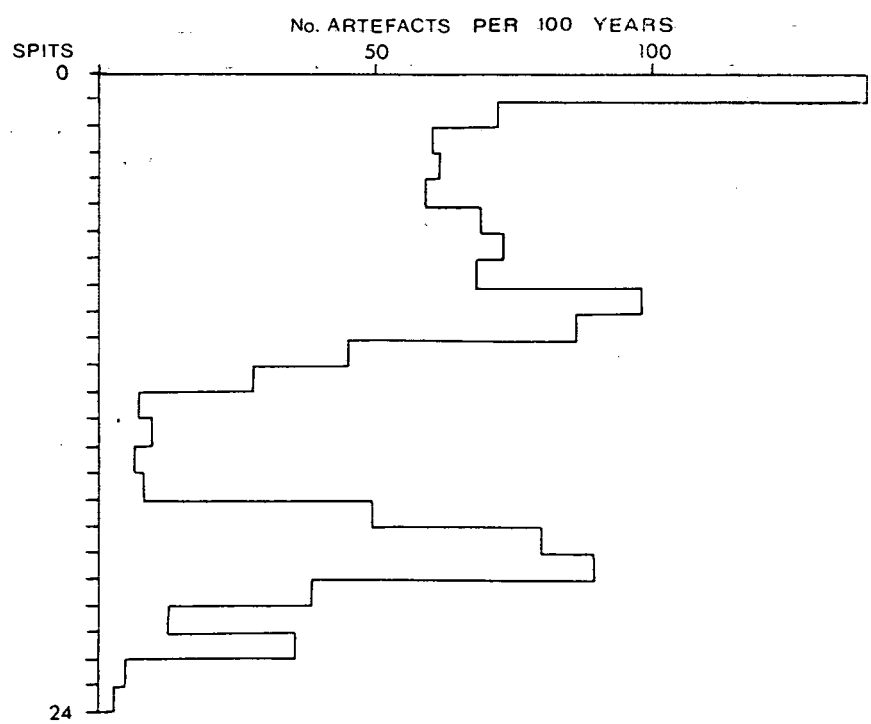


Figure 8. Artefact discard rate: number of artefacts (total) per 100 years at Green Ant Shelter (square O18).

The major points which emerge from this analysis and the data on Table 3 and 4 are:

a) A broadly consistent sequence is found in all quadrants. Its major feature is a much higher artefact discard rate and a greater number of patinated artefacts around 7000 BP than before or after.

b) The dates of 7000 and 7550 BP both date the end of the period of high artefact discard rate and high sedimentation rate. This is followed by a period of low artefact discard and sedimentation until about 2550 BP. These rates then rise again and reach their highest levels since 7000 BP in the surface layer.

c) The quadrants (NW and NE) nearest the dripline contain twice as many artefacts as the other quadrants. This would seem to indicate a greater use of the outer part of the shelter floor for activities involving use of stone artefacts. This correlates well with results obtained by Morwood (1981) in the Central Highlands, where the interior of shelters was apparently used for sleeping, and the dripline area and exterior for tool-manufacturing.

d) A much higher percentage of patinated artefacts is found in the quadrants (NW and NE) closest to the dripline. The NE quadrant is closest of all to the dripline and contains the highest number of patinated artefacts. These are concentrated in the upper part of the basal rocky horizon (layer 4) between about 8000 and 7000 BP, at about 2500 BP and in layer 1 on the present ground surface. While proximity to the dripline clearly correlates with an increased number of patinated artefacts, there is no evidence that this also caused truncation of the deposit, for the amount of sediment in each of the four quadrants is virtually identical, with 26% in the NW, 25% in the NE and SW and 24% in the SE.

e) The amount of sandstone rocks (of greater than 5cm) in the deposit is high from the beginning of occupation until about 5500 BP, when the percentage of rocks to sediment drops from more than 30% to 17%. About 3250 BP it declines again to 6% and remains low for the rest of the site's history (see Table 3). With increasing depth the amount of rocks increases, whereas the quantity of sediment per 100 years decreases. This could indicate a lag deposit, in which the rocks remain but some of the sediment disappeared.

The low artefact discard rate would seem to imply reduced occupancy of the site between about 7,000 and 2,500 BP. The correspondingly low rate of sediment accumulation appears to confirm the hypothesis advanced by Hughes (1980:11) that there is a direct relationship between occupancy of the site (as measured by artefact discard rate) and accumulation of deposits. The lack of bone in the middle layers of the deposit (see below) in spite of its presence above and below is additional evidence in support of the hypothesis of reduced occupancy. Likewise there is more ochre in the upper and lower levels of the site than in the middle layer, both in 018 and the other excavation squares well inside the dripline. Fifty per cent of the ochre pieces in the site as a whole occurs in the uppermost 45cm, only 17 percent at a depth between 50cm and 85cm, and 34 percent below 90cm. It is also possible, however, that the increased precipitation posited by Kershaw (1975) between about 9,000-3,000 BP contributed to increased run-off and removal of sediment

Table 3. Chronological changes in quantity of sediment, rocks and artefact densities in square O18,

LAYER	SPIT	AGE (YEARS BP)	DEPTH (cm)	TOTAL SEDIMENT WEIGHT (kg)	ROCKS >1cm (kg)	CHARCOAL (gm)	RATIO OF CHARCOAL TO SEDIMENT %	TOTAL FLAKED STONE ARTEFACTS >20mm (gm)	NO.(A) FLAKED STONE ARTEFACTS >20mm #	NO.(B) FLAKED STONE ARTEFACTS <20mm #	NO.OF kg SED. PER 100 YRS #	NO.OF ARTEFACTS (A) PER 100 YRS	TOTAL ARTEFACTS (A and B) PER 100 YRS	BONE	OCHRE PIECES
I	1	0-800	0-8	59.75	3.75	2.25	3.7	156.6	39	12	7.4	4.8	6.3	0	0
II	2	800-1400	8-13	53.75	10.00	0.70	1.3	700.8	58	10	8.9	9.6	11.3	0	0
	3	1400-2400	13-19	60.25	3.50	0.75	1.2	166.8	38	13	6.0	3.8	5.1	X	0
	4	2400-2950	19-23	54.50	2.75	0.65	1.1	327.2	21	4	9.9	3.8	4.5	X	1
Total II		800-2950		168.50	16.25	2.10	1.2	1194.8	117	27	7.8	5.4	6.6		
III	5	2950-3650	23-27	46.50	4.25	0.50	1.0	359.7	18	6	6.5	2.5	3.4	X	0
	6	3650-4150	27-30	60.75	2.50	0.55	0.9	175.3	32	3	12.1	6.4	7.0	X	2
	7	4150-5100	30-36	59.75	3.75	0.70	1.1	157.3	31	1	6.2	3.2	3.3	X	1
Total III		2950-5100		166.00	10.50	1.75	1.0	692.3	81	10	7.7	3.7	4.2		
IV	8	5100-5650	36-42	83.75	4.00	0.95	1.1	352.5	40	4	15.2	7.2	8.0	0	1
	9	5650-5950	42-48	70.00	0.00	0.90	1.2	209.4	34	5	23.3	11.3	13.0	X	3
	10	5950-6450	48-54	101.25	0.00	0.95	0.9	368.0	29	0	20.2	5.8	5.8	X	3
	11	6450-6850	54-59	78.75	0.00	0.80	1.0	292.1	25	2	19.6	6.2	6.7	0	0
Total IV		5100-6850		33.75	4.00	3.60	1.0	1222.0	128	11	19.0	7.3	7.9		
V A	12	6850-7280	59-65	24.00	4.00	0.10	0.4	2.3	1	0	11.1	0.2	0.2	0	0
	13*	7280-7650	65-70	15.50	6.00	0.05	0.3	7.2	1	0	16.7	0.2	0.2	0	0
Total V Upper				39.50	10.00	0.15	0.3	9.5	2	0	13.7	0.2	0.2		
V B	14*	½m² only*	70-75	20.25	6.50	0.05	0.2	0	0	0	-	0	0	0	0
	15*	"	75-80	33.00	14.00	0.05	0.1	0	0	0	-	0	0	0	0
	16*	"	80-90	34.00	13.00	0.05	0.1	0	0	0	-	0	0	0	0
	17*	"	90-106	27.00	10.50	0.05	0.2	0	0	0	-	0	0	0	0
Total V (A and B)				153.75	54.00	0.35	0.2	9.5	2						11
Grand Total				355.20		10.05		3275.2	367	60					

Table 4. Chronological changes in artefact densities in the quadrants of square 018, Green Ant Shelter.

	SPIT	NW** Quadrant Artefacts (>20mm) #	NW** Quadrant Artefacts (>20mm) %	NW** Quadrant Pat. #	NW** Quadrant # Arts. 1kg sed.	SW Quadrant Artefacts (>20mm) #	SW Quadrant Artefacts (>20mm) %	SW Quadrant Pat. #	SW Quadrant # Arts. 1kg sed.	NE** Quadrant Artefact (>20mm) #	NE** Quadrant Artefact (>20mm) %	NE** Quadrant Pat #	NE** Quadrant # Arts. 1kg sed.	SE Quadrant Artefacts (>20mm) #	SE Quadrant Artefacts (>20mm) %	SE Quadrant Pat #	SE Quadrant # Arts. 1kg sed.	Square 018 Overall Artefact (>20mm) #	Square 018 Overall Artefact (>20mm) %	Square 018 Overall Pat. #	Square 018 Overall # Arts. 1kg sed.
LAYER 1	1	28	13.5	5	1.30	8	9.0	1	**0.38**	8	3.1	1	**0.48**	2	1.9	1	0.10	46	7.0	**8**	**0.55**
LAYER 2	2	3	1.4		0.15	8	9.0	1	**0.58**	0	0.0		0.00	5	4.8		0.30	16	2.4	1	0.23
	3	7	3.3		0.35	5	5.6		0.33	7	2.7		0.33	4	3.8	1	0.21	23	3.5	1	0.30
	4	7	3.3		0.37	6	6.8		0.36	3	1.1		0.14	5	4.8		0.26	21	3.2	0	0.28
	5	6	2.8		0.28	2	2.2		0.11	6	2.3		0.33	5	4.8		0.28	19	2.9	0	0.27
	6	5	2.4		0.25	0	0.0		0.00	3	1.1		0.17	3	2.9		0.16	11	1.6	0	0.15
	7	8	3.8	1	0.45	3	3.4		0.17	5	1.9		0.29	8	7.7	1	0.44	24	3.6	2	0.35
	8	9	4.3	1	0.51	2	2.2		0.10	8	3.1	2	0.43	5	4.8		0.26	24	3.6	3	0.33
	9	14	6.7	2	**0.65**	4	4.5		0.22	21	8.2	4	1.00	6	5.8		0.30	45	6.8	6	**0.58**
	10	9	4.3		0.37	8	9.0		**0.40**	14	5.4	2	0.64	8	7.7		0.39	39	5.9	2	**0.50**
	11	8	3.8	1	0.49	4	4.5		0.20	7	2.7	1	0.35	2	1.9		0.10	21	3.2	2	0.28
	12	9	4.3	2	0.38	2	2.2		0.10	16	6.2	**11**	**0.80**	0	0.0		0.00	27	4.1	**13**	0.34
	13	2	0.9		0.11	4	4.5		0.32	7	2.7	3	0.37	4	3.8	1	0.20	17	2.6	4	0.25
	14	1	0.5	1	0.05	8	9.0		0.32	2	0.7	1	0.10	5	4.8		0.35	16	2.4	2	0.21
	15	2*	0.9	1	0.11	3	3.4		0.16	9	3.5	1	0.56	5	4.8		0.66	19	2.9	2	0.33
	16	11	5.3	1	0.60	5	5.6	1	0.21	42	16.4	**7**	**2.66**	15&	14.5	1	**0.92**	73	11.1	**10**	**1.03**
	17#	19	9.1		1.33	8	9.0		0.56	32	12.5	4	**2.25**	1	0.9		0.07	60	9.1	4	**1.05**
LAYER 4	18	15	7.2	1	**1.29**	1	1.1		0.08	26	10.1	**12**	**2.24**	11	10.6		0.94	53	8.1	**13**	**1.13**
	19	24	11.5	**4**	**0.88**	5	5.6	**4**	0.18	24	9.4	**18**	**0.88**	8	7.7		0.29	61	9.3	**26**	**0.56**
	20	10	4.8	3	**0.92**	2	2.2	1	0.18	7	2.7	2	0.64	1	0.9		0.09	20	3.0	6	0.45
	21	1	0.5	1	0.10	0	0.0		0.00	5	1.9	2	0.54	0	0.0		0.00	6	0.9	3	0.16
	22@	7	3.3	1	0.38	0	0.0		0.00	2	0.7		0.10	0	0.0		0.00	9	1.3	1	0.12
	23@	1	0.5		0.08	0	0.0		0.00	1	0.3		0.08	0	0.0		0.00	2	0.3	0	0.04
	24	1	0.5		0.05	0	0.0		0.00	0	0.0		0.00	0	0.0		0.00	1	0.1	0	0.01
TOTAL		207		25		88		8		255		71		103		5		653		109	

* = in situ sample
** = quadrant closest t dripline
____ = slight change in texture and colour of sediment between Layers 2 and 4 (no Layer 3 in Square 018)

* = 2450 ± 230
* = 4350 ± 190
& = 7550 ± 250
# = 7000 ± 250
@ = 8660 ± 340

resulting in a lag deposit. Square 018 is close to the dripline, and an accumulation of patinated artefacts, some slightly waterworn, was found during excavation of this square, especially in spits 16-19. Likewise, the percentage of rocks but low amount of sediment per 100 years may be indications of a lag deposit. On the other hand, the evidence of a bimodal distribution of bone and ochre came from squares well inside the dripline. There are no indications that any of the deposit and assemblage was washed downslope, and the ground inside and in front of the shelter is fairly level.

The hypothesis which best fits the evidence is that in the period between about 2,500 and 7,000 BP there was both increased precipitation and decreased occupancy of the Green Ant Shelter. This could be explained by the comparatively shallow overhang the shelter provides in contrast to other sites with much more weatherproof overhangs. It is likely that these shelters were mainly used in the wet season for protection against the monsoonal rain. In the dry season, at least in the ethnographic present in Cape York Peninsula, hunter-gatherers tend to focus on food-rich areas such as waterholes, lagoons and rivers, camping in the open rather than in rockshelters. Local Aboriginal informants such as Norman Upton were categoric that rockshelters such as Green Ant were wet season shelters.

Excavated Material

Organic remains

At first glance, the only organic material surviving in the excavated deposits was charcoal. This was present in greatest quantities in the upper layers, decreasing to practically nil in the lowest levels (Table 3). No animal remains were observed during excavation, apart from living termites and other small burrowers. The termites in particular were thought to be responsible for the absence of bone. Plant remains were largely confined to the surface layers (leaf litter, small seeds and an occasional piece of pandanus fruit), although roots and rootlets were present to some depth.

A search (using a binocular microscope with 50X magnification) for small plant and animal remains in the flotation samples and samples of fine residues from the finest sieve was more productive. In addition to various plant fragments (stems, petioles, leaf fragments, flowers, bark, seeds and grass glumes), stone chips, rootlets, charcoal, insects and faeces, a number of samples yielded tiny pieces of bone.

These pieces of bone have been recovered from three of the six squares excavated in 1981 (N20, N21, S20), and there appears to be a bimodal distribution of bone according to depth. Much of the bone has been found in the upper layers, between the surface and a depth of 48cm and thus is probably less than 2000 years old. (Evidence of modern termite activity has not been noted deeper than 65cm). The remainder of the bone was located between 85cm and 124cm below the surface and is likely to be in excess of 6300 years old. Unfortunately, the bone fragments are unidentifiable.

The distribution of organic material at Green Ant Shelter may be compared with that at the Early Man Shelter (Rosenfeld et al 1981:43-

44). There bone survived in the lower levels but not in the upper ones. No adequate explanation for this phenomenon has yet been forthcoming. One possibility at Early Man Shelter might be that dingo scavenging accounts for the absence of bone in the upper layers. However, the bone distribution at Green Ant Shelter cannot be attributed to this factor in view of the presence of bone in both the upper and lower, presumably pre-dingo, layers.

A team of CSIRO entomologists and termite experts, led by Dr. Tony Watson, visited Green Ant Shelter and other sites at our invitation in 1982. Whilst the focus of their work was on methods of preventing damage to rock paintings by termites, another outcome was some experimental research on termites' appetite for bone. Since the laboratory experiments proved conclusively that termites do consume bone (Watson and Abbey 1985), it is possible that the distribution of bone in these sites is affected by the presence or absence of termites (as well as other factors such as acidic soil). In neither Early Man Shelter nor Green Ant Shelter is there a sufficient sample of bone on which to speculate how changes in its distribution might relate to changes in human behaviour, such as eating food away from the shelter.

