Archaeological Studies at Bomaderry Creek, New South Wales

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ABSTRACT. Aboriginal hunter-gatherers briefly occupied a large rockshelter on Bomaderry Creek at about 1900 years bp and about 1400 years bp. While in residence they subsisted on a variety of local plants and animals, but their life style was also linked closely to that of people who occupied sites nearer the coast farther south. Excavation revealed not only aspects of their economic life but also the manner in which the evidence they left behind had been modified later by such agencies as human disturbance, scavenging by dingoes and weathering.

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This joint paper describes two independent pieces of research at the Bomaderry Creek rockshelter. Both authors are indebted to the pioneering archaeological research by F.D. McCarthy in eastern New South Wales, much of which remains a keystone to present day studies in the region. If only because they occurred 17 years apart (in 1970 and 1987), with immense changes having taken place in Australian prehistory during those years, it will be appreciated that the two projects were undertaken for different reasons. The results they produced, however, are complementary.

The site was excavated in 1970 as part of a program of research into the prehistory of the south coast of New South Wales initiated by Lampert (1966, 1971a, 1971b). Reflecting the interests of those years, the aims of the program centred on building a basic knowledge of prehistory in a largely unknown region. A local cultural sequence was sought which might be compared with the eastern regional sequence proposed by McCarthy (1967) from stratified sites at Lapstone Creek (McCarthy, 1948) and Capertee (McCarthy, 1964). At a time when economic prehistory was developing its research aims and a methodology, particular attention was paid to the economic uses of resources at coastal and near-coastal sites (Lampert, 1971a:1). In later years, data from this research was used to test different and often more sophisticated hypotheses (e.g., Lampert & Hughes, 1974; Hughes & Lampert, 1982; Steele, 1987; Sullivan, 1976).

Well-preserved organic remains in recent deposits – including artefacts of shell, bone, plant fibre and resin, and food remains of shell and bone – together with historical observations of Aboriginal economic activities, allowed a detailed picture of economic life to be reconstructed. This varied from site to site. While occupying the foreshore site of Durras North (Lampert, 1966) people subsisted almost entirely on such marine resources as fish, shellfish, mutton bird and seal, and had a specialised technology in which line and spear fishing equipment featured. Occupants of the Currarong rockshelters (Lampert, 1971b), located beside a tidal creek at the foot of a low rocky plateau some 600 m from the shore, enjoyed a more varied diet in which the local environments of land, sea and estuary were all represented. A similar picture was revealed at the Burrill Lake rockshelter (Lampert, 1971b) in an estuarine locality at the foot of wooded hills about one kilometre from the sea, except for greater emphasis on the adjacent estuary and woodland than the sea.

The overall picture that emerged from these sites was of visits by people with wide ranging economic interests but who were attracted strongly to the rich dependable resources of the littoral. They enjoyed a diverse economy while at Currarong, a more restricted one at Burrill Lake, and a specialised shoreline subsistence at Durras North. Identical artefact types of bone, stone and shell indicated a close relationship between the people who used these sites.

Bomaderry Creek was chosen to further examine the economic relationship between people and landscape because its environment shows another kind of variation. The site is on a major tidal estuary and thus shares some of the characteristics of Burrill Lake and Currarong, while being located at a much greater distance from the sea. Because of his interest in this question, Lampert excavated the site in 1970 in association with Dr J.H. Calaby (Division of Wildlife, CSIRO, Canberra) who identified some of the land fauna represented among excavated bones. In 1987 the identification and analysis of land fauna was completed by Steele as part of his research towards the degree of BA(Hons) at the University of Sydney (Steele, 1987). In this, Steele went beyond simple identification and used the distribution of the bones and their breakage patterns as the basis for an investigation of site formation processes which are summarised in this paper. However, as Steele notes (1987:99,162), to fully conduct this kind of investigation a larger area of the shelter floor should have been excavated, Lampert having merely excavated sufficient to recover evidence for the major thrust of economic activity.

Environment

The site is a sandstone rockshelter in the southern side of a steep-walled gully. Below the site flows Bomaderry Creek, a short but permanent stream rising in the Cambewarra Range some eight kilometres further inland. Only 700 m downstream from the site Bomaderry Creek is tidal, while one kilometre further downstream its course meets the broad estuary of the Shoalhaven River at a point some 12 km from the sea (Fig.1). This junction of the two streams occurs where foothills of the divide meet the flood plain of the Shoalhaven estuary. Beyond the cliff top above the site is elevated sandstone country supporting a low, fairly sparse natural cover of open eucalypt forest. Damper conditions and deeper soils near both Bomaderry Creek and the Shoalhaven River support typical gully flora. Dominant among canopy trees in this are large specimens of spotted gum (*Eucalyptus maculata*) while shrubs in the dense understorey include the narrow-leaved geebung (*Persoonia lanceolata*) and the burrawang (*Macrozamia communis*).

The overhang forming the shelter was produced by cavernous weathering of horizontally bedded sandstone of the Nowra Series. Rockshelter sites at Burrill Lake and Currarong, 60 km and 40 km to the south respectively, are in the same sandstone and were formed in like manner (Lampert, 1971b). Although the Bomaderry site has only two thirds of the floor area of the Burrill shelter, the largest known on the south coast of New South Wales, it has a much higher ceiling (up to 5.5 m) to give it an effect of greater spaciousness.

Facing almost due north, the site is well protected from southerly and onshore winds which bring most rain to this locality. Massive blocks of sandstone at the shelter mouth (Fig.2) restrict the entry of sunlight and so provide areas which are cool even on the hottest summer days.

Excavation

During an initial visit it was noticed that the deposits that make up the shelter floor had been disturbed in several places, and there were other signs that the

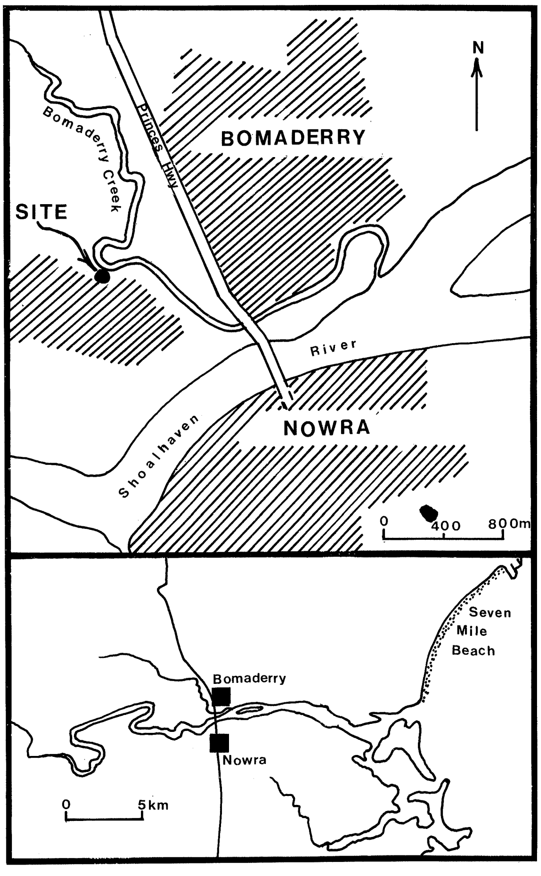

Fig.1. Location of Bomaderry Creek rockshelter in relation to the present towns of Bomaderry and Nowra.

immediate environment was under stress because of European activities. Houses which form part of a suburb of the present day town of Nowra stand on the cliff top immediately above, while the gully itself is a playground for local children.

Lying around recently disturbed patches of the shelter floor was such evidence for prehistoric occupation as flaked stone and fire-blackened macropod bones. The suitability of this site for occupation was suggested by its size and aspect, as well as its proximity to fresh water and the resources of a varied environment. Such favourable traits suggested that the shelter might have a reasonable depth of occupation deposits available for study. Because of this potential in a site threatened by gross disturbance, fairly immediate excavation seemed appropriate. A decision to excavate in 1970, when disturbance was limited, seems justified by subsequent events at the site. When Steele visited in 1987 he found the floor littered with rubbish and the walls covered with graffiti.