Termites

The antbed or termite mound material at Green Ant Shelter is probably derived from large mounds built by Coptotermes acinaciformis. As no living termites were found in the excavation (unlike Echidna Shelter), the antbed was probably all derived from mounds built by termites in the past. This antbed is not burnt, and it is unlikely to have been brought into the shelter by Aborigines to use as fuel, since the area is heavily wooded and there was always likely to have been an abundance of firewood available throughout the period the shelter was occupied. Antbed occurred to a maximum depth of 67cm, just below charcoal dated to 2450± 230 BP.

Ochre

Ochre was present in the deposit, but not in great quantity. The $5m^3$ excavated yielded 79 pieces. Yellow ochre predominated (200gm), followed by red (144gm), brown (100gm), and white (1gm). Ochre appears to have been used throughout the occupation of the site, but was not evenly distributed, as has been described above. The earliest ochre ("red" and "brown") came from a depth of 100cm to 105cm below ground surface (in spit 21 of square 018), immediately above the radiocarbon date of 8660± 340 BP and below that of 7550± 250 BP. The white pigment came from a depth of 10cm in S20 and from 85-95cm in spits 18 and 19 of 018, dated to approximately 8000 years ago. This is important evidence that white pigment was in use long before the recent period of rock painting, which is often characterized by extensive use of white.

The sample sizes of both ochre and rock paintings are too small to attempt any correlation between the distribution of ochre in the deposit and the quantity, technique or colour of the paintings on the back wall. It is interesting nonetheless that whereas all the rock paintings at Green Ant Shelter seem fresh and overlie the engravings, ochre is found back to levels dated in excess of 7500 years. Of course, ochre does not

always signal rock art, and could have been used for other purposes such as body painting or the decoration of artefacts.

Pieces of haematite and ferruginous sandstone also occurred. During excavation these were named 'ochre crayons', but on analysis they proved to be surface-modified artefacts with one or more ground facets, mostly made of ferruginous sandstone or haematite rather than ochre. They are not ochre since they do not mark paper like pieces of soft ochre found in the deposit. The facetted, smoothed, ground or grooved areas found on their surfaces may result from their use as a grindstone or whetstone, possibly in the preparation of ochre pigment in view of the heavy ochre staining present on many of them.

Stone Artefact Analysis

Stone artefacts with a maximum dimension greater than 20mm were measured and described following a scheme proposed by Mardaga-Campbell et al (1982; see also Mardaga-Campbell and Campbell 1985), with some minor modifications. Artefacts less than 20mm maximum length were sorted into raw material categories (see below), and weights and numbers per excavation unit were recorded.

Raw materials

Artefacts were classified into their respective raw material categories which were grouped as follows:

Group I. chert: Almost all the modified artefacts are in Group I, which also includes cherty mudstone. The chert is smooth, fine-grained and sometimes banded. There has been some debate as to whether it is chert or silicified mudstone, but authorities such as Dr. J. Kamminga (pers. comm) consider this material chert without doubt.

Group II. quartz: the quartz is predominantly opaque and milky quartz, with some clear transparent quartz.

Group III. other: mainly quartzites and sandstones, with occasional volcanics.

The proportions of raw materials in square 018 at Green Ant Shelter are shown in Table 5.

These raw materials all seem to be available locally. Chert sources were identified in the clifflines forming the edge of the escarpment about 4km from Green Ant Shelter. These deposits showed evidence of quarrying activity, both of removal of nodules from the chert veins and flaking debris in the locality. River and creek beds in the Koolburra area also contain cobbles and pebbles of a wide variety of raw material, which has been eroded out of the sandstone conglomerates. The geology of the region is described by de Keyser and Lucas (1968).

Stone artefact distribution

At Early Man Shelter, Rosenfeld (1981:22-23) showed a temporal

change in the selection of raw materials and a concomitant change in the size of artefacts. At that site there was an overall trend towards an increasing use of chert and the manufacture of smaller artefacts. No such change in the selection of raw material is discernible at Green ant Shelter over the 8500 years spanned by the occupation deposit, nor is there any indication of change in artefact size through time (Figure 9). Artefact size was also analysed by raw material, but again no significant temporal trends to smaller or larger artefacts emerged.

Table 5. Proportion of Raw Materials at Green Ant Shelter (Square 018)

RAW MATERIAL		NUMBER OF ARTEFACTS >20mm MAXIMUM DIMENSION	PERCENTAGE OF TOTAL
I.	**Chert**		
	(a) Chert (code 42)	412	
	(b) Laminated, banded chert (code 43)	96	
	(c) Cherty mudstone (code 12)	2	
	Group I Total	510	78%
II.	**Quartz**		
	(a) Opaque and milky quartz	74	
	(b) Clear quartz	1	
	Group II Total	75	11%
III.	**Other**		
	(a) Fine sandstone	9	
	(b) Quartz sandstone	3	
	(c) Quartzite	4	
	(d) Silcrete	28	
	(e) Volcanics	2	
	(f) Unidentified	8	
	(g) Other	14	
	Group III Total	68	10%
	Grand Total	653	

Another attribute tested for change was "chunkiness". When excavating the site, we received an impression that with increasing depth flakes tended to be more "chunky", that is, to have a higher thickness/breadth ratio. This impression, however, was not borne out by the analysis, which revealed remarkable homogeneity throughout the cultural sequence. The calculations were based on the breadth/thickness ratio, but breadth was taken as the lesser i.e. shorter axis of length and breadth of an artefact. (This was done to avoid distortion of the figures by side-struck flakes, but the breadth/thickness ratio using standard breadth measurement was also calculated and proved to be not significantly different).

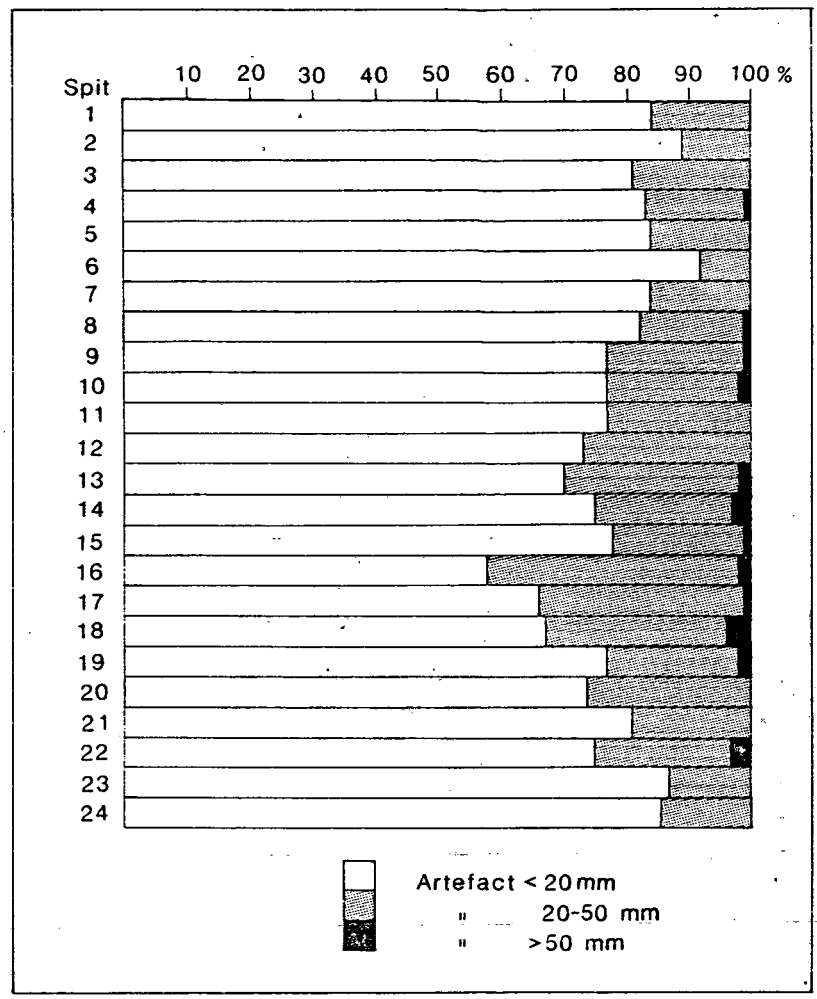


Figure 9. Distribution of flaked stone artefacts in Green Ant Shelter (square 018) by size.

The number of flaked artefacts of over 20mm in square 018 was 653, of which 55 or 9.2% had been modified. Twenty-six bore signs of retouch and 29 showed (macroscopic) signs of use-wear. The distribution of modified artefacts in 018 is shown in Figure 10. The percentage of modified to unmodified artefacts in each spit averages 11.7%, but the range is from 3.8% to 37.5%. The proportion of modified artefacts is highest (rising to 37.5 and 33.3%) in spits 6-7, at a depth of 25-35cm dating to ca. 1570 $\pm$ 60 BP (spit 6). This coincides with the peak in charcoal. However, the small sample size, with only 11 flaked artefacts in spit 6 and 24 in spit 7, means that not much importance can be attached to this peak.

The distribution of all flaked artefacts in square 018 is shown in Figure 10B. Occupation of the site commenced prior to 8660 $\pm$ 340 BP, but artefacts were few in the lowest occupation levels. However, the largest quantities of artefacts occur just below and within the 7000-year-old levels (spits 16 and 17). Two other minor peaks in artefact numbers are discernible in spits 9-10 and spit 1.

Flaked artefact modification attributes

The vertical distribution of various modification attributes of flaked artefacts was plotted to test for change through time. These included the percentage of the edge retouched or utilised, the edge angle and the shape of the edge. These attributes were selected because changes in the amount of retouch, the steepness of the working edges or the incidence of concave/convex edges have been identified in some other assemblages (cf. Flood 1974). No significant changes were discernible.

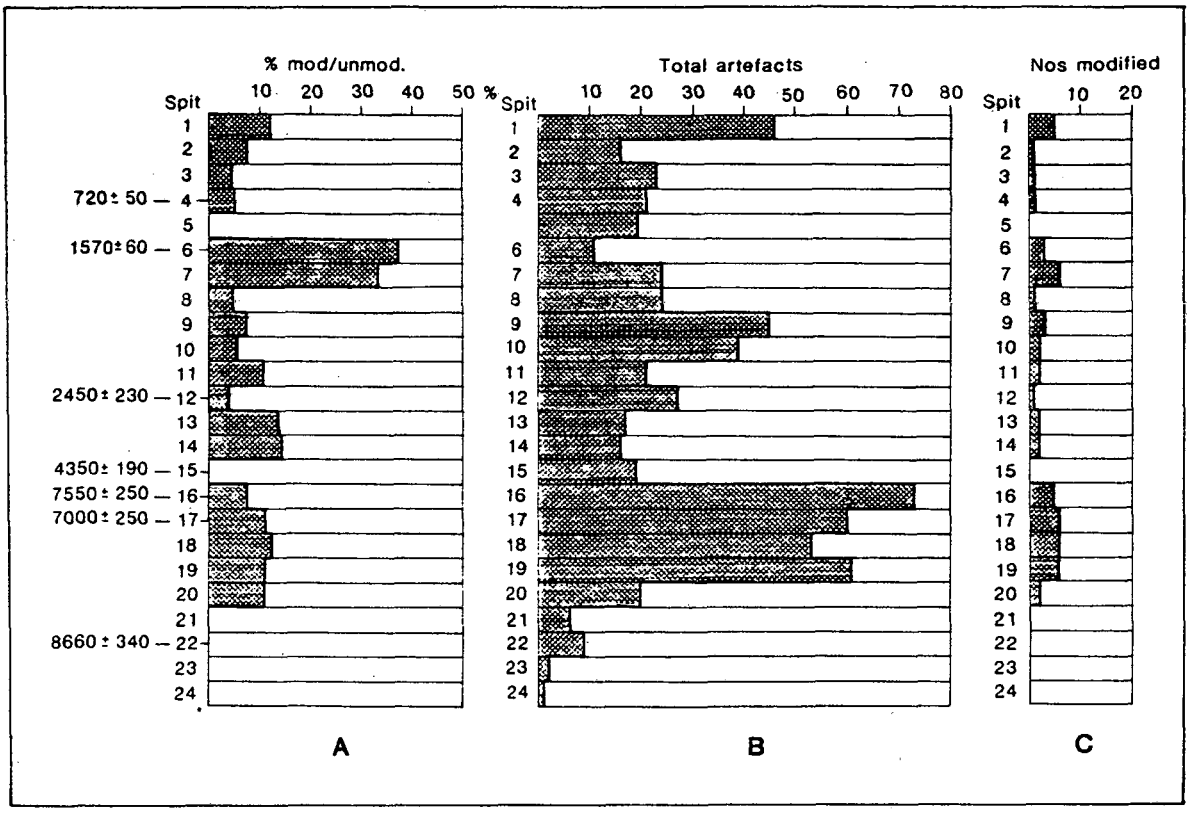


Figure 10. Distribution of modified flaked artefacts at Green Ant Shelter (Sq. 018). A: Percentage of modified/unmodified artefacts (incl. cores). B: Total number of artefacts plotted by spit (n=653). C: Number of modified artefacts plotted by spit (n=55).

Thermal fracture

All artefacts were examined for signs of thermal fracture. 103 artefacts were found to be thermally fractured, constituting 7.2% of all artefacts of more than 20mm. All were made of chert. There are no thermally fractured artefacts (and very few other artefacts) and very little charcoal below spit 19 in 018 or other squares, and the bulk of the charcoal and thermally fractured artefacts occur above spit 16. There is thus a reasonable consistency between the occurrence of charcoal and that of thermal fracture. This evidence suggests that thermally fractured artefacts are the result of Aboriginal activity, and that they correlate with the presence of charcoal. If this is the case, the

lack of charcoal in the lowest levels of the deposit may not be due solely to natural decay of charcoal over time, but may indicate much less occupation of the rockshelter. If, on the other hand, thermally fractured artefacts are primarily the result of natural bushfires, their absence in the lowest part of the cultural sequence is difficult to explain.

Stone artefact types

The major artefact categories identified were flake, core, flaked piece and fragment. These correspond closely with Hiscock's (1984) definitions of flake, core, flaked piece and non-diagnostic fragment respectively, although we may have been more ready than Hiscock to identify artefacts as flaked pieces. Initially two subdivisions of flaked pieces (chunks and flake-like pieces) were distinguished on morphological grounds, but these were later merged for the analysis.

Some of the artefacts from which flakes had been removed (cores in Hiscock's definition) were classified as used manuports. An example is the bifacial chopper in Figure 13 which was made on a natural piece of tabular chert. It is a shortcoming of many stone artefact classifications that a distinction cannot readily be made between cores resulting mainly from the production of flakes and those artefacts from which flakes have been removed to produce an edge, especially when the latter are based on otherwise unmodified pieces of rock (see also Mardaga-Campbell and Campbell 1985:111).

The majority of artefacts from Green Ant Shelter were flakes. The high numbers of flaked pieces and fragments appears to be due to the lack of clear conchoidal fracturing in much of the raw material, including chert, used at Green Ant Shelter. The numbers and proportions of these categories of artefacts are shown in Table 6A for Green Ant Shelter as a whole (including material from the surface of non-excavated squares) and in Table 6B for square 018. The remarkably close similarity in proportion distribution between these two tables supports the belief that the assemblage from square 018 may be taken as a characteristic sample of the whole body of excavated material.

Table 6C gives the distribution of these artefact categories among the three major types of raw material. Points to emerge are the predominant use of the finest-grained material (chert of Group I) for flakes, the greater occurrence of other materials such as volcanics (Group III) as used manuports, and the higher number of cores in quartz than other materials. It should be noted that no bipolar cores or flakes were found.

Table 6A. All Flaked Stone Artefacts (> 20mm) from Green Ant Shelter

	FLAKES	FLAKED PIECES	FRAGMENTS	CORES	MANUPORTS (USED)	TOTAL
Number	996	305	75	25	20	1421
%	70.1%	21.5%	5.3%	1.8%	1.4%	

Table 6B: All Flaked Stone Artefacts (>20mm) from Square 018

	FLAKES	FLAKED PIECES	FRAGMENTS	CORES	MANUPORTS (USED)	TOTAL
Number	437	173	32	9	2	653
%	66.9%	26.4%	4.9%	1.4%	0.3%	

Table 6C. Raw material of all Flaked Stone Artefacts (> 20mm).

	FLAKES	FLAKED PIECES	FRAGMENTS	CORES	MANUPORTS (USED)	TOTAL
Group I	825	201	62	11	4	1103
Chert	74.7%	18.2%	5.6%	0.9%	0.3%	
Group II	97	60	7	11	1	176
Quartz	55.1%	34.0%	3.9%	6.2%	0.5%	
Group III	74	44	6	3	15	142
Other	52.1%	30.9%	4.2%	2.1%	10.5%	
						1421

Cores: Very few of the cores are classic examples of the end product of flake production and most of them could be defined as "pre-cores" under the system proposed by Mardaga-Campbell and Campbell (1985:111). Twenty-five cores were found at Green Ant Shelter, of which 11 are quartz, 11 of chert, and three of other materials. Their weight ranges from 3gm to 224gm and length from 19mm to 78mm. They were fairly evenly spread throughout the sequence and no changes are apparent in size, raw material or platform angle over time. Figure 11 illustrates two cores from Green Ant Shelter, one tiny core of chert from the surface of the site and one of quartz from the base of the occupation deposit.

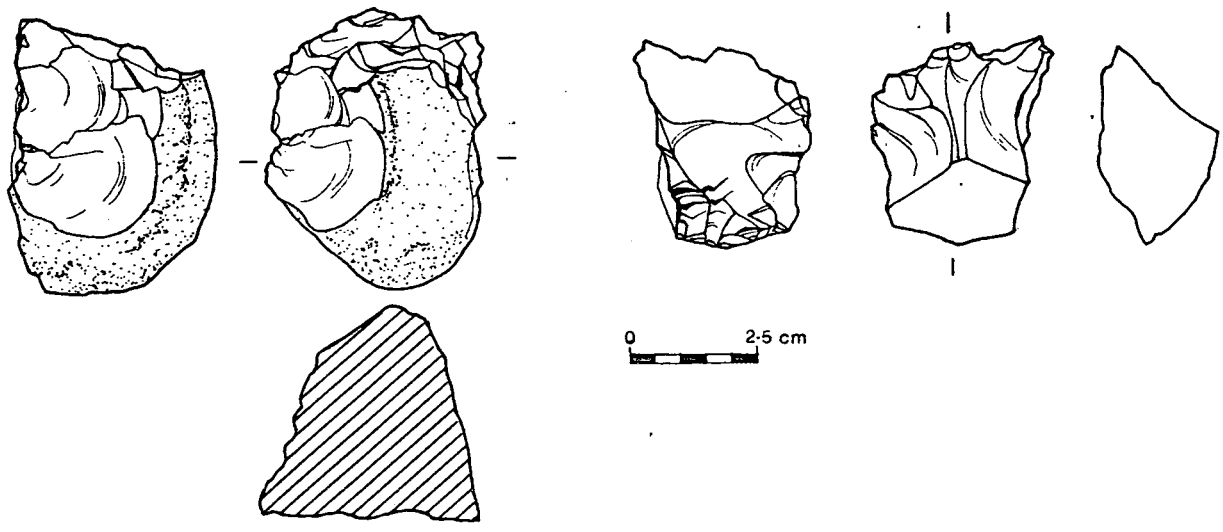


Figure 11. Cores from Green Ant Shelter. Left: tiny chert core with three platforms (018, Spit 1 - No. 1009). Right: quartz core dated to ca. 7000 BP. (018, Spit 17 - No.1409).

As Table 7 below shows, there are very few classic tool types amongst the modified material. Each are discussed below.

Table 7. Retouched and utilised stone artefacts from Green Ant Shelter

DESCRIPTION	NUMBER
Small flake scrapers	20
Backed flake scrapers	4
Retouched flaked artefacts (ie. with one or more retouched edges), including scrapers and point-like artefacts	35
Core tools (retouched manuports), including a bifacial chopper	3
Used flakes (ie. with one or more edges showing use-wear)	74
Hammerstones	2
Ground volcanic fragments (prob. edge-ground axes)	2
Grindstone	1
TOTAL	141

Small flake scrapers: these have been described by Kamminga who characterises them as follows:

> Morphologically, small flake scrapers are not a tightly bound group. Within certain limits, shape variations do occur although a basic design is discernible. Most often the flakes are long in relation to their width, which does not normally exceed 2.5cm. Only rarely is length greater than 5cm... Almost invariably, small flake scrapers were made from two fine-textured silicates - chalcedony and chert... The distinguishing feature of these tools is dorsal face retouch along one or both straight lateral edges. This retouch varies from scalar to abrupt step, hinge and retroflexed hinge fracturing on heavily retouched specimens. Sometimes the retouching was more pronounced in the middle of the working edge, giving it a slightly concave profile. While the dorsal surface is quite often irregular, the ventral face (normally bulbar face) is either flat or slightly convex (Kamminga 1978:340-341).

Such small flake scrapers have been variously termed side-struck adze flake, flat adze, rectangular scraper, and burren adze. The term burren was coined by McCarthy et al (1946:30) to describe a type of hafted adze, retouched on one or both lateral margins. "Burren adzes" from Early Man Shelter are thus described by Rosenfeld:

> The only type which occurs in significantly large numbers to justify identification as a formalised tool are the adze flakes. These are manufactured on a longitudinal flake, usually relatively thick and with a more or less tri-hedral section. One side with retouch is straight or concave, but never convex, and the edge angles range between 60-80°, with a few approaching 90°. The opposite edge shows much greater variability, being usually straight or slightly convex but sometimes irregular. This edge is either naturally blunt or

has some discontinuous retouch. The edge angles also show greater variation, from 40° to obtuse angles (Rosenfeld et al 1981:15).

Kamminga (1978:341-343) has carried out use-wear analysis of 25 small flake scrapers from Wright's excavation at Mushroom Rock near Laura (Wright 1971), as a result of which he characterised the Laura artefacts as wood scrapers, and excluded the possibility that they were wood adzes. Functional analysis of a sample of the Koolburra artefacts by Kamminga has led to a similar conclusion in relation to that material and this conclusion is supported by Dan Witter (pers. comm.) who has also examined a small sample. The term "adze" should therefore not be applied to these artefacts, which are small flake scrapers or scraper slugs (see examples in Figures 12 and 13).

The five flake scrapers from Green Ant Shelter illustrated in Figure 12 are all made on flakes and are all of chert. Retouch is usually abrupt and direct with the angle of the edge generally lying between 80° and 90°, and averaging 83°. Length ranges from 26mm to 50mm, breadth from 21mm to 33mm, thickness from 6mm to 14mm, and weight from 36gm to 140gm. Average length is 39mm, average breadth 25mm, average thickness 10mm, average weight 88gm. Half of the retouched edges are sinuous in shape, the others concave, straight or convex. One scraper has black resin adhering to both its dorsal and ventral face on the opposite margin to the abruptly retouched edge (Figure 12(b)). This is clear evidence of the method of hafting these artefacts.

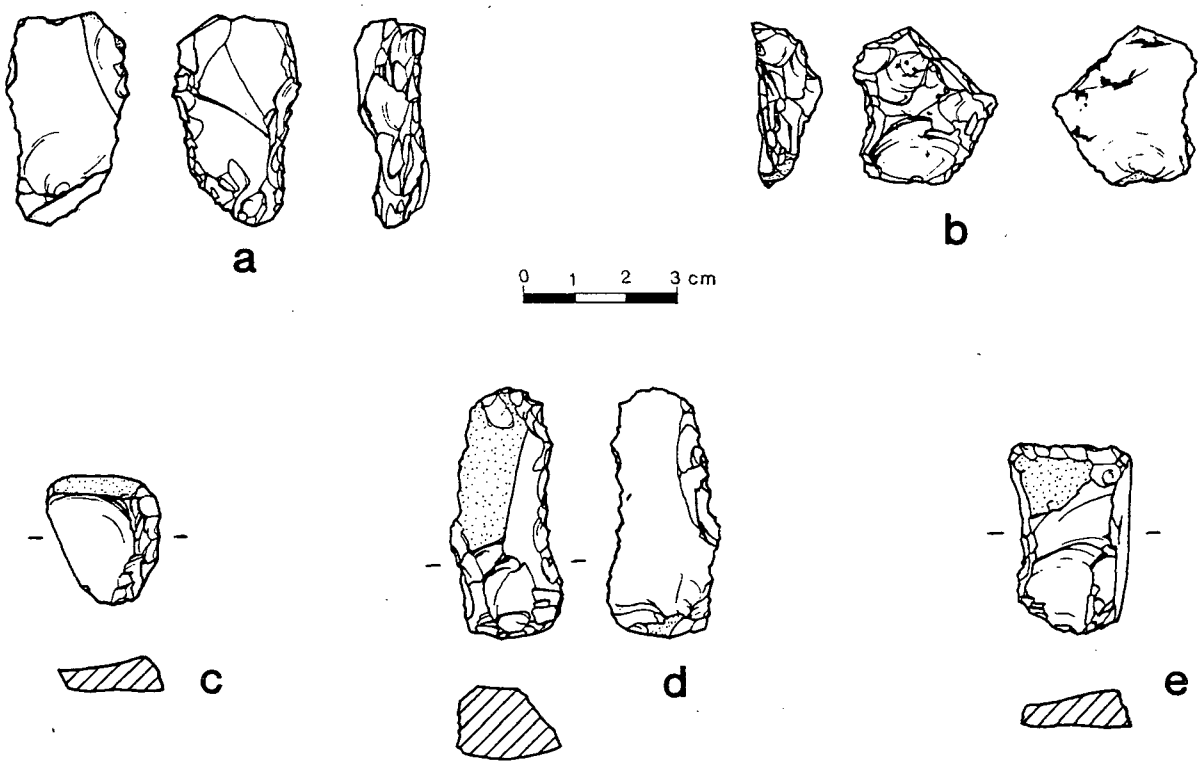


Figure 12. Small chert flake scrapers from Green Ant Shelter. a) No.690 - N20, Spit 7; b) No.362 - N21, Spit 2, showing extensive traces of black resin on both surfaces; c) No.392 - N21, Spit 4; d) No.270 - S20, Spit 7; e) No.1011 - O18, Spit 1.

Four small scraper slugs were found (Figure 13). They are all of chert, and their average dimensions are a length of 21mm, breadth of 28.5mm, thickness of 9.7mm and weight of 50gm.

All flake scrapers occurred between the surface and a depth of 60cm, and were distributed in all 5m^2 of the excavation. The lowest occurred in N20 spit 7, 30cm below the surface and were associated with the date of 1570 ± 60 BP, and in 018 spit 7, 45cm deep and 15cm above the date of 2450 ± 230 BP. By means of extrapolation from the depth-age curve, this spit is estimated to fit between 1200 and 1400 BP.

Backed flake scrapers (Elouera-like): Four chert examples occur and are illustrated in Figure 14. They average 33.2mm in length, 24.7mm in breadth, 10.5mm in thickness, and 61.2gm in weight, and in shape they approximate an orange segment. All have backing retouch to form a thick convex edge. Two occurred in the lower levels of square S20, one at 85cm below surface only 5cm above the date of 6340 ± 70 BP. The youngest was in spit 6 of 018 at 30cm below surface, and 30cm above the date of 2450 ± 230 BP, with an estimated age of between 1000 and 1200 BP.

Other scrapers: No thumbnail scrapers occurred, and only a few other retouched pieces which could be described as scrapers. Some of these are illustrated in Figure 15 (c to g). They are all of chert and display a wide variety in the shape and other attributes of their working edges. One scraper (Figure 15d) on a cortex flake has been identified by Kamminga as a hand-held wood saw with use-wear consistent with a sawing function such as fashioning of barbs on a wooden spear.

All these scrapers seem to be for light duty wood scraping or shaving, since they are often not robust and are retouched back to very small or narrow pieces of stone, which, when embedded in hafting resin, would not resist much load before breaking. There seems to have been a shortage of good quality chert and thus artefacts were used until they had worn back to a thin slug and had to be discarded (Kamminga pers. comm.).

Kamminga has compared prehistoric small flake scrapers and ethnographic hafted flake scrapers (eg. Mulvaney 1975:234) and comments:

> Tindale (1965:153) observed the use-life of a flake scraper on a spearthrower over a two week period in 1933 (SAM A21673) and his description of its transition from an initially unretouched flake to a worn-out slug with abrupt retouch along both lateral margins corresponds with the forms of retouch exhibited by the prehistoric samples. To further accentuate the correspondence between the ethnographic and prehistoric scrapers there is direct evidence to indicate that at least a proportion of the latter tools were formerly hafted (Kamminga 1978:342).

Evidence of hafting resin was identified on flake scrapers in both excavated assemblages from the Laura area (Wright 1971:138; Rosenfeld pers. comm.), as well as at Koolburra. Further discussion of the precise function of the Koolburra small flake scrapers must await the results of Kamminga's detailed analysis, but there seems little doubt that they were used as wood scrapers and were functionally equivalent to the thumbnail scraper or small hafted end scraper (Kamminga 1978:344).

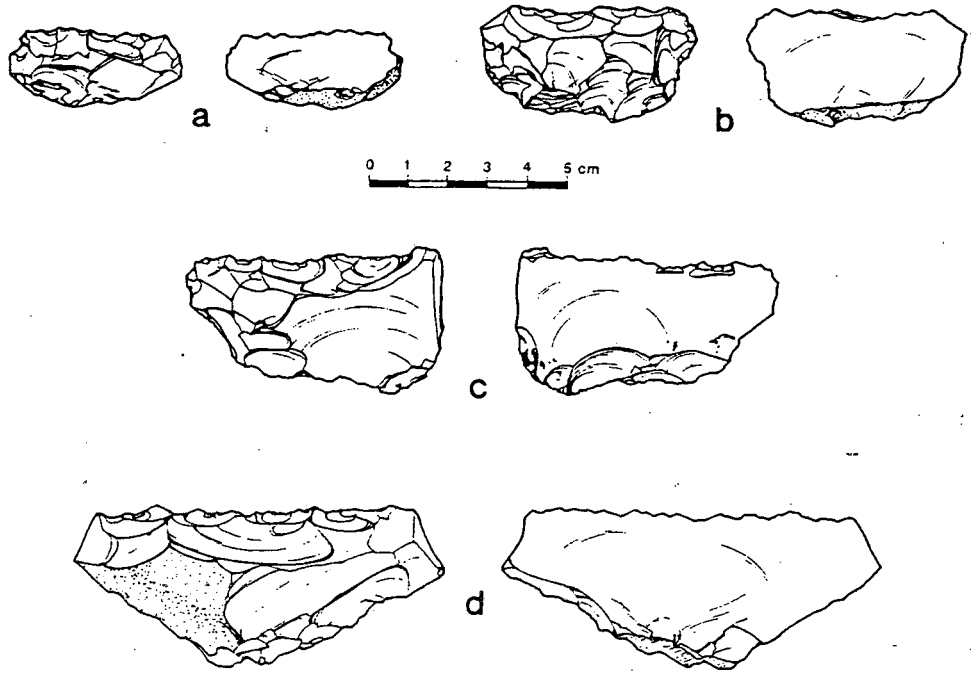


Figure 13. Small flake scraper slugs from Green Ant Shelter. a) No.279 - R20, Spit 7a; b) No.1115 - O18, Spit 7; c) No.680 - N20, Spit 7, showing traces of black resin on the ventral surface opposite the working edge; d) No.417 - N21, Spit 7.

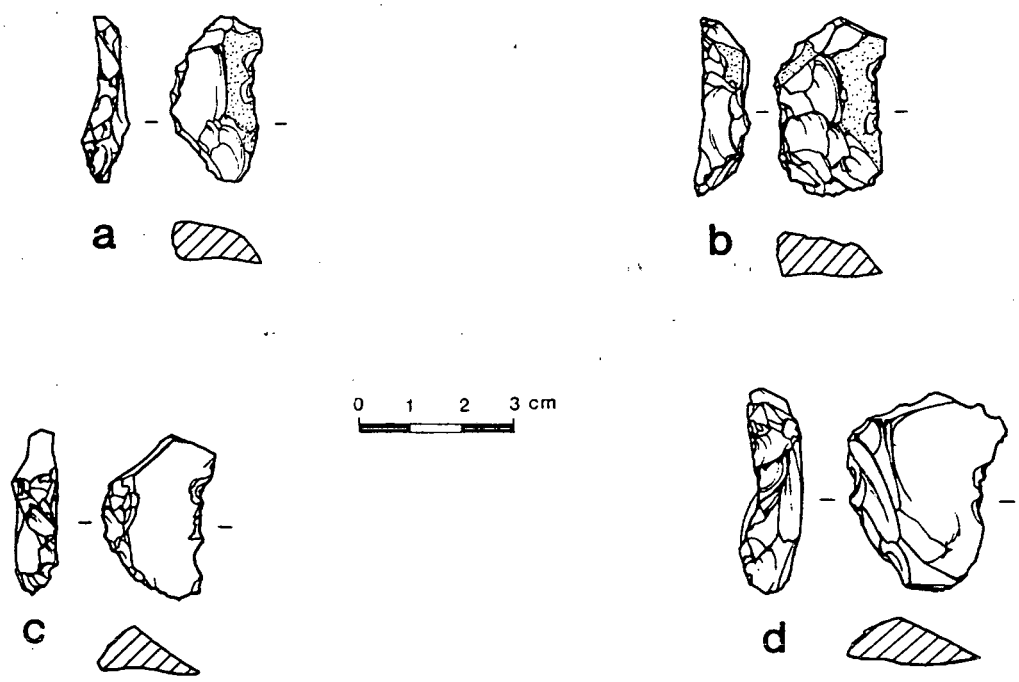


Figure 14. Backed flake scrapers of chert from Green Ant Shelter. a) No.466 - S20, Spit 14; b) No.1079 - O18, Spit 6; c) No.440 - N21, Spit 12. D:No.535 - S20, Spit 19B.