Stratigraphy and occupational history. Test squares at three dispersed points (Fig.2: Squares A13, I13 and B4) soon showed that the occupation deposit was extremely shallow. In B4, sterile sand was reached 19 cm below the surface, and bedrock at 60 cm; in I13, where more than 1 m of sand was penetrated, cultural material was found only in the top 20 cm; in A13, such material petered out at a depth of 39 cm.

The excavation of squares adjacent to both B4 and A13 showed the limited extent of suitable deposits. Squares A12 and A14, to the east and west of A13, contained only sparse evidence as the zone of occupation appeared to be petering out, while to the north most of B13 was found to be disturbed. In squares around B4, the evidence for occupation also petered out, though less rapidly than it did around A13. North of B4, towards the mouth of the shelter, bedrock was visible at the surface, while east of A13 the narrowing of the overhang together with an absence of cultural material near disturbances made the prospect of discoveries there seem remote. Over the whole shelter floor only the deposits immediately against the back wall were entirely without disturbance.

The deposit was made up of well-defined strata which were excavated individually. Because each stratum was shallow it was removed as a whole without vertical division into spits. Excavated material was sieved through a 3 mm screen. Stratigraphy at the western end of the shelter is typified by Square B4. The earliest cultural material, a few stone flakes and bone fragments, lay on the top of 6-7 cm of bright yellow basal sand. Presumably the first occupants of the shelter had trodden these into the surface of a deposit entirely natural in origin. Above lay the occupation horizon: compact dark grey-brown sand 7-8 cm in thickness containing lenses of ash and charred wood. From the charred wood a date of 1930 +/- 60 years bp (ANU-1021) was obtained. This horizon was capped by loose surface sand only 3-4 cm in thickness.

Square A13, at the eastern end, also had a basal layer of bright yellow sand. It was overlain by grey-brown sand varying in thickness between 10 and 18 cm but containing very few cultural remains. Above this was the main zone of occupation, a well-demarcated dark brown layer some 10 cm thick. The brown colour was caused

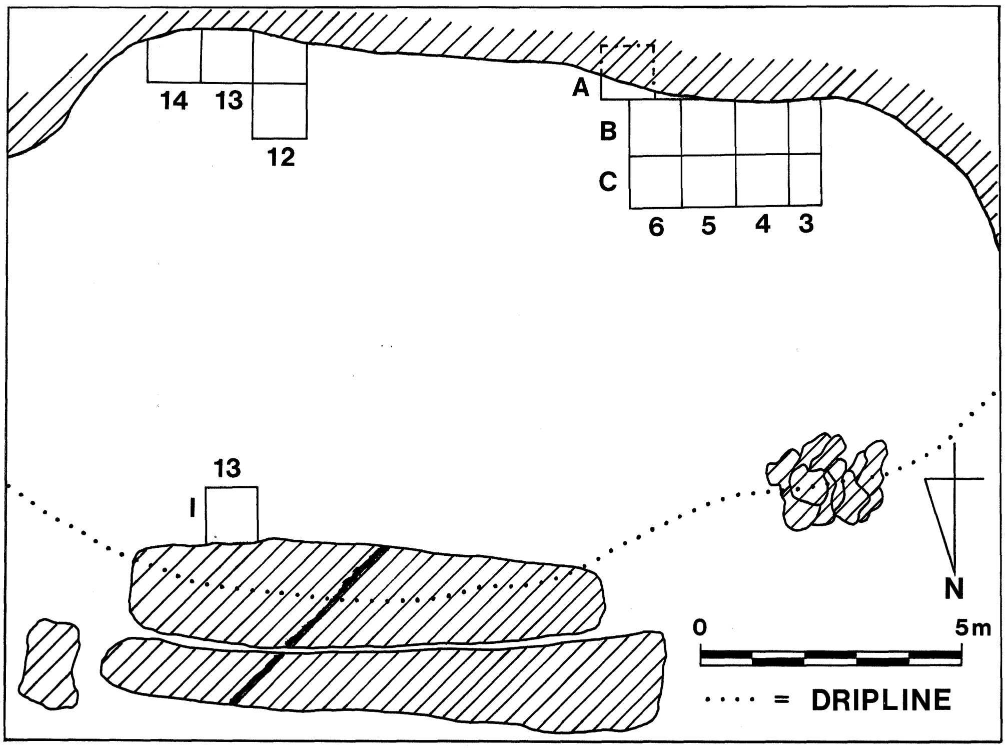

Fig.2. Floor plan of the Bomaderry Creek rockshelter.

mainly by the presence of numerous fragments of seed husk of the cycad *Macrozamia communis*. Charred wood from this layer gave a date of 1410 +/- 60 years bp (ANU-1020). Some 10 cm of sand devoid of cultural material lay above.

Thus there are two discrete areas of shallow occupation deposit with dates a few centuries apart, each surrounded by zones of much sparser occupation, indicating that the shelter was not used frequently.

The Stone Industry

The classification of the stone industry is based primarily on that of McCarthy (McCarthy, Bramell & Noone, 1946; McCarthy, 1967) with modifications suggested by White (1968), Lampert (1971) and Kamminga (1982). The spatial distribution of the various classes is shown in Table 1 (Appendix). A description of each class follows.

Raw materials. Chert and reef quartz were the stone types most commonly used at the site. The source of reef quartz is widespread, appearing both as isolated pebbles and within conglomerate bands in the Nowra Sandstone Series. This sandstone forms not only the Bomaderry shelter but also those at Currarong and Burrill Lake. The chert used at Bomaderry has a much more localised distribution, being known only from the courses of streams that rise in the nearby Cambewarra Range. The closest of these is Tipitallee Creek in which chert is found some 4 km from Bomaderry as nodules that have been eroded by stream action from conglomerate bands in the Permian beds. The chert varies widely in colour, with yellows, browns and reds predominant. It varies also in quality, from opaque material with a hackly fracture, to fine translucent chalcedony with excellent potential for knapping. Chert from this source was found also in the stone industry at Currarong, 40 km to the south (Lampert, 1971), indicating that it was of a quality valuable enough for transportation over some distance.

Perhaps of greater value was a small quantity of silcrete brought to the site from a more distant source, probably outcrops in the Bendalong-Ulladulla region (Hughes, Sullivan & Lampert, 1973), the nearest of which lies some 45 km to the south. Of the ten silcrete artefacts found at the shelter, five are backed blades, one is a utilised flake and four are unmodified flakes. There is no debitage of silcrete normally associated with knapping, which shows that the stone was brought to the site in the form of finished tools rather than as raw material. Seven of the pieces are pale grey like the flaked silcrete found in profusion at the Murramarang site just south of Bendalong-Ulladulla outcrops, where it was the stone favoured for backed blades (Hughes, Sullivan & Lampert, 1973).

Eloueras. The elouera, according to McCarthy (1967:26), is:

> A segment triangular in section, trimmed along one or both edges of the thick margin, it has either trimming, use-polish or evidence of cutting use on the chord.

More recent investigations of New South Wales coastal industries show that the elouera is only part of a broader functional range of tools that include also certain untrimmed stone flakes with use-wear on a longitudinal margin (Lampert, 1971b; Kamminga, 1982). However, these studies support McCarthy's view that the elouera was hafted as a chisel blade, and in south-eastern Australia was end-hafted, perhaps in the handle of a spear-thrower.

This broader functional range was found at Bomaderry. Ten of the tools are formally eloueras in McCarthy's terms, with trimmed backs, while nine are longish flakes of size and shape like the formal elouera and with the same sort of modification along the thinner long margin, but without backing on the thicker margin. To facilitate discussion these groups are named A and B respectively. Table 2 (Appendix), which lists the characteristics of the tools, shows that all are use-worn along the thinner of the long margins. Use-wear is of two sorts, both of which can be present on the same tool. There is use-polish which invades both faces as described by both Lampert and Kamminga, and chipping which in a few cases is light unifacial chattering but more often is bifacial, the most extreme bifacial wear producing a rounded blunting of the edge. Three of the tools have been retouched lightly along the working edge. On six tools there are small areas of hafting resin remaining on the thicker of the long margins and from there spreading across the faces of each tool for up to two-thirds its width. These characteristics are listed individually for the two groups (Table 2 [Appendix]), as are their metrical attributes. Except for edge angle, where the difference is 'probably significant' (alpha less than .05), the two groups do not vary significantly in any of the characteristics investigated.