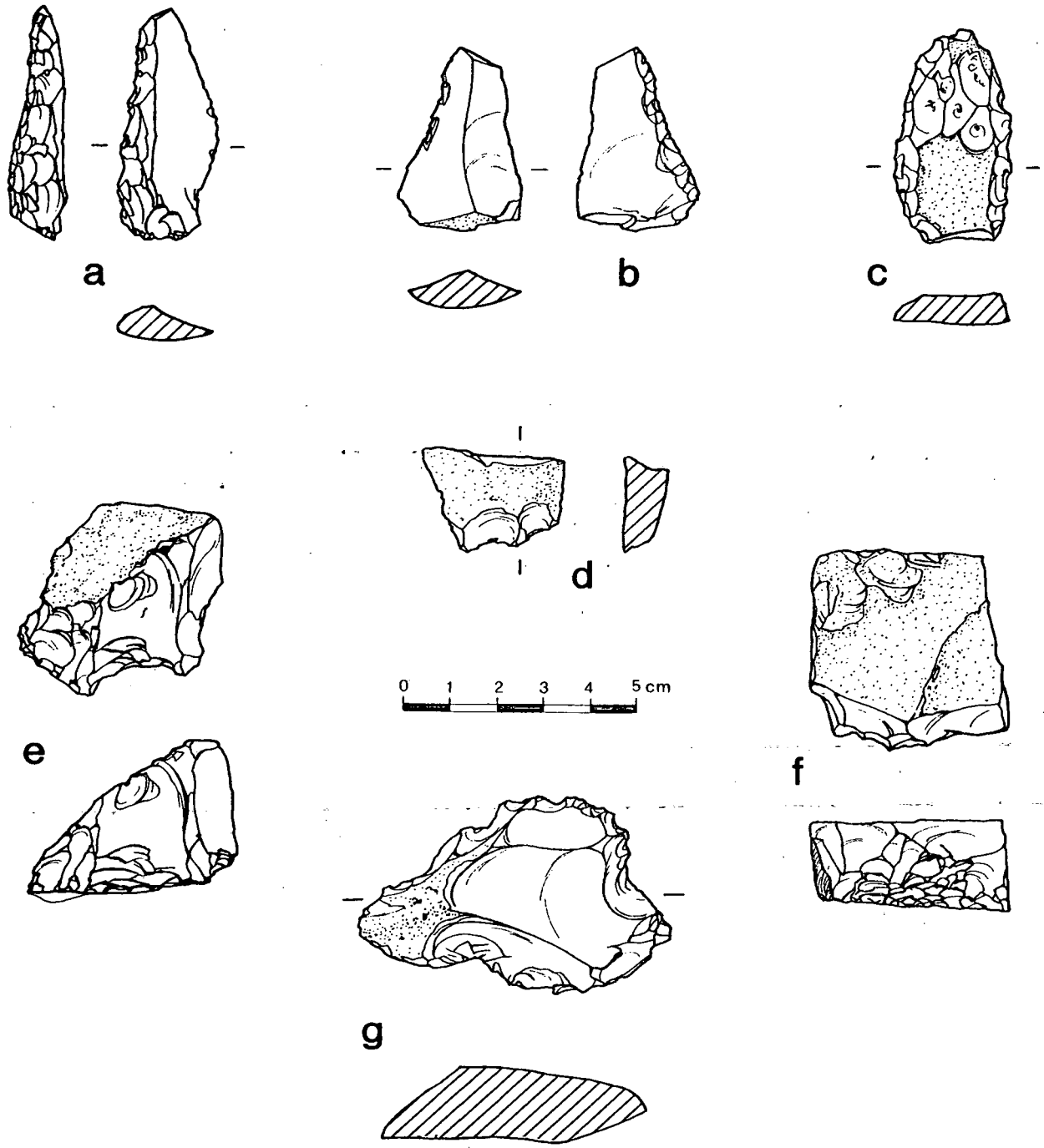


Figure 15. Scrapers, point-like and thermally fractured retouched artefacts of chert from Green Ant Shelter. a) point-like artefact No.704 - N20, spit 9B; b) point-like with broken tip, No.1023 - O18, spit 1; c) thermally fractured and retouched artefact, No.692 - N20, spit 7; d) cortical fragment with sinuous retouched edge, No.406 - N21, spit 7; e) scraper with 3 retouched edges including pronounced concave edge with abrupt direct retouch, No.565 -S20, spit 1; f) tabular scraper with one sinuous edge bearing abrupt inufacial retouch, No.797 - N20, spit 14; g) scraper with 2 edges retouched with direct abrupt retouch, No.1303 -O18, spit 16.

Point-like artefacts: Among the retouched flaked artefacts, two point-like chert artefacts were found, one with a broken tip, in square 018 spit 1, and one in N20, spit 9B associated with charcoal dated to 1570± 60 BP (Figure 15A and B). Neither are classic points of the type found in such large numbers at sites such as Yarar in the Northern Territory (Flood 1970), but on the other hand both would fit into the Yarar assemblages very readily. Points were found at Kenniff Cave (Mulvaney and Joyce 1965) and their presence at Koolburra would not cause the map of their distribution to be revised more than a little (cf. Flood 1983a: Figure 15.1). However, in view of their rarity in the Koolburra sites, it seems more likely that the two point-like artefacts are part of a continuum of flakes and flake scrapers rather than a distinct tool type.

Grindstone: A large semi-circular shaped slab of sandstone with central depressions on both faces was found on the surface of Green Ant Shelter (square M19, artefact No. 1807). The oval upper depression (75mm x 40mm) is ground fairly smooth, and was perhaps used for grinding ochre. The depression in the lower surface (65mm x 40mm) is rougher and appears unused. It seems to be truncated by the straight side of the stone, and may have been the working surface of an originally circular, larger grindstone. Its weight is about 2kg.

Bifacial chopper: A large tabular slab with retouch or use-wear on three edges occurred in R20, spit 9B, at a depth of 42-48cm below the surface. This means that it is probably less than 2000 years old. It is made of chert and measures 124mm x 95mm x 25mm, and weighs 312gm (Figure 16). The type of use-wear suggests that it was used for chopping wood (Kamminga pers. comm.).

Hammerstones: Two hammerstones were found. One found on the surface of square M21 weighs 363gm and measures 93mm x 81mm x 31mm. It is a flat oval sandstone pebble with one end partly removed, apparently by bi-facial flaking and ground or worn down so that the end now presents a flat surface approximately 55mm x 10mm in area. The other end shows minor wear from battering. It has pitting on the more pointed end, and weighs 687gm (Figure 16).

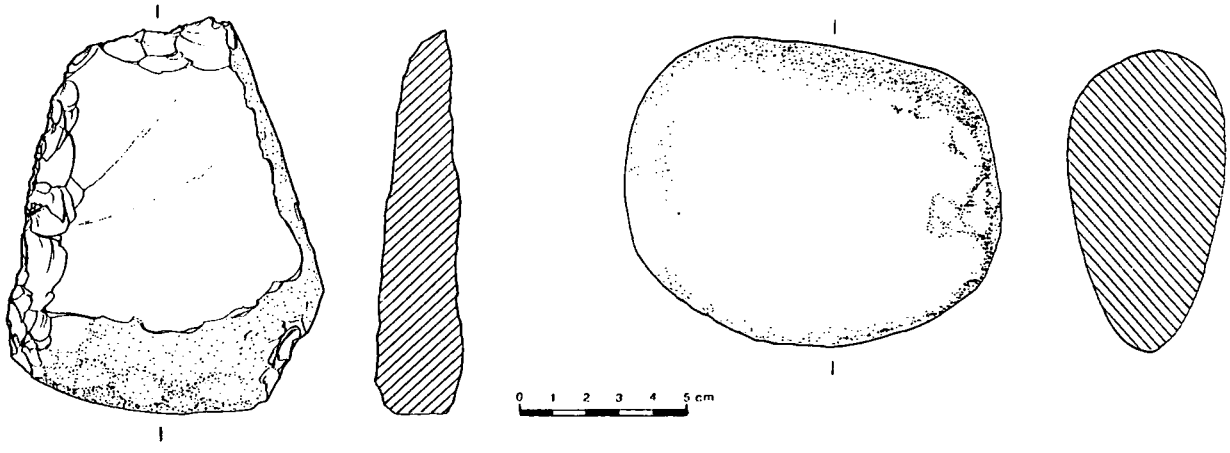


Figure 16. Large artefacts from Green Ant Shelter. Left: a large tabular chopping tool of chert, retouched bifacially, No.346 - R20, spit 9B. Right: hamerstone, No.457 - S20, spit 15.

Summary

Green Ant Shelter is a good example of an art site used for general camping activities. It seems likely that it was used primarily in the wet season, occupation in the dry season being focussed more on good sources of water and food such as the Kennedy River. Occupation appears to have begun on a small scale some time before 8500 BP and continued intermittently up until last century. Very little change in the size or raw material of stone artefacts occurred during this period. The only apparent artefactual innovations were the advent of small specialised tools such as backed scrapers around 6000 BP and of small hafted flake scrapers about 2000 BP. The latter clearly formed an important part of the more recent tool kit and were evidently used for wood working. There appears to be a diminution in the intensity of site use reflected in the occupational deposits at a depth of approximately 75-80cm below the surface. This is associated with a reduction in rates of sedimentation and artefact discard, extending in square 018 from a depth of about 62cm to 86cm (spits 13-17), both these factors suggesting reduced occupancy of the site during the time period ca 7500 - 2500 BP. The bimodal distribution of bone and ochre in the site supports this interpretation. Such reduced occupancy may well be linked to increased precipitation in the early to mid-Holocene, this suggestion being supported by the distribution of patinated artefacts and sandstone rocks in square 018.

Kershaw (1975) has evidence from lake deposits in the Atherton Tablelands of wetter and cooler conditions between about 9000 and 6000 BP in that region, and significantly wetter and warmer conditions between about 6000 and 3000 BP, with average annual rainfall twice as high as at present. Sedimentological and faunal data at the Early Man Shelter (Rosenfeld et al 1981:13-14) are entirely compatible with such a climatic change, although not conclusive per se.

There are indications of a lag deposit in the dripline zone of Green Ant Shelter. A similar phenomenon seems to have occurred at Chillagoe, to the south of Koolburra (Campbell 1982; David 1983:61, 1984a and b). At Walkunder Arch Cave there was a major stratigraphic break between layers 7 and 8, dated to 3,700 ± 60 BP and 13,490 ± 110 BP respectively (Campbell 1982:63-65). Likewise at Echidna's Rest, Chillagoe, David (pers. comm.) has found a coarser-grained deposit and absence of plant remains in pre-2,500 BP layers. Consideration of the Chillagoe data provides strong evidence in favour of a wetter period in the mid-Holocene, which at some sites at least may have removed portions of occupational deposits.

With regard to antiquity of rock art, the minimum age of the lowest engravings at Green Ant Shelter is 1570 ± 60 BP, the date of charcoal from the sediments covering deeply pecked pits in square N20 at a depth of 25-30cm below present ground surface. Since these engravings are only 75-85cm above charcoal dated to 8660 ± 340 BP, they would have been only just above knee height at that time. It is likely therefore that they were made during the early occupation of the shelter, rather than at a later time when the engraved surface would have been only just above ground level. The fact that the fresher-looking engravings are all higher up the back wall supports this interpretation. It may be that rock painting was also being done throughout the shelter's occupancy, since red, brown and white pigments are present in levels dated to between 8000 and 8500 years ago.

ECHIDNA SHELTER

Echidna Shelter lies some 3km southeast of Green Ant Shelter and was identified as a site of great archaeological potential by an exploration party on the 1981 Earthwatch expedition. The most capacious shelter found in the Koolburra area, it affords excellent protection from the elements.

It is located at A.M.G. point 834883 on the 1:50,000 Lakes Creek map sheet 7767-111 (15° 28′ S. latitude, 144° 03′ E longitude). It lies at an elevation of approximately 160m ASL, just above the floor of the valley of Echidna Creek (Figure 3). There is no water in the upper reaches of the creek in the dry season, but a permanent spring occurs ca 250m west of the shelter on the opposite side of the creek.

The site is formed by a massive overhang on the west end of a huge split sandstone boulder lying at the foot of a steep slope. About 225m to the southeast and 120m above the shelter is a cliffline forming the lip of the escarpment of this part of the Koolburra Plateau (Figure 17). This cliff contains a number of rockshelters bearing paintings on their rear walls. The largest and most striking of these shelters exhibits a large number of anthropomorphic echidna figures. Hence it was named Echidna Dreaming, and the shelter in the valley immediately below it became Echidna Shelter (originally coded as ED1, and then renumbered K79). Facing west and with a soft gently sloping earth floor, the shelter is approximately 14m long, 5m wide and 4m high, and the area of earth floor protected by the overhang is some $65m^2$, almost all with adequate headroom. It thus provides considerably more living space than Green Ant Shelter (Figures 18 and 19).

The site overlooks a lightly wooded grassy slope leading down to the deeply cut bed of Echidna Creek, and about 100m away from the creek on the opposite side from the shelter is a permanent fresh-water spring and some small rock pools. Some stone artefacts were visible on the surface of the shelter floor, and Aboriginal presence was likewise attested by paintings and engravings on its walls. There was also an artefact scatter on flat ground between the shelter and the spring.

The art at Echidna Shelter includes about 18 paintings, 6 hand stencils of both adult and children's hands and more than 200 engravings. The paintings in red, orange and white include a large bichrome catfish, a small red human figure, four white star-like motifs on the ceiling, six painted-in engraved pits, and a number of indeterminate motifs. It is the pecked engravings, however, which dominate Echidna Shelter. They cover the rear wall, but are so weathered that it is extremely difficult to discern individual motifs. Ones which are discernible are bird tracks, macropod tracks and lines of dots and pits. Many dozens of the heavily weathered pecked engravings appear now to be simply short vertical lines, but may originally have depicted bird or macropod tracks. On the outer face of the northern end of the shelter are fresher, less deeply incised engravings of various motifs including twelve spear-throwers.

The high degree of weathering of the engravings on the back wall of the shelter suggested that they might be of considerable antiquity. It also seemed possible, although less likely than at Green Ant Shelter, that they continued below the present ground surface.