However, eloueras in group A from Bomaderry are significantly smaller than those from Currarong I (Table 2 [Appendix]), although they have essentially the same gross shape as defined by breadth-length ratio and edge angle. This variation could arise from the small size of raw material available to Bomaderry residents rather than cultural choice, which can be seen at the most likely source of the chert on which all eloueras (A and B) are made. Smallness is apparent also among the chert cores and flakes found at the shelter. At Currarong, however, it is apparent from examining the whole of the stone industry that larger pieces of stone from more varied sources were available.

Utilised flakes. These have the same size range as utilised flakes from Currarong I. Compared with unbacked eloueras (Group B) from Bomaderry, utilised flakes are more irregular in shape, use-wear is in nearly all cases unifacial chattering, working edges are not consistently on a long margin, and hafting gum is entirely without visible trace. Of the 30 specimens recognised, only one is of reef quartz, which could simply mean that casual use-wear of this kind is difficult to detect on reef quartz.

Scrapers. To allow comparison with scrapers from Currarong I the same characteristics (Lampert, 1971b: table 17) were recorded for the Bomaderry specimens (Table 3 [Appendix]). A sample of only eight scrapers from Bomaderry means that a statistically rigorous comparison with other sites is not possible. Nevertheless, within a context of relatively small artefacts, the lower mean values for length, breadth and thickness of Bomaderry scrapers suggests that they are truly smaller than those from Currarong, and the absence of statistical discrimination through the t-test results from the small sample size. Support for this view can be seen in the fact that half of the Bomaderry scrapers are made on cores, suggesting an attempt by the tool makers to make scrapers as large as possible from small-sized raw material. These core-scrapers fall within the same size range as scrapers made on flakes at both Currarong I and Burrill Lake, but are quite unlike the more massive core-tools found at those two sites.

Two of the scrapers are of the thumbnail variety (McCarthy, Bramell & Noone, 1946:42; Lampert, 1971b:27), while the remaining six are 'thick' scrapers as defined for Burrill Lake (Lampert, 1971b:23) and found also at Currarong. In essence, this is a thick side-scraper, lacking regular shape and having a fairly short but steep retouched edge. It can be seen as a local variant of the 'steep-edge scraper' noted by Jones (1973; *cf.* Bowler *et al.*, 1970) as being widespread in Australia during Pleistocene times and later.

Of the six thick scrapers from Bomaderry, three have working edges that are concave and nosed. Use-wear on these, as shown by the rounding of ridges between secondary flake scars, can be seen on the noses but not in the concavities. Whether the concave sections were also used or were simply a structural necessity in making a nosed edge is unknown. However, the concavities are similar in size and shape to those on the notched scrapers from Rocky Cape, Tasmania, interpreted by Jones (1973) as being used to scrape thin wooden shafts such as those of spears.

Fabricators. This is the name used by McCarthy (McCarthy, Bramell & Noone, 1946; McCarthy, 1967) to describe cores from bipolar flaking known also as scalar cores (White, 1968), scaled pieces (Flood, 1973) and *outils ecailles* (Breuil & Lantier, 1965). Both chert and quartz were flaked by bipolar percussion, presumably to produce large numbers of small flakes. There is no difference in size between chert and quartz fabricators (Table 4 [Appendix]) which are both present in substantial quantity, suggesting that the type of raw material was not of critical importance in bipolar flaking. This situation contrasts with that for the elouera where chert alone was selected. Table 4 (Appendix) shows also that in overall dimensions fabricators from Bomaderry do not differ greatly from those found at other south coast and Sydney district sites of similar age.

Although fabricators are seen in the main as by-products of a flaking technique directed towards the production of small flakes, one specimen from Bomaderry was used also as a tool. Remnants of hafting resin along one long margin and bifacial use-wear along the opposite edge suggest that this artefact, like several of the eloueras, was end-hafted as a chisel blade. Fabricators with bifacial use-wear in this position were found also at Currarong I.

Backed blades. Of the nine backed blades recovered, seven are bondi points, one is a geometric microlith (McCarthy, Bramell & Noone, 1946; Glover, 1967; Lampert, 1971b) and one is indeterminate in form. Four of the specimens are of local chert while the remainder are of silcrete from the Bendalong-Ulladulla region (Hughes, Sullivan & Lampert, 1973).

Edge-ground axe. Two fragments of basalt with ground facets to suggest they were once part of the cutting edge of an edge-ground axe were found in the same excavation square and spit. The angle of the cutting edge is 82°.

Other implements. A piece of quartzite with cortex on one surface, and which appears to have spalled naturally, was brought to the site and used. The more acute of its long margins has use-wear both as blunting of the edge and as the removal of long invasive flakes from the cortical surface. The edge angle of 50° falls within the range for eloueras (Table 2 [Appendix]) rather than scrapers (Table 3 [Appendix]), suggesting a cutting-chopping function rather than scraping or planing. It is a fairly large implement (111 *x* 60 *x* 27 mm) and, though formed primarily by natural fractures, is like the cleavers or slices described by McCarthy, Bramell & Noone (1946:21), who say their occurrence in Australia is 'occasional'.

Of the two hammerstones found at Bomaderry, one is a quartz pebble with dimensions of 75 *x* 55 *x* 35 mm and weight of 190 g, while the other is a broken specimen of quartzite. On each the characteristic fine pitting is concentrated at the ends with no sign of pitting on a plane surface, as noted for some of the Currarong hammerstones, to suggest use as an anvil as well as a hammer.

Cores. Mean and standard deviation values for the 13 multiplatform cores are: Length: 37.2 +/- 4.1 mm; Breadth: 26.6 +/- 10.2 mm; Thickness: 18.2 +/- 4.1 mm. These values are only slightly greater than those for scrapers, reflecting again the small size of raw material. Nine of the cores are of chert and four are of quartz.

Unmodified flakes. This category comprises flakes which lack signs either of retouch or of use. Most are small in size (Table 5 [Appendix]). Considered together with multiplatform cores and fabricators (i.e., bipolar cores), they suggest that stone must have been knapped at the site. As at Currarong I, the association of so many small flakes with fabricators shows that part of the industry was directed towards the production of small flakes in large numbers using the bipolar flaking technique. Ethnographic evidence from the region suggests that one use for such flakes was in arming death spears (Lampert, 1971b:46). However, no trace of hafting resin was found on any of these, which could reasonably be expected if a significant number had been attached to death spears and given that hafting resin is preserved on a number of the eloueras. For chert, there are 42 flakes to each fabricator; for quartz, 52 flakes to each fabricator.

Stone Industry: Temporal and Cultural Implications

The stone artefacts described above are from two separate areas of the shelter floor designated 'east' and 'west' in Table 1 (Appendix) which lists the distribution of artefacts within excavation squares. In both areas the occupation deposit is shallow and, towards the surface, has been disturbed in some places. However, because the carbon samples and most of the artefacts were recovered from stratigraphically secure positions in two widely separated areas, we assume that we are dealing with two temporally discrete samples of the stone industry. Further, we assume that artefacts found within loose sand towards the surface must have been disturbed from the occupation layers which are intact immediately below (*cf.* Matthews, 1965; Stockton, 1973) and are unlikely to have moved laterally through disturbance for as great a distance as that between the two areas. Therefore, Table 1 (Appendix), which includes artefacts from within the top loose sand, is seen as an acceptably accurate distribution map.

Several of the artefact types from Bomaderry are well known as culture markers in south-eastern New South Wales (McCarthy, 1948, 1967; McCarthy, Bramell & Noone, 1946; Megaw, 1965; Lampert, 1971a; Johnson, 1979; Attenbrow, 1982). Backed blades first appear in the archaeological record shortly before 5,000 years ago and flourished for some 3,000 years. Around 2,000 ago backed blades lost their popularity in favour of fabricators and eloueras, two artefacts which remained in use until the time of European settlement (Lampert, 1971).

At Bomaderry the western area of occupation has 43 fabricators, 20 eloueras and five backed blades. Dated to 1930 +/- 60 years bp, this assemblage is consistent with the sequence at Currarong I in which a date of 1970 +/- 80 years bp marked the beginning of a numerical ascendancy of fabricators over backed blades. Likewise, the eastern area of occupation, dated to 1410 +/- 60 years bp and yielding 12 fabricators and nine eloueras but no backed blades is also consistent with the Currarong sequence.

Organic Remains

Plant remains. Prominent among plant remains were the seed husks of the cycad *Macrozamia communis*, known locally as Zamia or Burrawang, a shrub common on the low sandstone plateaux which bridge the foothills of the divide with the Shoalhaven flood plain. This species is one of a genera widely distributed in Australia, notably on seaward lower slopes of the eastern highlands where it is an understorey shrub in open eucalypt forest. Seeds vary in size according to species. Those of *M. communis* are seven to ten grams in weight and are produced in large clusters, mostly in winter. While for individual plants fruiting is sporadic, the large number of shrubs can mean an abundant supply of seeds in some areas.

The use by Aborigines of the seeds of *Macrozamia* spp. as food is recorded for many parts of eastern Australia, even though the seeds in their natural state are poisonous, as some early European settlers found to their cost (Phillip, 1789:135). However, Aborigines leached out the poison with water. Precise methods of preparation varied regionally, perhaps because different species of the plant were used, but all involved soaking seeds in water and grinding or crushing them to flour. James MacGlashan (*in* Curr, 1887, vol.3:20) notes that Aborigines in central eastern Queensland:

> ...prepare some portion of the zamia (palm), shelling the edible portion...into a basket, and steeping it in water for three or four days. It is then ground between two stones, wrapped in a covering of ti-tree bark, and so baked.

According to James Backhouse (1836:64), the method near Newcastle, New South Wales, was to:

> ...roast and pound the seeds...place the mass for two or three weeks in water, to take out the bitter principle, after which they are eaten.

In the Braidwood-Nelligen district, some 100 km south of Bomaderry, European settlers in the late 1800s subsisted partly on the seeds of *Macrozamia communis*. A settler who exhibited 50 lb (23 kg) of the flour at an agricultural show at Braidwood said it resembled arrowroot and had been eaten by his family daily for several years. To prepare the flour he crushed zamia nuts, allowed the 'starch' to settle in tubs of water, then spread it to dry (Maiden, 1899:738). Possibly the basis of this method had been learned from local Aborigines.

At Bomaderry, seed husks were present throughout the occupation level, but were prolific only in Square A13 where they formed a dense layer 2 cm in thickness. Table 6 (Appendix) shows the weight of husks for individual squares. From the weights of several complete husks the number of seeds per square was estimated. Weights of useable food were then calculated by applying a husk/kernel weight ratio which was the mean value obtained from a sample of 11 present day seeds collected locally.

Other vegetable remains which may be attributed to Aboriginal occupation of the site include blobs of resin, possibly used for hafting judging from its resemblance to resin on the backs of some eloueras. The most likely source of this material is the local grass tree, *Xanthorrhoea resinosa resinosa* (*cf.* Lampert & Sanders, 1973). Also recovered were fragments of paper bark from a tea-tree (*Melaleuca* sp.). Such bark, in larger sheets, was used in the region as wrapping material and as blankets for babies (*cf.* Lampert, 1971). Another possible use of this bark at Bomaderry was in the cooking of *Macrozamia* flour, given James MacGlashan's description of the preparation of *Macrozamia* seeds as food quoted above, and the presence of numerous husks of these seeds throughout the site (Table 6 [Appendix]). Of a number of small pieces of wood found throughout the site the only piece that had obviously been shaped came from Square C4/2. This is the tip of a stick shaped to a point, tapering from a maximum diameter of 4 mm over a length of 21 mm, partly coated with red ochre, and with parallel impressed lines diagonal to the long axis which suggest it was bound with thin fibre, perhaps for hafting. Possibly this was the prong of a spear to which a bone point had been attached (*cf.* McCarthy, 1940; Lampert, 1966, 1971; Lampert & Konecny, 1989).

Molluscs. From Table 7 (Appendix), which sets out various molluscan species in minimum numbers per excavation square, it can be seen that, though the amount of shell is not great, the species are from a wide range of habitats. Those found typically in estuaries and embayments are Teredinidae (Shipworms), *Crassostrea commercialis* (Sydney rock oyster), *Trychomya hirsutus* (Hairy mussel) and *Mytilus planulatus* (Common mussel). There is little doubt that these were gathered from the nearby estuarine waters of the Shoalhaven. The normal habitat of *Plebidonax deltoides* (Pipi), however, is a sandy ocean beach, the nearest being Seven Mile Beach which extends northward from Shoalhaven Heads, minimally 14 km from the Bomaderry site. Too few to have been a significant food resource at this site, *P. deltoides* appears to have been brought to the site mainly for use as an implement because two of the valves are chipped along the margin like those from Durras North where this role is also indicated (Lampert, 1966:114). However, there is no record of the use as an artefact of *Dicathais orbita* (Cartrut shell), which must have been carried a similar distance, being a reef gastropod found mainly on the intertidal rock platforms that often surround coastal headlands in this region. A fresh water bivalve, *Velesunio ambiguus* (Fresh water mussel), common to most inland waterways of south-eastern Australia, could have been collected from Bomaderry Creek itself.

The most numerous molluscs represented at the site are shipworms of the family Teredinidae (no closer identification possible). The shell of this animal is very small compared to the size of the body (MacPherson & Gabriel, 1962), the 37 g of shell recovered by excavation representing a much greater weight of flesh. A number of early white settlers on the east coast of Australia saw Aborigines eating shipworms. On a bank of one of the creeks leading to the Hawkesbury River, an Aborigine was seen by Collins (1798:558) with:

> ...a piece of water-soken wood (part of the branch of a tree) full of holes, the lodgement of a large worm, named by them cah-bro, which they extract and eat.

Quite close to the Bomaderry site, on the lower Shoalhaven, a man was seen by Alexander Berry (1807:34):

> ...enjoying the luxury of the Cabra - which he was sucking out from fragments of rotten wood.

The names 'cah-bro' and 'cabra' are probably the origin of the common name 'cobra' used by Macpherson & Gabriel (1962:386) for shipworms. As well as remains of the shipworms themselves, pieces of rotten wood penetrated by numerous closely spaced holes were found at the Bomaderry site, indicating that the worms had been brought to the site within the waterlogged wood in which they lodged.

Land mammals. Seventeen species of land mammal were identified from bone remains. The species range shown in Table 8 (Appendix) is consistent with exploitation of animals in the immediate vicinity of the site. Although European encroachment upon the natural environment has brought about the almost total demise of native fauna, in the past the dense, moist thickets of the gully in which the shelter is situated would have suited a range of animals that include the numerically well-represented swamp wallaby (*Wallabia bicolor*) and the eastern swamp rat (*Rattus lutreolus*). Also within the gully, the handsome stands of large spotted gum (*Eucalyptus maculata*) which form a dense canopy would have been an ideal habitat for possums (*Trichosaurus vulpecula* and *Pseudocheirus peregrinus*), and the sugar glider (*Petaurus breviceps*). The elevated sandstone plateau beyond the cliff above the site, with its open eucalypt forest, would have been favoured by the larger macropods (*Macropus giganteus*, *M. robusta* and *M. parma*) and the bettong (*Aepyprymnous rufescens*).