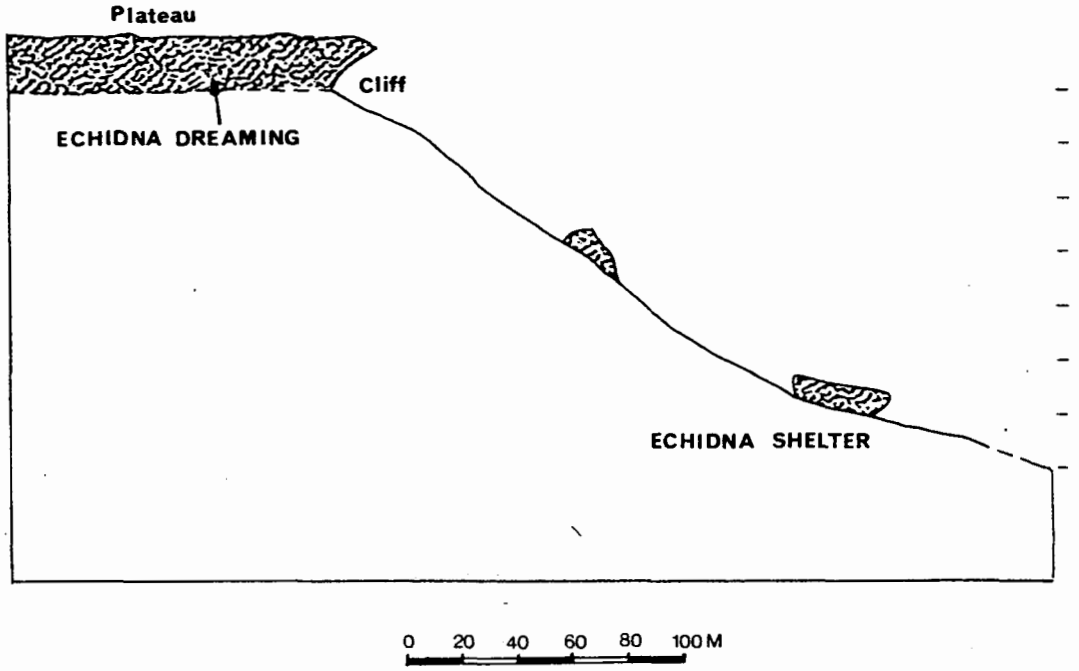


Figure 17. Echidna Shelter: Profile from the north

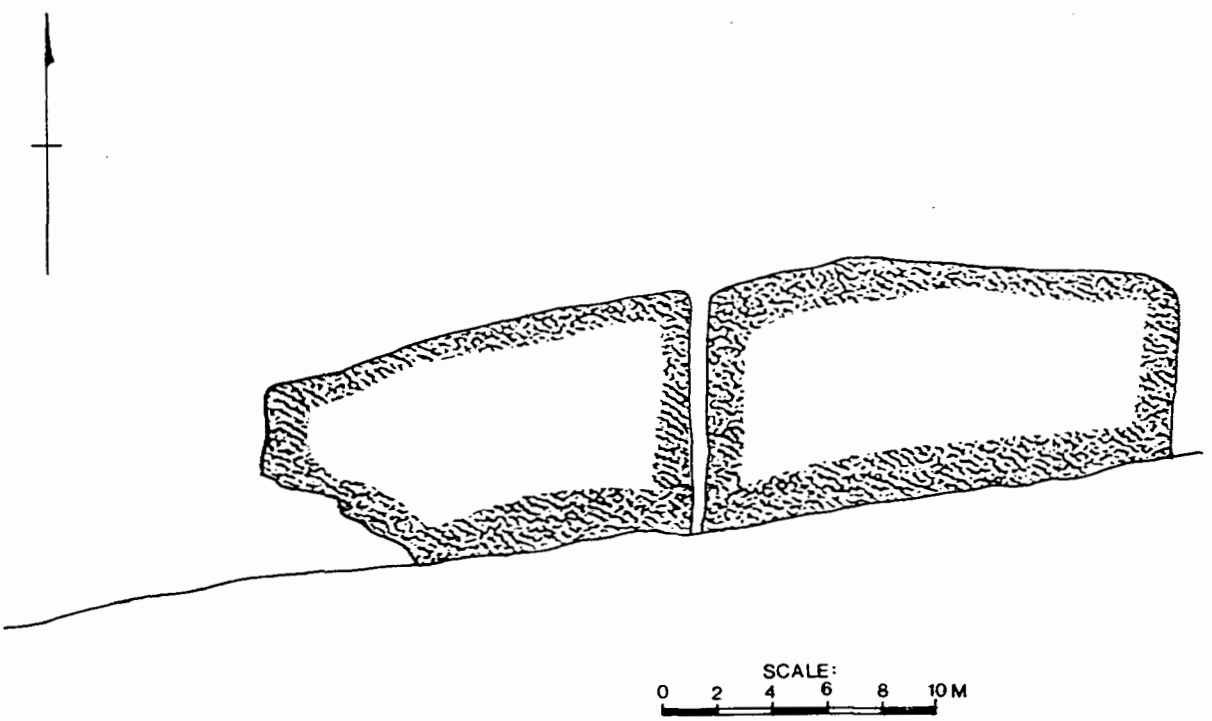


Figure 18. Echidna Shelter: Profile from the south.

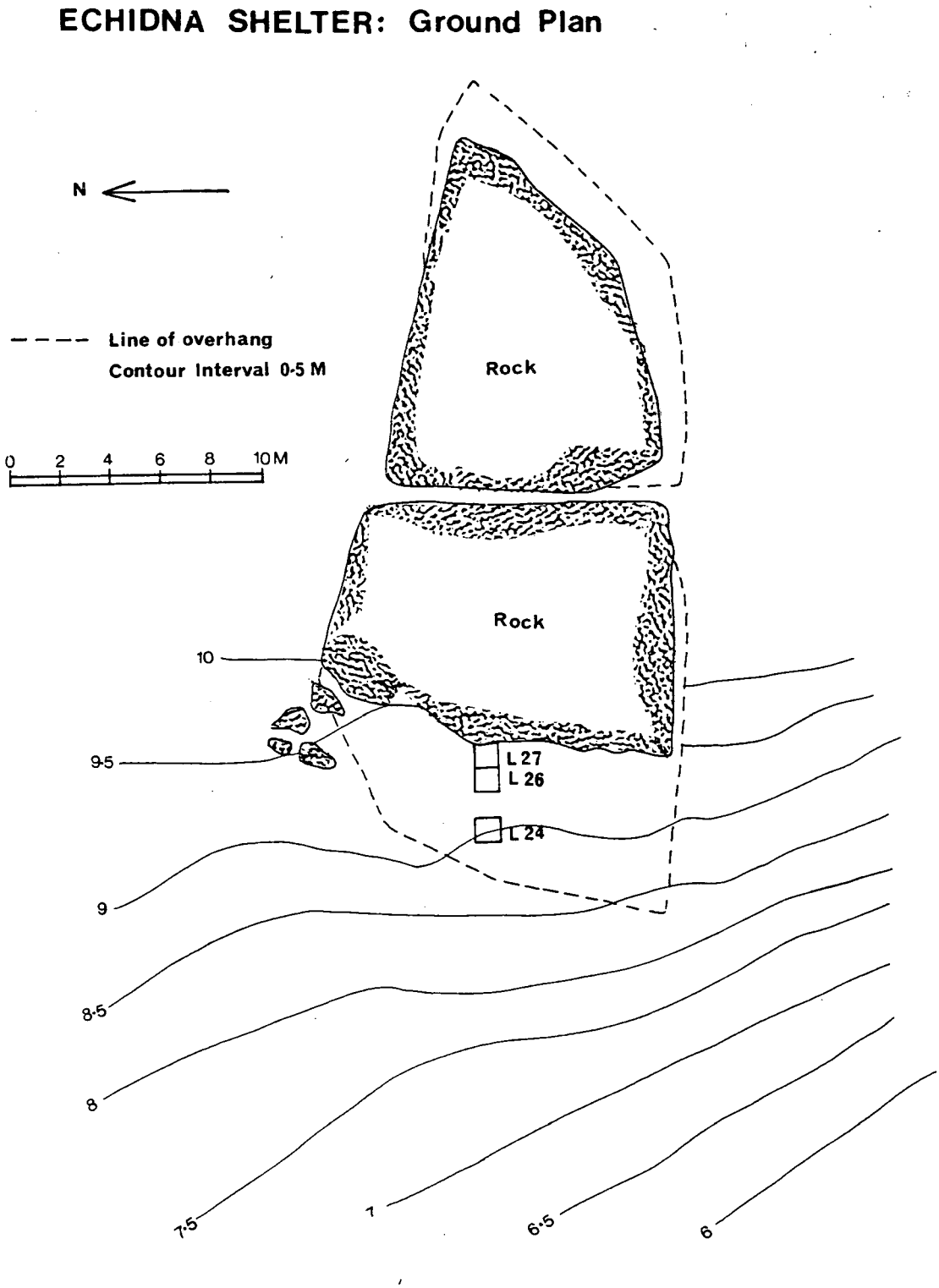


Figure 19. Echidna Shelter: Ground plan.

The Excavation

A trench was dug at an angle 90° to the back wall of the shelter out to the dripline (Figure 19). It was placed on an east-west alignment in the centre of the shelter, avoiding large termite mounds which occurred below the dripline at the southwestern end and by the end of the back wall at the northeastern end. The trench measured 1m by 4m, consisting of grid squares L24, 25, 26, 27. Three squares were excavated, L25 being left intact as a baulk. Square L27 abutted the back wall of the shelter, which proved to slope gently outwards and did not yield engravings below ground level. West of square L24 auger holes were put down on the dripline and 2m down the talus slope, in the centre of squares L22 and L20. These revealed no cultural material.

Excavation was carried out by Earthwatch volunteers under the direction of Flood, Horsfall and Lilley between June 16 and July 6, 1982. Approximately 73 person-days were spent on the excavation. At the same time the shelter's art was recorded by conventional methods and photogrammetry, and casts of some of the engravings were made by Janet Stone and Pip Hinman of the Canberra College of Advanced Education. Excavation methods were the same as for Green Ant Shelter and approximately 5% ($3m^2$) of the shelter's earth floor and potential excavation deposit was excavated.

Stratigraphy

The stratigraphy in the deepest part of the excavation (square L24) is shown in Figure 20. Four layers were identified in squares L26 and 27 and five in L24. The latter are described in Table 8.

Square L24 yielded the deepest occupation deposit of 70cm. This square was excavated to a depth of 110cm, but the lowest 40cm yielded only sterile decomposed sandstone. In square L27 adjacent to the back wall, artefacts and charcoal occurred to 30cm, sterile sandstone being encountered at a depth of 35cm. In square L26 artefacts continued to 40cm and charcoal to 50cm; sandstone was encountered at 70cm. There was little rock fall in the deposit but much ant-bed, especially in square L24. This square was just inside the dripline, where modern mounds are also concentrated. The mounds are made by Coptotermes acinaciformis (Frogatt), which seems to prefer to build in damper areas - in this case on the dripline or close to the back wall.

Radiocarbon dates obtained on charcoal from square L24 are shown in Table 9, and estimated rates of deposition in Table 10. The latter were calculated from the age-depth curve, shown in Figure 21.

The average rate of sediment accumulation at Echidna Shelter is 9cm/1000 yrs but it varies considerably, as indicated by estimating the number of kilograms of sediment per 100 years (Table 10). The average sedimentation rate in layers I, II and III - spanning the last 5000 years - is fairly steady (7.4 - 7.8kg/100yrs), but between about 5100 and 6850 BP the rate doubled to between 15.2 and 23.3kg per 100 years (average is 19 kg/100 yrs). The small volume of deposit excavated below this makes it difficult to be sure of the rate for the earliest cultural layers, but it appears to be slower between 6850 and 7280 BP.

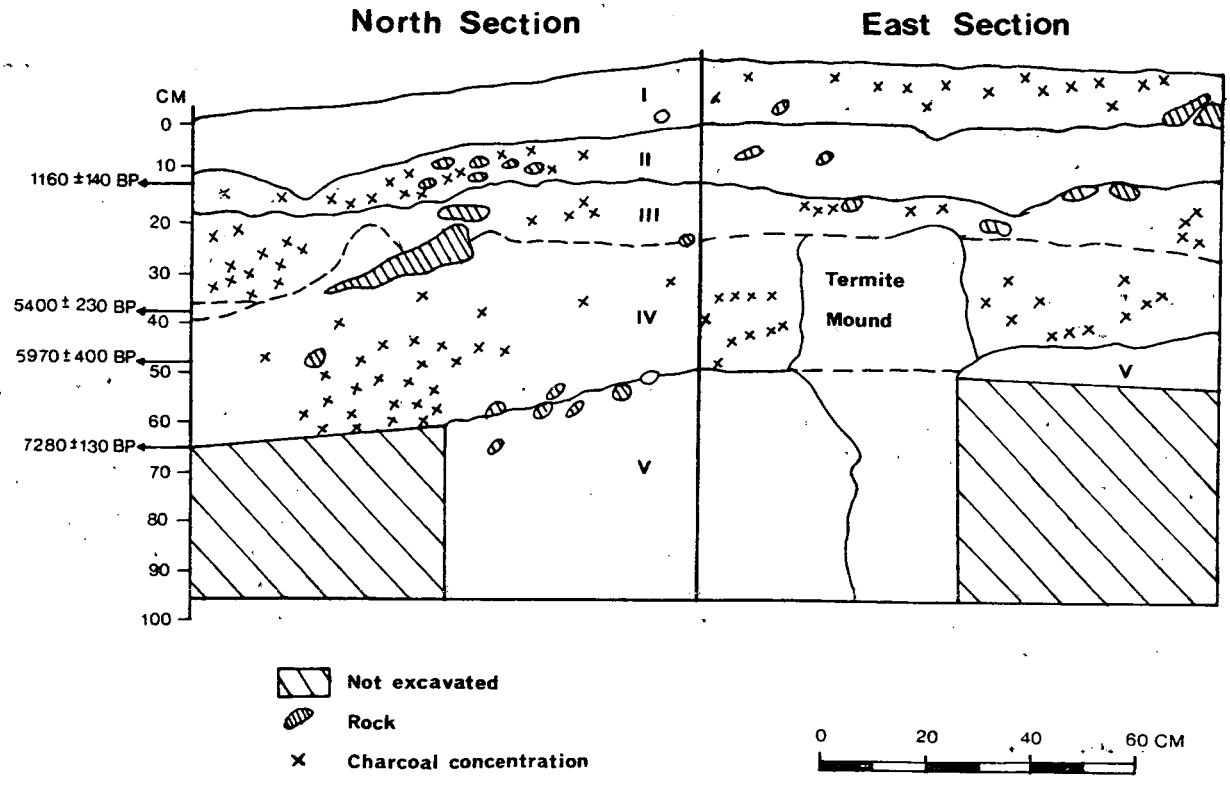


Figure 20. Echidna Shelter: Stratigraphy of square L24.

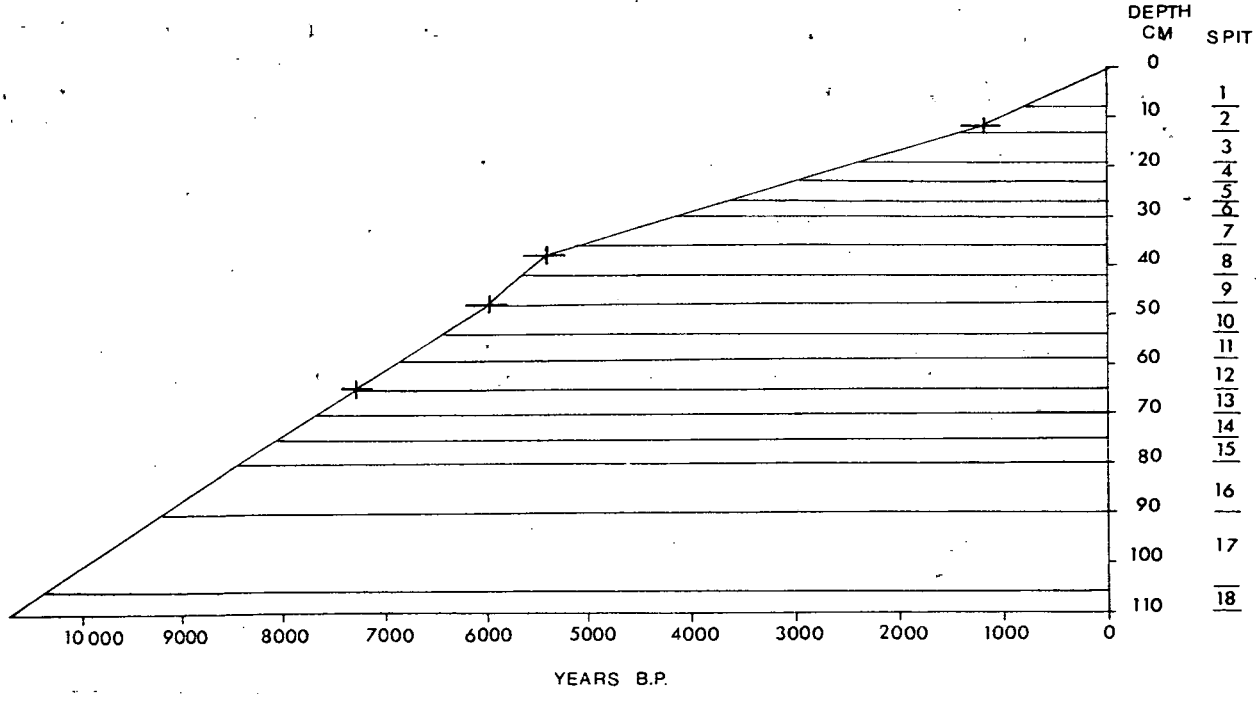


Figure 21. Echidna Shelter: Depth/age curve.

Table 8. Echidna Shelter: stratigraphy (Square L24)

LAYER	SPIT	SEDIMENTS	MUNSELL COLOUR	pH	ASSOCIATION
I	1	Soft dusty grayish-brown	5YR 4/2	5	Artefacts, bone, charcoal, ash, ant-bed
II	2-4	Firm, dark grayish-brown	5YR 3/2	5	Artefacts (eg.thumbnail scraper, geom. microlith), bone, charcoal, ant-bed.
III	5-7	Compact, very dark gray	5YR 6/4	5	Artefacts, bone, charcoal, ant-bed
IV	8-11	Hard, darkish reddish-brown giving way to light reddish-brown	5YR 3/4 (spit 8) to 5YR 6/4 (spit 11)	5	Artefacts, some fragmentary bone, a little charcoal, much ant-bed, rubble
V	12-17	Very hard, dull orange.	7.5YR 7/4 (spit 12) to 5YR 6/4 (spit 16)	4	Artefacts only in spits 12 and 13, no bone, very little charcoal or ant-bed, much decomposed sandstone. Lowest charcoal at 70cm below surface (spit 14)

Table 9. Radiocarbon dates on charcoal from Echidna Shelter

LAYER	SQUARE	SPIT	DEPTH	LAB NO.	AGE	ASSOCIATIONS
II	L24	2	12cm	ARL-152	1160±140 BP	Artefacts
IV	L24	8	38cm	ARL-153	5400±230 BP	Artefacts
IV	L24	10	48cm	ARL-154	5970±400 BP	Artefacts
IV	124	12	65cm	ARL-155	7280±130 BP	Lowest artefact is 5cm below this date.