Other fauna. A small number of reptile bones was recovered, the only identifiable bone being the left mandible of a blue-tongue lizard (*Tiliqua scinoides*). Bird remains, consisting of unidentified skull and long bone fragments, were scarce. The skeleton of a small passerine bird found in Square A6/7 probably results from a natural death. The vertebrae of fish, also unidentified, were distributed throughout the site except in Squares B3, C3 and A13.

Site Formation Analysis

The large floor area of the Bomaderry shelter, with its widely separated eastern and western excavation trenches showing broadly similar contemporaneity for occupation, prompted closer examination of the spatial structuring of the archaeological material. Both the original disposal of material and its possible later disturbance are the factors which govern archaeological spatial patterning (Hivernel & Hodder, 1986:97). Therefore, the possibility of post occupational disturbance should be examined if spatial configurations are to be assessed as evidence of prehistoric behaviour. At Bomaderry this question was addressed mainly through examination of the sample of bone, even small unidentifiable fragments being considered useful for this purpose. The post-depositional mechanisms likely to have affected the distribution of bone are weathering, scavenging and human occupational disturbance, each of which is examined in turn.

Patterns of Distribution that Might Arise from Differential Weathering of Bone

To examine this, two main questions were addressed: (a) is the distribution of bone shown in Table 9 (Appendix) the result of varying survival rates in different parts of the site, and (b) have specific components of the bone sample survived better than others?

The absence of bone in Square I13 at the front of the shelter, and its high concentration in those squares against the rear wall (Fig.3; Table 9 [Appendix]) could reasonably be seen as the result of differential preservation. Frontal areas of rock shelters are exposed to moisture flux, wind blast, running water and sunlight. Although all bone when discarded on the surface will start to undergo physical and chemical deterioration, the rear of a shelter is more likely to favour preservation than the front because of its deeper protective overhang. However, the large rock-fall at the shelter mouth against which Square I13 was placed protects the deposit there from sun, wind and rain, as both authors have observed independently. Table 10 (Appendix) shows that other organic material in I13, more susceptible to decay than bone, survived. Although only four fragments of shell were recovered they do not exhibit the chalky texture of shell on its way to dissolution by running water under aerated conditions (*cf.* Hughes, 1977:207). An admittedly tiny amount of *Macrozamia* from this square (Table 10 [Appendix]) also survived. It is unlikely that all traces of bone would have disappeared while less durable materials remained, leading us to conclude that the absence of bone in I13 is 'real' rather than the result of decay.

Square A13 presents a different picture. In addition to being the only excavation square at the eastern end to produce bone, the bone itself shows more extensive weathering than that observed for the rest of the Bomaderry sample, notably a flakiness of the bone surface and the exposure of the cancellous interior. The illustrations and descriptions of the stages bones pass through during weathering provided by Behrensmeyer (1978), Miller (1975) and Tappen & Peske (1970), suggest the A13 sample had weathered during dry, rather than wet or acidic conditions. This view is supported not only by the protected inner location of the square but also by the presence of well-preserved shells and a large number of *Macrozamia* seed husks. While it is possible that bone in A13 was ravaged by purely local agents of deterioration, an alternative explanation is that the A13 bones were deposited as a discrete 'dumping event' and were weathered through not being buried quickly rather than corroding within the deposit (*cf.* Gifford, 1981:416; Miller, 1975; Rosenfeld, Horton & Winter, 1981:43; Yellen, 1977:323). The latter view would accord with the slow natural sedimentation rates for sandstone shelters in the region (Hughes, 1977, 1978) which would allow attrition to occur before the bones were covered.

Bone from the western excavation provides yet another picture. It is well preserved, apparently from having been incorporated rapidly within a loose sandy matrix before significant deterioration could take place. Such rapid mixing with sediments is characteristic of 'sweeping behaviour' by the shelter's occupants. The terms 'dumping' and 'sweeping' refer to site maintenance activities observed ethnographically among Aborigines and other hunter-gatherers, and discussed more fully elsewhere (Steele, 1987).

By these arguments the distribution of bone at Bomaderry does not result from differential preservation, an interpretation supported by an analysis of skeletal element distribution (Table 11, Appendix) which demonstrates that no class of bone is consistently absent. Notably, thin bones with low survival potential, such as scapulae, are present, as are fragile bird and reptile bones across the site. Just over 5% of the sample by weight is burnt and a negligible proportion of this is calcined, showing that the rate of survival could not been enhanced by burning.

Scavenging

Unless tooth marks can be seen on bones, the possible role of dogs or other scavengers in the accumulation, fragmentation and distribution of a faunal sample is usually not considered (David, 1984:40). However, the possibility of this having occurred at the Bomaderry site was investigated by the following procedure.

As much as possible of the Bomaderry bone sample was identified by the NISP method (number of individual specimens present). This method of quantification was chosen for two reasons. First, animals are commonly divided up for consumption among different groups within sites (Gould, 1967; Solomon, 1985), making it more likely that animals will be differentially distributed according to particular body parts than according to species (Rosenfeld, Horton & Winter, 1981:44). Second, in the context of this discussion, certain types of bone may be either disposed of in a particular manner or subjected to a peculiar kind of attrition.

The problem of determining whether bone has been deposited by people or by scavengers is a common one in Australian shelter and cave sites, which are favoured for habitation not only by humans but also by both nonhuman predators and certain of their prey. Predators take their prey to these sites for consumption, and animals live and die within them.

In the context of the Bomaderry site, four features are potentially diagnostic of bones resulting from activity by such large scavengers as dingoes rather than people. These are: i) a low ratio of burnt to unburnt bones; ii) tooth marks to indicate extensive chewing; iii) a highly fragmented sample; and iv) a concentration of deposits along the shelter wall where dingo lairs are most likely to be found (David, 1984).

Owls, which prey on small animals and regurgitate their bones whole and without tooth marks, as owl-pellets, have been disregarded because the overwhelming majority of faunal remains are those of larger animals (Table 8 [Appendix]).

Of the sample of 2830 fragments, fewer than 1% bear tooth marks as evidence for scavenger chewing, a figure within the order of magnitude described by David (1984:44) for Walkunder Arch. The tooth marks seen at Bomaderry are all on bones greater than 3 cm in maximum dimension, occurring both on the shaft and ends of bone fragments. The former perhaps represent unsuccessful attempts at chewing through the bone while the latter suggest that scavenger chewing contributed to some extent to the fragmentation of the sample. With 84% of the sample less than 3 cm in maximum dimension it seems possible that this high percentage of splinters represents 'successful' chewing, but no tooth marks were detected on them to support this view.

Seven bones bear marks typical of rodent gnawing (Binford, 1981; Miller, 1975) of which five are compact macropod metapodial bones. According to Gifford (1981:414), 'rodents favour bone that is somewhat weathered and free from fat and sinew'. Given the infrequent human occupation of the site suggested by the ^{14}C dates, and the shallowness and sparseness of the deposits, it is likely that the presence of rodents reflects the absence of people at that time. If this is so, the rodent skeletal remains at the site probably result from natural deaths (*cf.* David, 1984:49).

It is most unlikely that the concentration of bone along the rear wall is solely the result of scavenger activity. Indeed, the association of the bones with stone artefacts, shellfish and plant remains suggests people as the principal agents of deposition. The absence of scats or any evidence for bone having passed through a dingo's digestive tract further supports this view (Binford, 1981:55; Klein & Cruz-Urbe, 1984:7). In any case, scavenger activity of appreciable magnitude would have dispersed the bones to a greater degree than they are (*cf.* Walters, 1984). A more likely explanation is that following human habitation, scavengers rummaged through the occupation deposits which retained their essential location and associations. While the precise contribution by scavengers to the fragmentation and distribution of bone cannot be ascertained, it does appear from the evidence discussed above that their role was limited.

Human Occupational Disturbance

Two types of human occupational disturbance are considered likely to have affected the Bomaderry shelter: (a) trampling and (b) site maintenance activities.