Since changing sediment accumulation rates may be related to changes in the intensity of human use of a site, the relative amounts of cultural activity were estimated for the time span of human occupation. Artefacts were present throughout the deposit to a depth of 70cm, which was 5cm below the charcoal sample dated to 7280± 130 BP. The discard rate of flaked artefacts per 100 years was calculated for each spit and each layer, as shown in Table 10. The ratio of charcoal to sediment was also calculated.

Table 10. Chronological changes in quantity of sediment, rocks, charcoal and artefact densities in Square L24, Echidna Shelter.

LAYER	SPIT	AGE (YEARS BP)	DEPTH (cm)	TOTAL SEDIMENT WEIGHT (kg)	ROCKS >1cm (kg)	CHARCOAL (gm)	RATIO OF CHARCOAL TO SEDIMENT %	TOTAL FLAKED STONE ARTEFACTS >20mm (gm)	NO.(A) FLAKED STONE ARTEFACTS >20mm #	NO.(B) FLAKED STONE ARTEFACTS <20mm #	NO.OF kg SED. PER 100 YRS #	NO.OF ARTEFACTS (A) PER 100 YRS	TOTAL ARTEFACTS (A and B) PER 100 YRS	BONE	OCHRE PIECES
I	1	0-800	0-8	59.75	3.75	2.25	3.7	156.6	39	12	7.4	4.8	6.3	0	0
	2	800-1400	8-13	53.75	10.00	0.70	1.3	700.8	58	10	8.9	9.6	11.3	0	0
II	3	1400-2400	13-19	60.25	3.50	0.75	1.2	166.8	38	13	6.0	3.8	5.1	X	0
	4	2400-2950	19-23	54.50	2.75	0.65	1.1	327.2	21	4	9.9	3.8	4.5	X	1
Total II		800-2950		168.50	16.25	2.10	1.2	1194.8	117	27	7.8	5.4	6.6		
	5	2950-3650	23-27	46.50	4.25	0.50	1.0	359.7	18	6	6.5	2.5	3.4	X	0
III	6	3650-4150	27-30	60.75	2.50	0.55	0.9	175.3	32	3	12.1	6.4	7.0	X	2
	7	4150-5100	30-36	59.75	3.75	0.70	1.1	157.3	31	1	6.2	3.2	3.3	X	1
Total III		2950-5100		166.00	10.50	1.75	1.0	692.3	81	10	7.7	3.7	4.2		
	8	5100-5650	36-42	83.75	4.00	0.95	1.1	352.5	40	4	15.2	7.2	8.0	0	1
IV	9	5650-5950	42-48	70.00	0.00	0.90	1.2	209.4	34	5	23.3	11.3	13.0	X	3
	10	5950-6450	48-54	101.25	0.00	0.95	0.9	368.0	29	0	20.2	5.8	5.8	X	3
	11	6450-6850	54-59	78.75	0.00	0.80	1.0	292.1	25	2	19.6	6.2	6.7	0	0
Total IV		5100-6850		33.75	4.00	3.60	1.0	1222.0	128	11	19.0	7.3	7.9		
V	12	6850-7280	59-65	24.00	4.00	0.10	0.4	2.3	1	0	11.1	0.2	0.2	0	0
A	13*	7280-7650	65-70	15.50	6.00	0.05	0.3	7.2	1	0	16.7	0.2	0.2	0	0
Total V Upper				39.50	10.00	0.15	0.3	9.5	2	0	13.7	0.2	0.2		
	14*	½m² only*	70-75	20.25	6.50	0.05	0.2	0	0	0	-	0	0	0	0
V	15*	"	75-80	33.00	14.00	0.05	0.1	0	0	0	-	0	0	0	0
B	16*	"	80-90	34.00	13.00	0.05	0.1	0	0	0	-	0	0	0	0
	17*	"	90-106	27.00	10.50	0.05	0.2	0	0	0	-	0	0	0	0
Total V (A and B)				153.75	54.00	0.35	0.2	9.5	2						11
Grand Total				355.20		10.05		3275.2	367	60					

The results of this analysis show that the highest average artefact discard rate correlates with the highest sedimentation rate in layer IV, between about 5100 and 6850 BP. The greatest amount of ochre was also found in layer IV, although the very small quantity found means that no weight can be attached to its distribution. Over the last 5000 years the artefact discard rate has been fairly steady, apart from a marked increase at the top of layer II between about 800 and 1400 BP. The lowest artefact discard rate occurred in the lowest level of occupation. The amount of charcoal in the deposit was highest in the uppermost layer spanning the last millennium, but since charcoal, like bone, tends to fragment and disappear with age, quantity of charcoal present is generally not a good guide to the intensity of human occupation.

Bone (identified macroscopically) was found to a depth of about 47cm, but was all extremely fragmented and it was impossible to ascertain the species represented. Ant bed occurred throughout the deposit to a depth of 50cm below the surface. Live termites were also found at this depth, indicating that the tunnels in the base of the mounds were still active. The ant bed in general was not burnt, and appears to have resulted from the presence of mounds in the shelter rather than human use of ant bed for fuel.

Ochre occurred in small quantities down to a depth of 50cm, the lowest ochre being in spit 10 of square L24 associated with a date of 5970 $\pm$ 400 BP. Colours represented included brown, red, dark red, yellow and white, the latter probably kaolin. None of the small pieces showed signs of use as they did at Green Ant Shelter. However, a few pieces of ferruginous sandstone, such as ED 1071 from square L24 spit 8, displayed parallel striations similar to some of the ochre "crayons" at Green Ant Shelter. They were not soft enough to make a mark on paper or card, but nonetheless may have been used as a source of ochre.

Stone Artefact Analysis

The three square metres excavated yielded a total of 1606 stone artefacts, of which over half (934 or 58%) were small chips less than 20mm long of quartzite, chert or other material not local to the shelter. The raw materials were classified into four groups: chert, quartz, quartzite and other. Analysis of all 449 stone artefacts (modified or unmodified) equal to or greater than 20mm in length from square L24 is shown in Table 11.

A comparison with Green Ant Shelter 1 shows considerable differences. Fine-grained chert was predominant at Green Ant Shelter, whereas quartzite dominates the Echidna Shelter assemblage. It is likely that these differences stem from differences in local availability of raw material, although there is a source of chert which shows signs of Aboriginal quarrying only 1km away on the upper reaches of Echidna Creek.

The question of chronological changes in dominant raw material, size or morphology of artefacts was addressed by analysis of all excavated material from square L24, the deepest part of the excavation. The results of the raw material analysis by weight and by absolute number of all flaked stone artefacts (427) are shown in Table 12 and Figure 22 (groups 111 and IV were combined for this analysis). Chert

outnumbers quartz and quartzite in layer I, but quartzite artefacts predominate in layers II, III and IV (in layer V the sample is too small for meaningful analysis). This result indicates that chert replaced quartzite as the preferred raw material during the last millennium. The proportion of quartz used remained comparatively steady, varying between 23% and 35%.

Table 11. Proportions of raw materials at Echidna Shelter.

MATERIAL	NO. ARTEFACTS (>20mm)	PERCENTAGE
Group I Chert	(N=449)	%
fine-grained chert	97	21.6
laminated coarse chert	10	2.2
cherty mudstone	6	1.3
mudstone	10	2.2
Total Group I	123	27.3
Group II Quartz		
opaque and milky quartz	123	27.3
vein quartz	1	0.2
Total Group II	124	27.5
Group III Quartzite		
quartzite	56	12.4
poor quality quartzite	112	24.9
Total Group III	168	37.3
Group IV Other		
basic igneous rock	19	4.2
sandstone (hard)	11	2.4
schist	1	0.2
unidentified	3	0.6
Total Group IV	34	7.5

Analysis of the stone artefacts showed that there was neither change in their size nor in the degree of their "chunkiness", the latter being assessed by the breadth/thickness ratio. Artefacts occurred in all spits over the 7000 year span, and their density did not vary greatly, as shown in Table 13. The percentage of modified to unmodified artefacts varied from 0 to 20%, averaging 5%.

The flaked stone artefacts at Echidna Shelter were divided into the same categories as those from Green Ant Shelter: cores, flakes, flaked pieces and fragments. Their distribution is shown according to type of raw material in Table 14, and by excavated level in Table 15.

Thermally fractured artefacts were found in the deposit but they were not numerous; only six were identified among the 367 flaked artefacts (>20mm) from square L24. These were all of chert. Heat spalled artefacts are identified in Figure 23, d and h. The latter is a particularly good example of a "pot-lid". Likewise, the chert of which the artefact illustrated in Figure 23f is made, is heat-crazed.

Table 12. Echidna Shelter: all flaked stone artefacts (square L24).

LAYER	SPIT	GROUP I (chert)		GROUP II (quartz)		GROUPS III & IV (quartzite etc.)		TOTAL	
		NO.	WT(gm)	NO.	WT(gm)	NO.	WT(gm)	NO.	WT(gm)
I	1	27	60.4	12	54.3	12	54.0	51	168.7
Total I		27	53%	12	23%	12	23%	51	
II	2	15	26.7	25	437.0	28	246.4	68	710.1
II	3	13	22.1	21	54.5	17	105.0	51	181.6
II	4	6	4.9	6	12.3	13	314.0	25	348.4
Total II		34	24%	52	36%	58	40%	144	
III	5	10	54.3	7	16.5	7	291.2	24	362.0
III	6	13	28.4	5	22.2	17	126.2	35	176.8
III	7	7	36.8	10	44.0	15	77.3	32	160.1
Total III		30	33%	22	31%	39	43%	91	
IV	8	13	73.6	9	58.7	22	224.9	44	357.2
IV	9	7	16.6	14	86.2	18	111.8	39	214.6
IV	10	7	32.0	4	152.1	18	183.9	29	368.0
IV	11	5	21.7	6	30.1	16	241.7	27	293.5
Total IV		32	23%	33	24%	74	53%	139	
V	12	0	0	0	0	1	2.3	1	2.3
V	13	0	0	0	0	1	7.2	1	7.2
Total V		0	0	0	0	2		2	
Grand Total		123	377.3	119	966.9	185	1985.9	427	

The stone artefacts that occurred at Echidna Shelter are comprised of the following types:

Cores: Ten cores were found in square L24. One small one with two platforms is of chert, six are of quartz and three of quartzite. They range from 24mm to 84mm in length, with an average of 49.2mm. They weigh between 5gm and 191gm, with an average of 76gm. Most have only one platform, but one has two and another two (made of quartz) have three platforms.

Geometric microlith: One classic geometric microlith occurred in layer II (spit 4) of square L24 (Figure 24) dating between ca. 2500 and 3000 BP. It is made of chert and is 17mm long by 15mm wide by 5mm thick, and weighs 1.0gm. It's retouched backed edge is convex and the angle of the edge is 85°. The chord shows signs of use wear.

Table 13. Modified artefacts >20mm at Echidna Shelter (square L24).

SPIT	TOTAL FLAKED ARTEFACTS	NO. MODIFIED	% MODIFIED/ UNMODIFIED	USED	RETOUCHED	GROUND*
1	39	3	8.3%	1	2	1
2	58	0	-	0	0	1
3	38	3	8.6%	2	1	0
4	21	0	-	0	0	0
5	18	3	20.0%	2	1	0
6	32	1	3.2%	1	0	0
7	31	5	19.2%	3	2	0
8	40	2	5.3%	0	2	0
9	34	2	6.3%	0	2	0
10	20	1	3.6%	1	0	0
11	25	0	-	0	0	0
12	1	0	-	0	0	0
13	1	0	-	0	0	0
Total	367	20	5.8%	10	10	2

Note: there were also two retouched artefacts of less than 20mm; both were in spit 4

* These ground artefacts were fragments of volcanic rock with part of their surface ground, probably edge-groundaxe fragments.

Table 14. Distribution of flaked artefacts >20mm by raw material, Echidna Shelter (square L24).

ARTEFACTS	CHERT	QUARTZ	QUARTZITE ETC.	TOTAL
cores	1	6	3	10
flakes	62	41	46	149
flaked pieces	35	48	109	192
fragments	0	3	13	16
Total	98	98	171	367

Thumbnail scraper: One chert thumbnail scraper was found in layer II (spit 3) of square L24, dating between ca. 1500 and 2500 BP. It is tiny, weighing only 1.8gm and measuring 20mm x 18mm x 6mm (Figure 24). It has two convex retouched edges, both with an edge angle of about 60°. Sixty-three percent of the perimeter is retouched.

Small flake scrapers: Similar small flake scrapers to those at Green Ant Shelter were found in the upper levels of the Echidna Shelter deposit (eg. Figure 23a,b,f and g). One of these scrapers (Figure 23b) has clear traces of resin/gum on both faces of the end opposite the cutting edge. This is a definite indication that the tool was hafted.

Table 15. Distribution of flaked artefacts >20mm by level, Echidna Shelter (Square L24)

LAYER	SPIT	CORE	FLAKE	FLAKED PIECE	FRAGMENT	TOTAL
I	1	1	21	17	0	39
II	2	2	22	27	7	58
II	3	2	14	20	2	38
II	4	1	6	14	0	21
Total II		5	42	61	9	117
III	5	1	9	8	0	18
III	6	0	12	20	0	32
III	7	0	17	13	1	31
Total III		1	38	41	1	81
IV	8	1	17	20	2	40
IV	9	0	8	23	3	34
IV	10	1	10	18	0	29
IV	11	1	12	11	11	25
Total IV		3	47	72	6	128
V	12	0	1	0	0	1
V	13	0	0	1	0	1
Total V		0	1	1	0	2

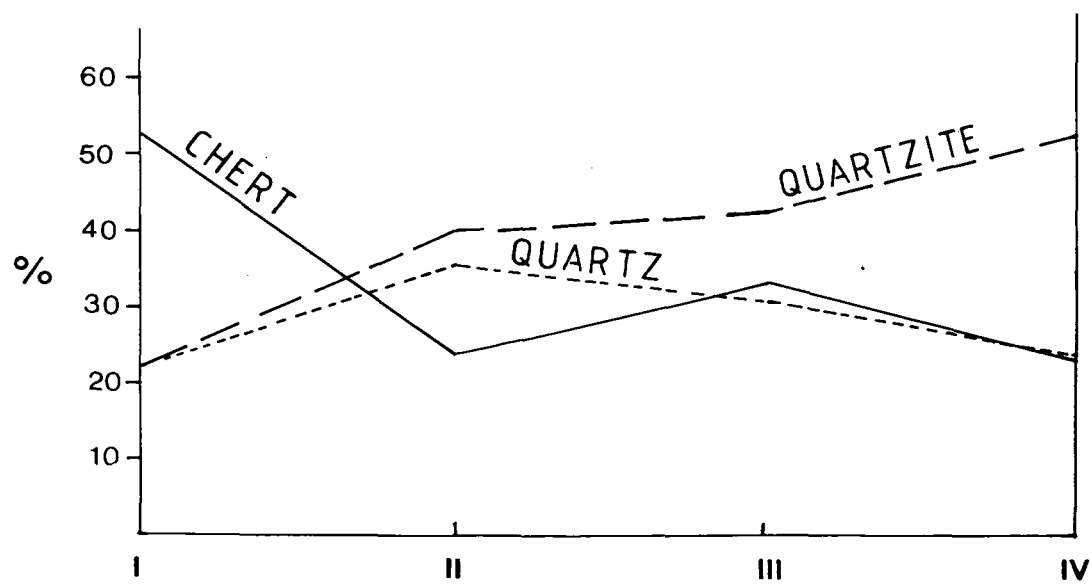


Figure 22. Echidna Shelter: distribution of chert, quartzite and quartz, artefacts in square L24.

The residue, edge character and design indicate that this was a hafted scraper with backing. Other small flake scrapers have been reduced to "slugs". For example, number ED 141 (Figure 23f) is a heat-crazed chert scraper slug, utilised on both faces and rejuvenated. Wood-scraping flake damage is extensive, consisting of overlapping shallow steps of the bending and conchoidal varieties. The spurs between the scars are rounded by fine abrasion (Kamminga pers. comm.). There is no doubt that this was a wood scraper, and it was almost certainly hafted.