Trampling is the unintentional disturbance of cultural deposits by the movement of people during everyday activities. Trampling has two effects: scuffage which causes upward movement and lateral displacement of objects, and treadage which causes downward migration (Matthews, 1965). Experiments by Stockton (1973) and Gifford-Gonzalez *et al.* (1985) show that vertical displacement is dependent upon the intensity of human traffic, the size, shape and weight of an object and the penetrability of the deposit. In general large objects tend to be scuffed upwards and displaced laterally while smaller ones move down (Gifford, 1978:82). Even slight differences in sediment compaction and granularity can affect movement (Rosenfeld, Horton & Winter, 1981:7).

These experiments and observations have tended to assess the effect of trampling on stone artefacts rather than on bone. We suggest that because of its fragility, the main effect of trampling on bone is fragmentation, particularly if it is repeatedly scuffed into the zone of maximum disturbance. Indeed, Schiffer (1987:129) suggests that bone, like a number of other materials, can be fragmented under trampling until stable size and shape levels are reached.

By detailed plotting of size classes for both stone and bone, Steele (1987) is able to demonstrate the likely effects of trampling at Bomaderry. Stone is clearly sorted by size in most squares (Table 12 [Appendix]), notably in Squares C3 to C6 where large artefacts appear to have been scuffed up into the 3-4 cm of loose sand that cap the cultural deposits over much of the shelter. The presence of European artefacts in this sand suggests that some displacement at least is recent. Bone, however, has a more limited vertical distribution (Table 13 [Appendix]), very little of it falling outside of the level which marks the stratigraphic peak of all cultural material. From this evidence it may be inferred that bone fragments and disperses laterally under trampling, while stone because of its greater density and strength is more prone to vertical displacement. Further, differences in the vertical distribution of bone and stone across the shelter appear to reflect gradients in trampling, related perhaps not only to the amount of human traffic but also to variation in sediment compaction and granularity, and to the relative strength and mass of the objects themselves.

Site maintenance activities involve the deliberate removal and subsequent redeposition of certain classes of refuse by the occupants of a site. On the basis of a wide-ranging survey of ethnographic information Steele (1987:44) proposes maintenance behaviour as the primary structuring process behind the spatial configurations evident in Australian sites. Admittedly this view is based almost entirely on observations at open sites, but it is believed that the closer confines of a rockshelter would increase the need for site maintenance.

Irritating objects such as sharp bones and stones, and materials likely to putrefy or attract scavengers, are commonly removed from habitation areas by sweeping, raking, tossing or dumping. Also, certain activities likely to produce such materials may be carried out in special areas away from those used for sleeping and eating.

Discussion

Just as the Currarong and Burrill Lake sites, which are also located on estuaries, display economic exploitation of the immediate landscape while retaining links with the foreshore, this pattern is apparent also at Bomaderry, though the use there of shoreline resources is rarer because of the greater distance. Indeed, looking at a number of sites on the southern coast a steady decline in the influence of the foreshore can be seen as distance from it increases. At both Bass Point and Durras North, situated immediately on the foreshore, exploitation of the sea and its shore was more important than any other economic activity, as is demonstrated by the predominance among food remains of fish and molluscan species that inhabit the ocean shore. Evidence for the hunting of land mammals or use of plant foods at these sites, though present, was subdued. At the Currarong sites, 600 m inland along the estuary of a tidal creek, the high number of fish and shellfish represented among food remains shows the foreshore still to be the most important economic sector, but there is a marked increase in the numbers of land mammals over Durras North to show that hunting had a higher popularity. In the Burrill Lake situation, on an estuarine lake shoreline minimally 1 km from the ocean, food remains are mainly those of estuarine shellfish and mammals whose habitat is woodland or swamp, with ocean shoreline shellfish still present but in a distinct minority, and ocean fish slightly fewer than estuarine species. This indicates a major economic dependence by the shelter's occupants upon local resources while still exploiting the ocean shoreline in a minor way. The Bomaderry site, 12 km from the sea, continues this pattern of diminishing use of marine resources with increasing distance, with estuarine molluscs, land mammals and plant foods making up almost the entire subsistence catalogue. Marine molluscan shells are not only rare but in the main restricted to species known to have used as artefacts and, indeed, displaying use-wear to support this role.

An identical shift away from marine exploitation can be seen in the distribution of certain artefacts among these sites. Fish hooks, fish hook files, and small bone bipoints used to arm fishing spears are common at both Durras North and Currarong. At Burrill Lake, no fish hooks, one fish hook file and only a few bone points were found. At Bomaderry each of these types of artefact is absent.

Superimposed on this pattern of change in economic activities between sites, however, is one of technological similarity among the assemblages of flaked stone artefacts, common throughout the region but best demonstrated between Bomaderry and Currarong I, the two sites with reasonably large stone samples. Currarong, with its deeper deposits and longer occupation, shows more clearly the change from backed blades to fabricators that took place around 2,000 years ago, matched at Bomaderry by ratios between the two types that accord with the Currarong chronology. Eloueras, scrapers, backed blades and fabricators, together with associated small flakes, are not only all present at both sites but are also identical in their main characteristics, except for slight variations in size attributable to a greater use at Bomaderry of small nodules of chert from nearby Tipitallee Creek, and less use of the massive silcretes that outcrop in the Bendalong-Ulladulla region. However, stone from both sources is present not only at Bomaderry and Currarong but also at Burrill Lake and other sites in the region, indicating that its quality was known well enough for it to have been sought after and transported over appreciable distances.

Information about the human occupation of Bomaderry Creek rock shelter has been derived mainly from the excavation of two spatially separated samples of the deposits. These are different in age by a few centuries and shallow enough to suggest that occupation of the shelter took the form of a limited number of visits of short duration. Except for such widely spaced activity areas, site maintenance behaviour appears to have been the primary cause of the spatial structure of occupation deposits at this site. In composition and density, the deposits appear characteristic of those accumulated by basic daily subsistence and maintenance activities. This is particularly the case in the western excavation area, where deposits contain varied food remains and quantities of flaked stone including formal tool types, all in association with a possible hearth in Square B4. The situation closely parallels the 'domestic dumps' associated with virtually all ethnographically-observed hunter-gatherer habitation sites (Steele, 1987).

The concentration of refuse along the rear wall, notably the high number of large, obstructive objects in Square A6/7, suggests that this material reached its location by sweeping to clear middle and frontal areas, which were the most frequented. Given that the shelter is large and was occupied infrequently and briefly, it is perhaps surprising to find such strong evidence for site maintenance behaviour. The distribution of materials over the eastern and western excavated areas shows that occupation was concentrated in what might be seen as the optimum part of the shelter, that is the zone well protected by both the overhang and the large rock falls at the shelter mouth. No restrictions upon space exist in this zone, either in terms of head room or low, inwardly sloping walls, to necessitate refuse control by ejection of material from the area. However, the fact that some areas of the Bomaderry shelter were highly favoured, as well as limitations on entry and exit routes caused by rock fall at the mouth, are likely reasons for stringent maintenance behaviour.

No similarly detailed examination of site formation processes has been made elsewhere in the region to allow close comparison between sites. At both Durras North and the Currarong shelters, however, which are much more restricted in size than Bomaderry, lack of headroom through rapidly accumulated deposits and inwardly sloping walls suggests that their large external scree deposits result from the control of refuse by ejecting material from the shelter mouth. This process, aimed at extending a shelter's useful life, is seen as the reason for a large pit that had been dug into previously accumulated material towards the back wall at both Currarong 1 (Lampert, 1971b:34) and the Curracurrang rock shelter just south of Sydney (Megaw, 1968:326).

Conclusions

While occupying Bomaderry Creek rock shelter, people subsisted by exploiting the immediate environment, gathering molluscs from the nearby tidal estuary of the Shoalhaven River, and hunting game and collecting plant foods on the wooded slopes that surround the site and on the plateau top above. In the shelter itself, food was prepared and eaten, stone was shaped into sharp-edged tools used for a variety of purposes including woodworking, and the stone tools themselves were attached to wooden hafts with the aid of plant resin. Even though residence at the site was infrequent, these activities produced an accumulation of debris sufficient to make life difficult in those areas most favoured for occupation, prompting the sweeping of rubbish towards the back of the shelter.