Another scraper slug is number ED9 (Figure 23a). This chert conchoidal flake was made by a hard indenter. About half of the flake was removed by rejuvenation retouch. It is heavily use-fractured, with shallow overlapping step fractures with bending initiations indicative of scraping wood. Edge rejuvenation has brought the cutting edge on one side back to meet the opposite side at the distal end. The lateral margins were both used as cutting edges. The concave edge was the last used, and as the tool approached its distal form, that part of the edge ceased to be used for contact with worked material. All use-scars are concentrated on the proximal part of the concave edge (Kamminga pers. comm.). This artefact was also a wood scraper and was probably formerly hafted.

Steep-edged scrapers occur in small numbers at Echidna Shelter, and are not confined to one time period, being found in spits 1, 4, 7, 8 and 9 of square L24 (Figure 25), and in spits 1 and 2 of square L26. In other words, they occur sporadically through the period from the most recent back to about 6000 BP. Although they are absent from the earliest occupation horizon, this absence may not be significant in view of the very small number of artefacts in the lowest cultural layers. A representative sample of artefacts made of quartz, chert and quartzite and spanning the whole cultural sequence in square L24 is illustrated in Figure 25.

Ground artefacts: Two fragments of volcanic rock were found in spits 1 and 2 of square L24. Both had part of their surface ground with striations and short multi-directional scratches, and appear to be edge-ground axe fragments.

Surface-modified artefacts: A few pieces of sandstone and laminated mudstone occurred with their surface modified by grinding or parallel striations. One was a triangular piece of sandstone of 85mm x 82mm x 30mm and weighing 186gm, with one face ground smooth and flat. Another two flakes of laminated mudstone weighing only two or three grams and measuring less than 40mm had areas of parallel striations on their dorsal face, and in one case also on the platform. The function or use of these artefacts is unknown.

Summary

The excavation at Echidna Shelter produced a cultural sequence spanning the last 7500 years. Like Green Ant Shelter, it appears to have been a camping place and it is likely that the dates of occupation bracket the rock art. Although there are many similarities to the Green Ant Shelter sequence, there are also significant differences. There is a much higher proportion of quartzite artefacts at Echidna Shelter as well as temporal changes in the proportions of raw materials.

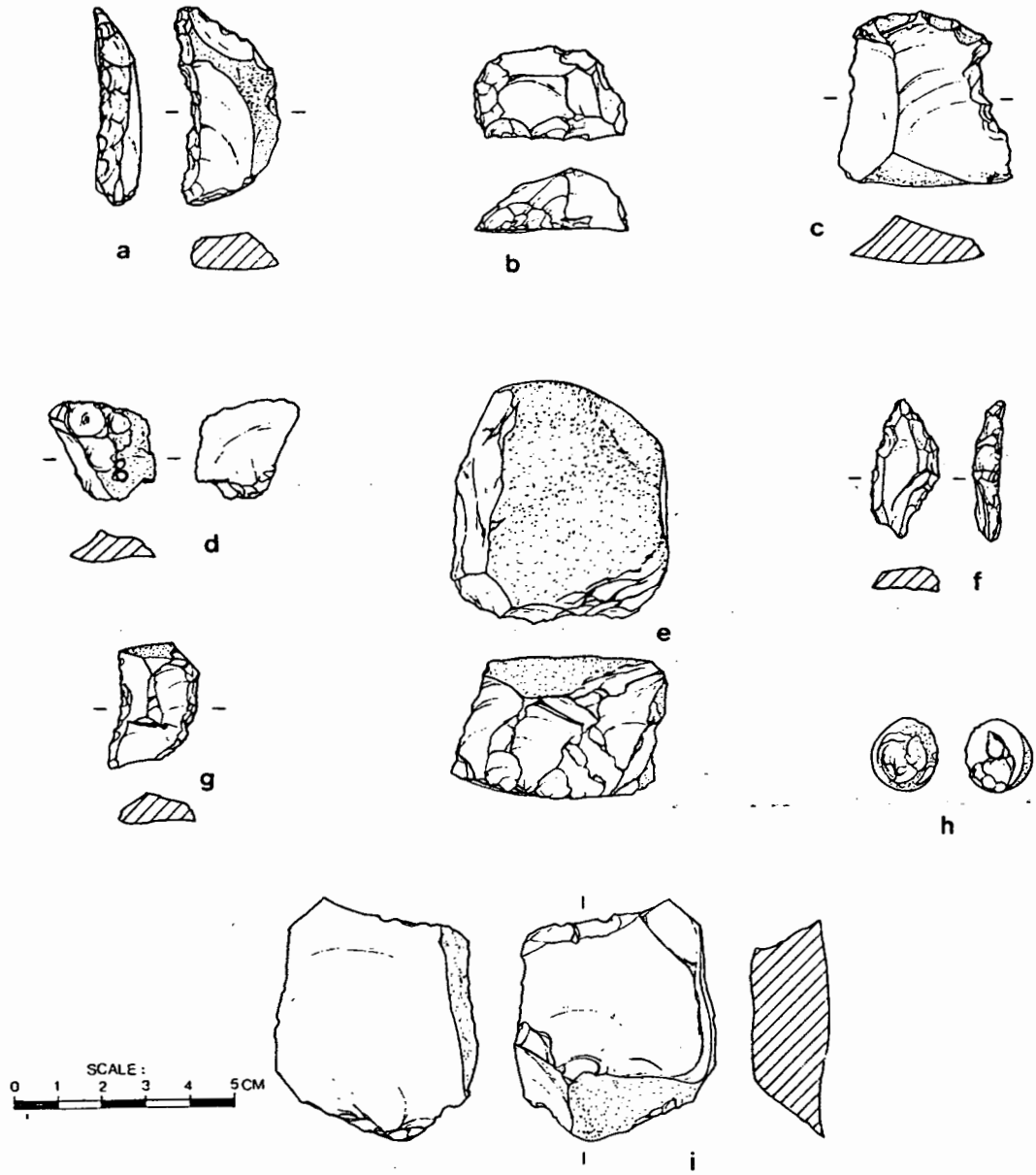


Figure 23. a) chert scraper slug, No.ED9 -L27, spit 1.
b) chert backed scraper with cutting edge on left and resin on right, No.ED27 - L27, spit 1.
c) chert scraper, No.ED48 - L26, spit 1.
d) heat-spalled chert flake, No.ED98 - L26, spit 2.
e) quartz pebble scraper, No.ED85 - L26, spit 2.
f) chert wood-scraper slug (heat-crazed) with resin traces, No.ED141 - L27, spit 3.
g) chert backed scraper with concave working edge on left, backing retouch on right and large snap fracture at tip, No.ED132 - L27, spit 3.
h) heat-spalled, pot-lidded flake, No.ED179 - L27, spit 4
i) utilised chert flake, No.ED214 - L26, spit 6.

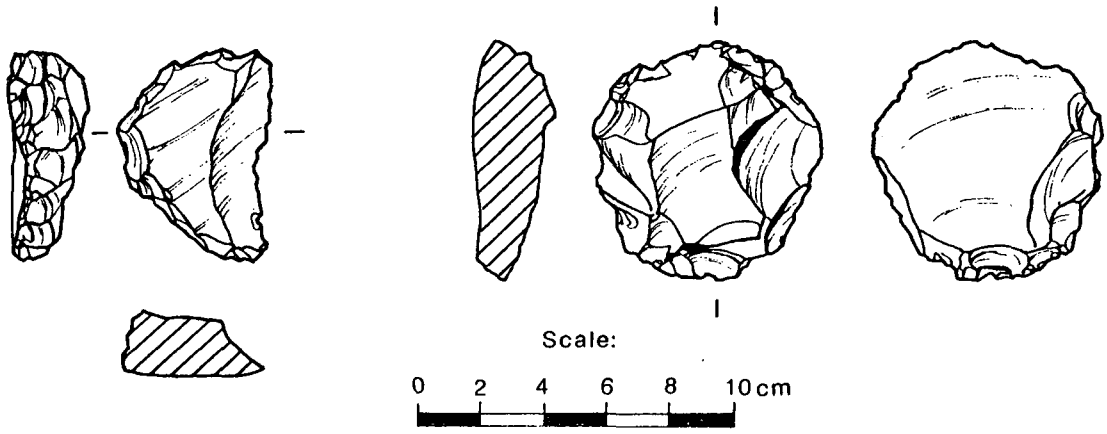


Figure 24. Left: Geometric microlith of chert (ED297- L24, Spit 4) Right: Thumbnail scraper of chert (ED292 - L24, Spit 3).

A change in preferred raw material from quartzite to chert took place fairly rapidly about 800 years ago. Quartzite was preferred throughout the earlier occupation, but during the last 800 years chert predominated.

Artefact types are generally similar to those at Green Ant Shelter, with the same hafted wood-scrapers in use from about 6000 BP to the most recent horizon. More specialized small tools appear in the sequence after 3000 BP - a thumbnail scraper from between about 1500 and 2500 BP and a geometric microlith between about 2500 and 3000 BP.

Occupation of Echidna Shelter seems to have commenced about 7500 BP, the lowest artefact being 5cm below a date of 7280 $\pm$ 130 BP. The highest rate of sedimentation correlates with the highest artefact discard rate, between 6850 and 5100 BP. There is another peak in artefact discard rate between about 1400 and 800 BP, but both the discard rate and absolute number of artefacts are lower than at Green Ant Shelter. The differences between both sites only 3km apart and spanning the same time period vividly demonstrate the difficulties of generalizing about a regional cultural sequence from the evidence at one site.

DISCUSSION

The Green Ant and Echidna Shelters show similarities with and differences from both each other and other north Queensland sites. Similarities between the two sites are their time span, some artefactual raw materials, artefact types and their dates, and the general lack of change in the cultural sequence. Differences are in proportions of raw materials, sedimentation rates and artefact discard rates.

One of the surprising features of the Koolburra sites is the apparent lack of change in their assemblages over an 8000 year time span. In both sequences there is a remarkable stability and continuity, with no basic change in the size, material or morphology of artefacts

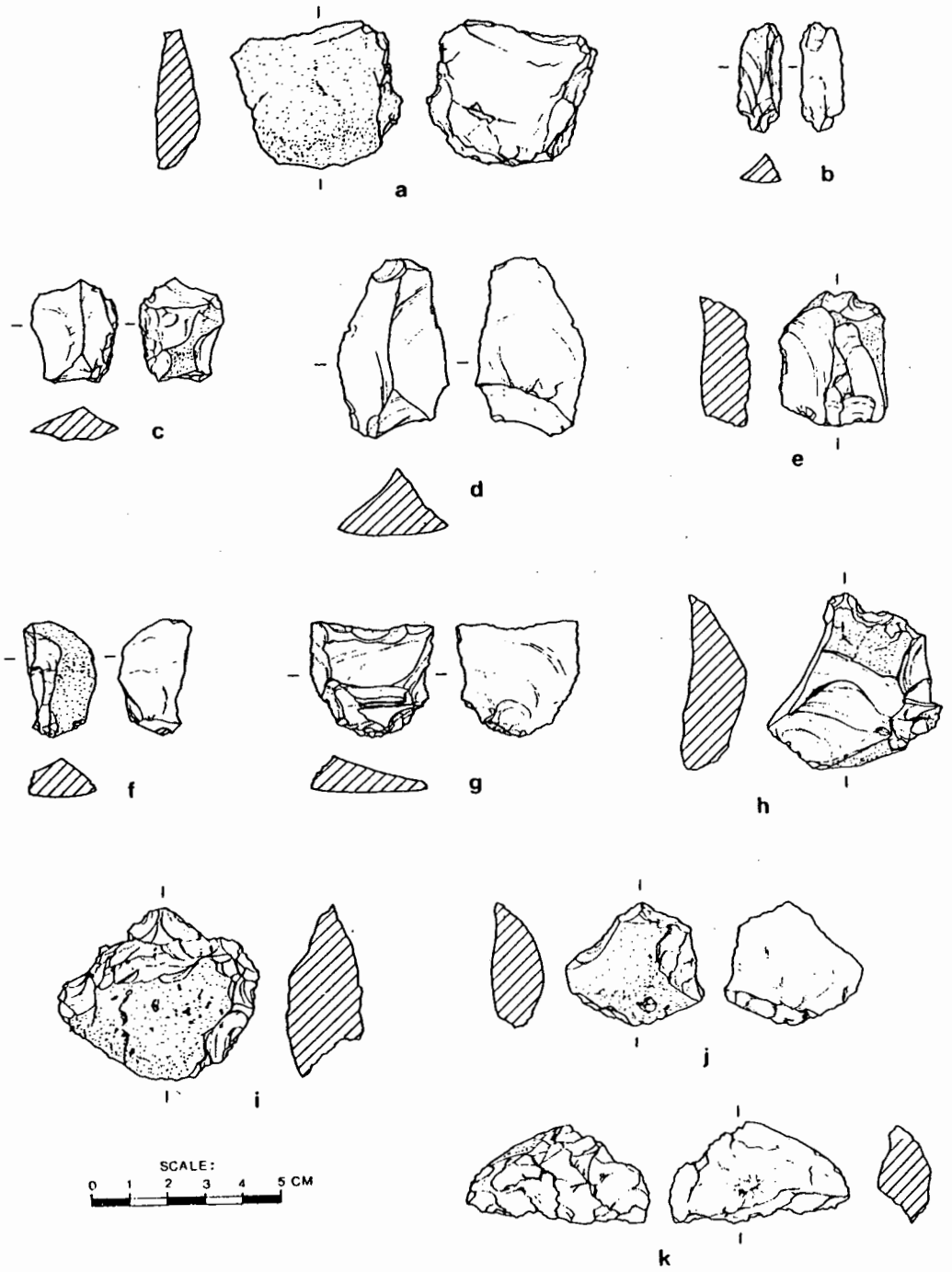


Figure 25. a) quartz flake, No.ED258 - L24, spit 2; b) quartz flaked piece with one used edge, No.ED1536 - L24, spit 3; c) chert flaked piece with one bifacially used edge, No.ED322 - L24, spit 6; d) chert flake with 2 used edges, No. ED330 - L24, spit 7; e) quartz flake with 2 used edges, No. Ed333 - L24, spit 7; f) chert flake, NO.ED1054 - L24, spit 8; g) chert flake with retouched and one used edge, No.ED1055 - L24, spit 8; h) chert flake with 2 retouched edges, No.ED1034 - L24, spit 8; i) quartz flaked piece with one retouched steep sinuous edge, No. ED1185 - L24, spit 9; j) quartzite flake with one retouched steep edge,No.ED1124 - L24, spit 9; k) quartz flake, No.ED1344 - L24, spit 11.

over a time span of more than seven millennia. Nevertheless, an extremely detailed analysis along the lines of Hiscock (1986) might reveal slight technological changes over time, and it would be worthwhile to carry out such an analysis on the unretouched flakes of Echidna and Green Ant Shelters. At Echidna Shelter there is a change over the last millennium from quartzite to chert as the dominant raw material. The only other change is the advent of a few specialised small tools at both sites in the later part of the Holocene period after about 3000 BP. In contrast, at Early Man shelter there were temporal changes in both raw material and artefact size.

Small backed wood scrapers resembling an elouera first appear at Echidna Shelter and Green Ant Shelter about 6000 years ago, although in view of the relatively small sample in both cases it would be unwise to argue from the absence of evidence in the lower levels. Small flake scrapers or "burrens" appeared in Green Ant Shelter at ca. 1500 BP. Use-wear analysis of these small flake scrapers by Kamminga has indicated they were used for wood scraping rather than adzing. It would therefore be misleading to describe them as adzes. The term "burren" may be used but not "burren adze", which originally in McCarthy's nomenclature was a variety of tula adze with retouch on the lateral margins rather than the distal end.

The Holocene industry from Green Ant and Echidna Shelters may be compared with those from other sites in north and central Queensland. The only type of specialised small tools present in all sites excavated so far in the Laura area (Green Ant, Echidna, Early Man Shelter and Mushroom Rock) is the small flake wood scraper or burren and all four sites yielded examples which still retained hafting gum on them. At Early Man they appear not to have been used prior to around 5000 BP (Rosenfeld et al 1981:15). These small flake scrapers are characterised by a steep working edge, sometimes worked back into a slug, and were apparently hafted as wood-scraping and shaving tools.

Backed pieces occur at virtually all the north Queensland sites excavated so far, except Walkunder Arch Cave, Chillagoe, where the Holocene assemblage contained very little retouched material (Campbell 1984:178-179) and in the rainforest sites, where their absence may be related to lack of suitable raw material. Backed scrapers were found at Green Ant Shelter, Mushroom Rock and sites in Central Queensland such as Kenniff Cave. Backed blades occur at Colless Creek and other sites in the Lawn Hills Gorge area (Hiscock and Hughes 1980). These were predominantly geometric in form but asymmetric ones of Bondi point form also occur. Backed blades, especially geometric microliths, were relatively common at Kenniff Cave and have also been found at Jourama and Turtle Rock in the Townsville region (Campbell 1982:63-64 and 1984:179) and in the Hughenden area (Morwood and Godwin 1982:51).

One geometric microlith occurred in the Koolburra excavations, in Echidna Shelter. This extends the distribution of backed blades further north into the Cape York Peninsula than previously recorded (cf. Davidson 1983:28). There was no evidence of the use of the bipolar technique and no bipolar scaled artefacts were found in the Koolburra sites, but three examples were present at Early Man Shelter. This is in marked contrast with sites such as Turtle Rock (near Townsville) and Jiyer Cave (near Cairns) where anvilling is a common technique for working quartz.

At all the excavated sites in the Laura area small fragments of fine-grained hard material occurred bearing bevels or other evidence of grinding. These appear to be fragments of ground-edge axes. At Green Ant Shelter they were in 018 spit 1 and N20 spit 13 (i.e. less than 2500 BP), but at Early Man Shelter they occurred in a 10,000 BP level, and at Mushroom Rock they were in the bottom of the deposit well below a date of 6780 ± 150 BP.

The similarities between the assemblages of the Koolburra Plateau, Kenniff Cave and the Lawn Hills area may relate to Koolburra's location on the watershed of the Great Dividing Range. The boundary between the West and East Cape York cultural areas runs down the Great Divide (cf. Flood 1983a:Figure 15.b). This means that Aboriginal people of the Koolburra Plateau are likely to have had as many or more links with the groups across the plains to their west as with the people of the Laura area to the east.

Further comparative research is needed on other sites in the west and north of Cape York Peninsula before any definitive statements can be made about tool type distribution, but the Koolburra sites have provided some important evidence of relevance to the prehistory of northwest as well as northeast Queensland.

The evidence from both Koolburra shelters supports Hughes's hypothesis of the association between high sedimentation rates and high artefact discard rates. However, there are differences between the two shelters both in the chronology and amount of site usage. The higher rate of sedimentation and high artefact discard rate between about 5000 and 7000 years at Echidna Shelter contrasts with Green Ant Shelter, where sediment accumulation was very low between 2500 and 7000 BP, accompanied by a low artefact discard rate. This evidence could be interpreted to mean that Echidna Shelter had a greater occupancy rate than Green Ant Shelter during the period 7000 to 5000 BP, possibly because it provided much better protection against the elements in this period of alleged increased precipitation. Nevertheless, it should also be noted that the amount of sediments and the artefact discard rate per century are consistently higher at Green Ant than Echidna Shelter. It seems that Green Ant Shelter received considerably more use than Echidna Shelter, except in the period from about 2500 to 7000 BP. This may have been due to the location of Green Ant Shelter at the tip of the Koolburra Plateau, whereas Echidna Shelter is tucked away in a valley in the centre of the massif.

There is an increase in both artefact discard and sedimentation rate at Green Ant Shelter at about 2550 B.P. (no such change is discernible in the smaller assemblage from Echidna Shelter). The quantity of charcoal is also higher in these upper levels, but this is probably due to taphonomic factors. There is no sign of any diminution in intensity of site usage in the most recent levels; indeed at Green Ant Shelter both the artefact discard and sedimentation rates appear to be very high over the last 200 years.

These data have implications for the intensification issue. The Green Ant Shelter evidence could be interpreted at indicating increased intensity of site use about 2500 BP. At Echidna Shelter the picture is less clear, due partly to the smaller sample, and at Early Man Shelter Rosenfeld *et al* (1981:12-13) concluded that the "overall rates of

sedimentation have not varied significantly since first occupation of the shelter." However, if one puts her B square dates in the same format as those for Green Ant Shelter (Figure 6), there is a marked increase in sedimentation rate at Early Man Shelter at about 5500 BP. There is also a significant increase in artefact numbers at Early Man Shelter at a depth of 60cm (about 2000 BP) in squares B4 and B5 (Rosenfeld et al 1981: Table 5). Changes which may reflect intensification are discernible at both Green Ant and Early Man Shelters, but there are no signs of "de-intensification".

Other data of significance from Green Ant Shelter concern environmental changes during the Holocene. While the evidence is not conclusive, it does not support Kershaw's hypothesis of increased precipitation in the early to middle Holocene. Such an environmental change also seems to be reflected in the Holocene sequence at Early Man Shelter, and possibly also at sites of the Chillagoe and Lawn Hill regions. Kershaw supports an increase in precipitation commencing about 11,000 BP, but not coming into full effect on the Atherton Tablelands until about 9000 BP. Although his observations relate particularly to the Atherton Tablelands region, he does consider that those changes may relate to climatic shifts of a more general nature. A significant increase in rainfall in the relatively dry area of the Koolburra Plateau about 9000 BP would have made this region a more attractive human habitat, and may account for the beginning of occupation at Green Ant and Echidna Shelters during the subsequent millennium.

It is likely that the dates of occupation in the Koolburra Shelters bracket the age of the art (cf. Morwood 1980, 1981) and that the oldest engravings are of similar age to the earliest occupation. The sequence of techniques, based on superimpositions, appears to commence with deeply packed engravings of motifs such as circles, pits, "mazes", lines and bird and macropod tracks. Superimposed on these weathered engravings are much fresher lighter coloured ones, lightly packed or hammered, including more figurative motifs such as human hands and feet, turtles and spear-throwers. Paintings and stencils overlie the engravings, and appear to be fairly recent. A detailed study of the art will be published separately, but it may be noted here that the marked differences in style of engravings between Early Man Shelter and the Green Ant-Echidna sites may be due primarily to chronological factors. The Early Man Shelter art commenced before 13,000 BP, whereas the Koolburra engravings are likely to post-date 8500 BP. Comparison of these engravings is being carried out by Natalie Franklin of La Trobe University in her study of the Panaramitee style, and considerable differences have already emerged both between the Cape York Peninsula sites and between them and the Panaramitee style of South Australia.

The Green Ant and Echidna Shelters, as only the third and fourth excavated rockshelter assemblages in a region of more than 40000km^2, make a significant contribution to the body of data on which all theoretical debates in Australian prehistory must be based. In particular, they point up the obvious danger in extrapolating for a whole culture area or region from one site, and demonstrate the considerable differences which may exist not only within a region but between two sites only 3km apart and spanning the same time period.

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Allan Mail
Mel Marquardt
Sylvia Marquardt
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REFERENCES CITED

Anderson, J.C. 1979 Aboriginal economy and contact relations at Bloomfield River, North Queensland. **Australian Institute of Aboriginal Studies Newsletter** 12:33-37.

Anderson, J.C. 1984 The political and economic basis of Kuku-Yalanji social history. Unpublished PhD thesis, University of Queensland.

Beale, E. 1970a **Kennedy Workbook**. Wollongong University College.

Beale, E. 1970b **Kennedy of Cape York**. Adelaide:Rigby.

Bolton, G.C. 1970 **A Thousand Miles Away: a history of North Queensland to 1920**. Canberra: Australian National University Press.

Brady, D., C. Anderson and B. Rigsby 1980 "Some of Us Are Still Alive": The Palmer River Revisited. **Australian Institute of Aboriginal Studies Newsletter** 13:30-36.

Campbell, J.B. 1982 New radiocarbon results for North Queensland prehistory. **Australian Archaeology** 14:62-66.

Campbell, J.B. 1984 Extending the archaeological frontier: a review of work on the prehistory of North Queensland. **Queensland Archaeological Research** 1:173-184.

Campbell, J.B., A. Pomeroy and M. Mardaga-Campbell 1982 It still hinges on stone. **Australian Archaeology** 15:108-112.

Chase, A., P. Sutton, M. Lorblanchet and R. Layton 1975 Flinders Islands Expedition. **Australian Institute of Aboriginal Studies Newsletter** 3:34-37.

David, B. 1983 To pick a bone: differentiating between cultural and dingo-accumulated bone debris - the case of Walkunder Arch Cave. Unpublished B.A. (Honours) thesis, Australian National University, Canberra.

David, B. 1984a Walkunder Arch Cave: a faunal report. **Australian Archaeology** 18:40-54.

David, B. 1984b **Man versus dingo: the identification of bone remains from archaeological sites, with specific reference to Walkunder Arch Cave, Chillagoe, northeastern Queensland.** Queensland Department of Community Services, Archaeology Branch, Cultural Resource Management Monograph Series No. 5.

Davidson, I. 1983 On the edge of the Simpson:recent additions to understanding of prehistoric artefact distributions in arid Australia. **Australian Archaeology** 17:27-37.

Flood, J. 1970 A point assemblage from the Northern Territory. **Archaeology and Physical Anthropology in Oceania** 5:27-52.

Flood, J. 1974 Pleistocene man at Cloggs Cave - his tool kit and environment. **Mankind** 9(3): 175-88.

Flood, J. 1983a **Archaeology of the Dreamtime.** Sydney: Collins.

Flood, J. 1983b Quinkan Country: the archaeology and art of Cape York Peninsula. **Hemisphere** 27:315-320.

Flood, J. 1983c The rock paintings of Cape York. **Heritage Australia** 2(1): 10-15.

Flood, J. and P. Trezise 1981 A boomerang from Cape York Peninsula. **Australian Archaeology** 13:95-96.

Hale, H.M. and N.B. Tindale 1933 Aborigines of Princess Charlotte Bay, north Queensland. **Records of the South Australian Museum** 5(1): 63-116

Hale, H.M. and N.B. Tindale 1934 Aborigines of Princess Charlotte Bay, north Queensland. **Records of the South Australian Museum** 5(2): 117-172.

Hann, W. 1873 Report From Mr. W. Hann, leader of the Northern Expedition Party. **Queensland Legislative Assembly Votes and Proceedings** pp. 1031-1070.

Harris, D.R. 1975 Traditional patterns of plant-food procurement in the Cape York Peninsula and Torres Strait Islands. MS report to the Australian Institute of Aboriginal Studies, Canberra.

Harris, D.R. 1976 Aboriginal use of plant foods in the Cape York Peninsula and Torres strait Islands. **Australian Institute of Aboriginal Studies Newsletter** 6:21-22.

Haviland, J. 1979 Guugu Yimidhirr. In R.M.W. Dixon and B.J. Blake (eds.) **Handbook of Australian Languages**, pp.27-180. Canberra: Australian National University Press.

Hiscock, P. 1982a The real meaning of edge angles? **Australian Archaeology** 14:79-85.

Hiscock, P. 1982b The north Queensland data bank. **Australian Archaeology** 15:103-107.

Hiscock, P. 1983 Stone tools as cultural markers?: the last two decades of stone artefact analysis in Australian archaeology. **Australian Archaeology** 16:48-56.

Hiscock, P. 1984 Preliminary report on the stone artefacts from Colless Creek Cave, northwest Queensland. **Queensland Archaeological Research** 1:120-151.

Hiscock, P. 1986 Technological change in the Hunter River Valley and its implications for the interpretation of Late Holocene change in Australia. **Archaeology in Oceania** 21:40-50.

Hiscock, P. and P.J. Hughes 1980 Backed blades in northern Australia: evidence from northwest Queensland. **Australian Archaeology** 10: 86-95.

Hughes, P.J. 1980 Thesis abstract: the geomorphology of archaeological sites on the south coast of New South Wales. **Australian Archaeology** 11:50-52.

Kamminga, J. 1978 Journey into the microcosms: a functional analysis of some classes of prehistoric Australian stone tools. Unpublished PhD thesis, University of Sydney.

Kershaw, A.P. 1975 Late Quaternary vegetation and climate in northeastern Queensland. In R.P. Suggate and M.M. Creswell (eds), **Quaternary Studies, Bulletin of the Royal Society of New Zealand** 13:181-187.

Keyser, F. de and K.G. Lucas 1968 Geology of the Hodgkinson and Laura Basins, north Queensland. Department of National Development, Bureau of Mineral Resources, Geology and Geophysics, Canberra, **Bulletin 84.**

Kirk, R.L. 1973 Genetic studies of Cape York populations. In R.L. Kirk (ed), **The Human Biology of Aborigines in Cape York**, pp 25-36. Canberra: Australian Institute of Aboriginal Studies.

Lawrence, R. 1968 Aboriginal habitat and economy. Department of Geography, Australian National University, **Occasional Papers** No.6.

McCarthy, F.D., E.Bramell and H.V. Noone 1946 The stone implements of Australia. **Memoirs of the Australian Museum** No.9.

McConnel, U.H. 1939-40 Social organisation of the tribes of Cape York Peninsula, north Queensland. **Oceania** 10(1):54-72; 10(4):434-55.

Mardaga-Campbell, M., A.B. Pomeroy and J.B. Campbell 1982 It all hinges on stone. **Australian Archaeology** 14:67-71.

Mardaga-Campbell, M. and J.B. Campbell 1985 Lithic occurrences and stratigraphic problems at Turtle Rock (Hervey Range), north Queensland. **Queensland Archaeological Research** 2:98-131.

Morwood, M.J. 1980 Time, space and prehistoric art: a principal components analysis. **Archaeology and Physical Anthropology in Oceania** 15(2):98-109.

Morwood, M.J. 1981 Archaeology of the Central Queensland Highlands: the stone component. **Archaeology in Oceania** 16:1-52.

Morwood, M.J. and L.M. Godwin 1982 Aboriginal sites in the Hughenden Region, north Queensland highlands. **Australian Archaeology** 15: 49-53.

Mulligan, J.V. 1904 Exploring expeditions and prospecting experiences 1850-1903. **The Queenslander** 3rd Sept. - 8th Oct.

Mulvaney, D.J. 1975 **The Prehistory of Australia.** 2nd edition. Ringwood: Penguin.

Mulvaney, D.J. and E.B. Joyce 1965 Archaeological and geomorphological investigations on Mt. Moffatt Station, Queensland, Australia. **Proceedings of the Prehistoric Society** 31:147-212.

Pedley, L. and R.F. Isbell 1971 Plant communities of Cape York Peninsula. **Proceedings of the Royal Society of Queensland** 82:51-74.

Peterson, N. 1976 The Natural and cultural areas of Aboriginal Australia: a preliminary analysis of population groupings with adaptive significance. In N. Peterson (ed), **Tribes and Boundaries in Australia**, pp.50-71. Canberra: Australian Institute of Aboriginal Studies.

Pike, G. 1978 **Queensland Frontier.** Adelaide: Rigby.

Rigsby, B. 1980 The language situation on Cape York Peninsula: past, present, future. In J. Wright, N. Mitchell and P. Watling (eds), **Reef, Rainforests, Mangroves, Man: A Focus on Cape York Peninsula**, pp. 5-7. Cairns: Wildlife Preservation Society of Queensland.

Robinson, T.W.L. 1983 A proto-history: early European exploration of the Chillagoe and Mitchell-Palmer areas. **Tower Karst, Chillagoe Caving Club Occasional Paper** 3:18-35.

Rosenfeld, A., D. Horton and J. Winter 1981 Early Man in North Queensland. **Terra Australis** 6, Department of Prehistory, Research School of Pacific Studies, Australian National University, Canberra.

Roth, W.E. 1897 **Ethnological Studies Among Queensland Aborigines.** Brisbane: Government Printer.

Roth, W.E. 1901-1910 **North Queensland Ethnographic Bulletins**, 1-18. Brisbane: Government Printer

Sharp, R.L. 1939 Tribes and totemism in north-east Australia. **Oceania** 9(3):254-75; 9(4):439-61.

Sutton, P. (ed), 1976 **Languages of Cape York.** Canberra: Australian Institute of Aboriginal Studies.

Thomson, D.F. 1933 The Hero Cult, initiation and totemism on Cape York. **Journal of the Royal Anthropological Institute** 63:453-537.

Thomson, D.F. (ed. H.W. Scheffler) 1972 **Kinship and behaviour in north Queensland. A preliminary account of kinship and social organisation on Cape York Peninsula.** Canberra: Australian Institute of Aboriginal Studies.

Tindale, N.B. 1965 Stone implement making among the Makako, Ngadadjara and Pitjandjara of the Great Western Desert. **Records of the South Australian Museum** 15(1):131-164.

Tindale, N.B. 1974 **Aboriginal Tribes of Australia.** Canberra: Australian National University Press.

Trezise, P.J. 1969 **Quinkan Country.** Sydney: Reed.

Trezise, P.J. 1971 **Rock art of south-east Cape York.** Canberra: Australian Institute of Aboriginal Studies.

Von Sturmer, J.R. 1978 The Wik Region: economy, territoriality and totemism in western Cape York Peninsula, north Queensland. Unpublished PhD thesis, University of Queensland, St. Lucia.

Watson, J.A.L. and H.M. Abbey 1986 The effects of termites (Isoptera) on bone: some archaeological implications. **Sociobiology** 11(3):245-254.

Wright, R.V.S. 1971 Prehistory in the Cape York Peninsula. In D.J. Mulvaney and J. Golson (eds), **Aboriginal Man and Environment in Australia**, pp. 133-40. Canberra: Australian National University Press.