Although daily subsistence exploited only the immediate locality, some of the materials from which artefacts were made came from more distant sources. Quartz could have been procured in the immediate vicinity but chert, which was the stone used most abundantly for tool making, came from a source some 4 km from the site. A small number of complete tools and a few flakes are of a silcrete found at many other sites in the region, originating from a source 45 km south of Bomaderry. Marine shells of species used elsewhere in the region as artefacts, and displaying use wear suggesting identical functions, were brought to the site from their coastal habitat at least 12 km away.

Of a number of coastal and estuarine sites investigated in the region, Bomaderry is situated the greatest distance inland. Like the other sites, there was an emphasis in the subsistence strategies of its occupants towards immediately local resources while still retaining a link with the sea. But at Bomaderry, 12 km inland along a tidal estuary, this link is tenuous and shown only in the use of marine shells as artefacts. Among all sites in the region there is a steady diminution of evidence for marine fishing as distance from the sea increases. At Bomaderry this form of subsistence has disappeared entirely as can be seen not only in the food remains but also by the absence of either fish hooks or small bone bipoints which armed the multipronged fishing spear. However, the affiliation of Bomaderry with the other sites in question is shown by the use of common sources of raw material for maintenance artefacts as well as typological similarity of the artefacts themselves.

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Steele's investigation of site formation processes, using Lampert's excavated evidence and field notes, originally formed part of his BA(Hons) thesis with the Department of Anthropology, University of Sydney, supervised by Dr Peter White and supported by a grant-in-aid from the Australian Museum, Sydney.

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Table 1. Distribution of artefacts according to excavation squares.

Square	East				West									N	
	A12	A13	A14	B12	A6-7	B3	B4	B5	B6	C3	C4	C5	C6	I13	Totals
Eloueras : 'A'	1	2				1		2	1	3	1			1	12
Eloueras : 'B'		4	1	1	2	2	2	1	2		1	1	1	1	19
Eloueras : total	1	6	1	1	2	3	2	3	3	3	2	1	1	2	31
Fabricators : quartz	1	2		1			4	3	1	7	1		1		21
Fabricators : chert	3	3	1	1		3	7	6	2	3	2	2	1	1	35
Fabricators : total	4	5	1	2		3	11	9	3	10	3	2	2	1	56
Other bipolar : quartz		1				1	3	2	1	2					10
Other bipolar : chert	2						1	1							4
Other bipolar : total	2	1				1	4	3	1	2					14
Scrapers		1			1		3			2	1				8
Backed blades						2			1	1		1		4	9
Cleavers					1										1
Hammer stones									1				1		2
Axes	2														
Cores : quartz		1				1	2								4
Cores : chert		2			2	1	1	2	1						9
Cores : total		3			2	2	3	2	1						13
Trimming flakes		1					4			1					6
Utilized flakes : chert		3	3		1	3	3	5	4	1	3		1	1	28
Utilised flakes : quartz															1
Utilised flakes : silcrete												1			1
Utilised flakes : total		3	3		1	3	3	5	4	1	3	1	1	1	30
Unmodified flakes : chert	94	186	31	27	6	107	286	146	134	180	171	71	68	66	1573
Unmodified flakes : quartz	17	77	2	25	7	142	268	79	50	145	155	66	57	22	1112
Unmodified flakes : quartzite	2	2	1		1	1	8	3	6	5	3		2		34
Unmodified flakes : silcrete					1		1	1		1					4
Unmodified flakes : total	113	265	34	52	15	250	563	229	190	331	329	137	127	88	2723
Bone points								1	1						2

Table 2. Comparison of Bomaderry eloueras in Group A with those in Group B, and with eloueras (A) from Currarong I.

Eloueras	length (in mm)	breadth	breadth/length	thickness	edge angle	hafting gum (no.)	use polish (no.)	chattering (no.)	bifacial use chipping (no.)	retouched chord (no.)	number
Bomaderry											
group 'A' (backed)	26.4±8.5	17.3±6.7	65.1±13.4	8.8±3.8	48.5±12.5	1	2	4	8	3	12
group 'B' (unbacked)	25.8±5.7	17.4±4.4	67.9±13.5	7.5±1.8	38.2±7.1	7	6	2	14	1	19
Currarong I	35.0±7.2	23.0±5.3	67.5±15.1			0	6	11	0	0	11

Table 3. Characteristics of Bomaderry scrapers and (lower) their mean (x) and standard deviation (s) values compared with those from Currarong I.

Catalogue no.	remarks	length (in mm)	breadth	thickness	breadth/ length	thickness/ breadth	weight (in gm)	retouch length	% of retouch	retouch angle	disposition of retouch	chert	quartz	quartzite	core	flake
A13/3	concave	46	34	27	74	79	53	56	40	85	SE			*		*
A6-7	concave-nosed	46	26	21	57	81	21	42	38	79	S	*			*	
C3/2	thumbnail	17	12	7	71	58	1	17	35	69	S	*				*
C3/2	straight	22	15	6	68	40	2	21	36	65	S	*				*
B4/2	concave-nosed	43	24	17	56	71	18	35	29	70	S	*			*	
B4/2	concave-nosed	30	27	23	90	85	19	33	33	71	S	*			*	
B4/2	convex	45	22	19	49	86	16	31	30	75	S			*	*	
C4/2	thumbnail	20	15	8	75	53	2	18	32	64	S		*			*
Bomaderry	x	33.6	18.0	16.0	67.5	69.1	16.5	31.6	34.1	72.3						
n = 8	s	12.7	7.7	8.0	13.1	16.9	17.0	13.2	3.8	7.1						
Currarong I	x	38.8	29.7	17.6	78.6	52.4	45.7	48.1	43.8	70.6						
n = 42	s	20.4	14.4	14.3	12.8	25.1	113.8	29.8	15.7	10.2						

Table 4. Dimensions of Bomaderry fabricators compared with those for fabricators from other sites in eastern New South Wales.

Fabricators	length in cm	breadth	breadth/length	thickness	number
Bomaderry : chert	1.89±0.45	1.47±0.38	0.80±0.20	0.70±0.29	35
Bomaderry : quartz	2.00±0.69	1.44±0.54	0.76±0.26	0.80±0.43	21
Bomaderry : total	1.93±0.55	1.46±0.44	0.79±0.22	0.74±0.34	56
Currarong I	2.11±0.80	1.87±0.72	0.89±0.22	0.77±0.34	37
Gymea Bay	2.00±0.60	1.80±0.60	0.92±0.10	0.70±0.30	42
Sassafras I	1.79±0.47	1.24±0.28	0.89	0.64±0.20	53

Table 5. Size distribution of unmodified flakes.

	size distribution %			total	
stone	<0.5 in.sq. (1.3 cm.sq.)	0.5- in.sq (1.3-2.6 cm.sq.)	>1 in.sq. (2.6 cm.sq.)	no.	weight in gm
chert	72.8	25.9	1.3	1573	1461
quartz	73.6	26.0	0.4	1112	1093
other	39.5	42.1	18.4	38	178
total	72.7	26.2	1.1	2723	2732

Table 6. Distribution of *Macrozamia* seeds according to excavation squares.

	East				West									N	
Square	A12	A13	A14	B12	A6-7	B3	B4	B5	B6	C3	C4	C5	C6	I13	TOTAL
Weight of husks (gm)	56.0	202.4	82.3	16.2	95.4	2.2	17.4	26.6	13.6	11.1	17.2	8.1	25.4	0.3	574.2
Estimated no. of seeds	32.0	115.7	47.0	9.3	54.5	1.3	9.9	15.2	7.8	6.3	9.8	4.6	14.5	0.2	328.1
Estimated weight of kernels (gm)	214.4	774.9	315.1	62.0	365.4	8.4	66.6	101.8	52.1	42.5	65.9	31.0	97.2	1.1	2198.2

Table 7. Distribution of molluscs in minimum numbers per excavation square.

	East				West									N	Total	
Square	A12	A13	A14	B12	A6-7	B3	B4	B5	B6	C3	C4	C5	C6	I13	No.	Weight
Species																
Teredinidae		5			30	2	7	116	55	7	20		2		224	36.8
Crassostrea commercialis	2	1	1	1	1		1	3	2		1	1	1	1	16	73.8
Pyrazus ebeninus		3				1	1	2	2		1				10	56.9
Trychomya hirsutus		1			7	1	5	2	2		1	1			20	6.0
Mytilus planulatus		1		1		1	1	1		1	1		1		8	4.1
Plebidonax deltoides	1	5	2	1		1	2	1	1	1	1	1	1	1	19	79.5
Dicathais orbita							1								1	1.0
Velesunio ambiguus		1			1		1		1		1		1		6	18.1
TOTAL No.	3	17	3	3	39	6	19	125	63	9	26	2	6	1	323	
TOTAL Weight (gm)	12.0	77.1	24.6	5.9	12.2	3.4	34.2	42.8	22.8	3.1	12.0	3.5	14.5	8.1		276.2

Table 8. Bomaderry Creek faunal identifications by NISP (superscript figures indicate identifications made by J.H. Calaby). Species: 1 *Macropus giganteus* - Eastern Grey Kangaroo; 2 *Macropus robustus* - Wallaroo; 3 *Macropus rufogriseus* - Red Necked Wallaby; 4 *Wallabia bicolor* - Swamp Wallaby; 5 *Thylogale thetis* - Red Necked Pademelon; 6 *Petrogale penicilliata* - Brush Tailed Rock Wallaby; 7 *Macropus parma* - Parma Wallaby; 8 *Potorous tridactylus* - Long Nosed Potoroo; 9 *Aepyprymnous rufescens* - Rufous Bettong; 10 *Isodon obesulus* - Short Nosed Bandicoot; 11 *Parameles nasuta* - Long Nosed Bandicoot; 12 *Trichosaurus vulpecula* - Brush Tail Possum; 13 *Pseudocheirus peregrinus* - Ring Tail Possum; 14 *Petaurus breviceps* - Sugar Glider; 15 *Rattus lutreolus* - Eastern Swamp Rat; 16 *Rattus fuscipes* - Native Bush Rat; 17 *Mus.* sp. - Native Mouse.

Square & level	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
A6/7				3^1						1^1	2^1				2			8
B3/2			1	1														2
B4/2			1	4^1							3^1	2			1^1			11
B4/3				7^1							1^1							8
B5/2		4	2	8	4	1		2^1	2				3		1^1		1^1	28
B6/1	1	1		7	1	1	2				1		1	1				16
B6/2	2	1	2	7	2			7^5							1^1			22
C4/2	1			4									1					6
A13/3			1	4	2							2^2						9
Unprovenanced	1	3			6	4		2	3	3	3	1	1			1		28
Total	5	9	7	45	15	6	2	11	5	4	10	5	6	1	5	1	1	

Table 9. Distribution of bone by weight in grams at Bomaderry by square and level.

					West							East		N
Square	A6/7	B3	B4	B5	B6	C3	C4	C5	C6	A12	A13	A14	B12	113
Level														
1	60.6				81.3									
2		26.6	197.3	273.0	135.2	17.0	76.9							
3			74.9				6.6			148.2				
4														
	60.6	26.6	272.2	273.0	216.5	17.0	83.5			148.2				

Table 10. Distribution by weight in grams of shellfish and macrozamia from Bomaderry by excavation square.

					West							East		N
	A6/7	B3	B4	B5	B6	C3	C4	C5	C6	A12	A13	A14	B12	I13
Shellfish	12.2	3.4	34.2	42.8	22.8	3.1	12.0	3.5	14.5	12.0	77.1	24.6	5.9	8.1
Macrozamia	95.4	2.2	17.4	26.0	13.6	11.1	17.2	8.1	25.4	56.0	202.4	82.3	16.2	0.3

Table 11. Distribution of mammalian skeletal parts by excavation square and level, in three size classes - small, medium and large.

	B3/2			B4/2			B4/3			C4/2			B5/2			B6/1			B6/2			A6/7			A13/3		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
Maxilla					1		1						1							1					2		
Mandible				3			1	2		1	1		3	1					6	1	2	3	1				
Scapula		1		1			1						2							1							
Clavicle													1	1								1				1	
Humerus				1			2	1			1		3	7	1		1		1	1	1				1		2
Radius				1	2	1							3	3	2	1	1			1							
Ulna				1	3					2			5	2	1	2	2	1		1							
Pelvis					1			1	1					1			1					1				1	1
Pouch bone						1									2				2								
Metacarpal														1											1		1
Femur				2	2	2	1	1	1	1	1	2	2	2	4	3	2		1	4	1	1		1	2	2	4
Tibia		1		4	4		2	2	1	1	1	1	6	13	3	2				2	1		1	1	1	3	
Fibula				2	2	1							2	2	1		2		2	2							
Metatarsal								1					2	4			2	1			1		2		2	1	
Astragalus														2					1	2							
Rib	1			5	6	2	1	3	1	1	2	2	11	5	3				2	3	1	2	2	1			
Vertebra				2	1		3	1					1	2		2	1	1	1	1			1				
Phalange		1		1	2								3	2	1		3	1					1	1	6	1	
Total	1	3		23	23	7	12	12	4	6	6	5	45	48	18	11	14	4	16	19	7	8	8	4	13	9	8

Table 12. Breakdown of Bomaderry stone into size classes per level.

	Total No.	0-9 No.	0-9 %	10-19 No.	10-19 %	20-29 No.	20-29 %	30-39 No.	30-39 %	40-49 No.	40-49 %	50-59 No.	50-59 %
B3/1	9	1	11.1	4	44.4	3	33.3			1	11.1		
B3/2	253	109	43.1	84	33.2	50	19.8	9	3.6	1	0.3		
B4/1	62	7	11.3	43	69.4	10	16.1	2	3.2				
B4/2	437	171	39.1	200	45.8	54	12.4	9	2.1	3	0.7		
B4/3	98	32	32.7	41	41.8	13	13.3	10	10.2	2	2.0		
B5/1	30	4	13.3	15	50.0	10	33.3	1	3.3				
B5/2	222	107	48.2	80	36.0	29	13.1	6	2.7				
B6/1	77	25	32.5	39	50.6	11	14.3	1	1.3	1	1.3		
B6/2	124	44	35.5	43	34.7	30	24.2	6	4.8	1	0.8		
C3/1	13	3	23.1	6	46.2	4	30.7						
C3/2	340	165	48.5	113	33.2	56	16.5	6	1.8				
C4/1	106	32	30.2	46	43.4	22	20.8	5	4.7	1	0.9		
C4/2	228	125	54.8	71	31.1	27	11.8	4	1.8	1	0.4		
C4/3	18	6	33.3	10	55.6	1	5.6	1	5.6				
C5/1	35	4	11.4	19	54.3	11	31.4	1	2.9				
C5/2	105	16	15.2	69	65.7	18	17.1	2	1.9				
C5/P	28	3	10.7	19	67.9	4	14.3	2	7.1				
C6/1	46	6	13.0	19	41.3	12	26.1	4	8.7	4	8.7	1	2.2
C6/2	124	50	40.3	57	46.0	14	11.3	3	2.4				
C6/P	36	12	33.3	14	38.9	9	25			1	2.8		
A6/7	20	2	10.0	3	15.0	8	40.0	5	25.0			2	10.0
A12/1	18	2	11.1	7	38.9	9	50.0						
A12/2	99	12	12.1	52	52.5	27	27.3	8	8.1				
A12/3	3			1	33.3	2	66.6						
A13/1	20	4	20.0	11	55.0	5	25.0						
A13/2	84	31	36.9	34	40.5	17	20.2	2	6.4				
A13/3	169	90	53.2	56	33.1	19	11.2	4	2.4				
A13/4	14			2	14.3	6	42.9	3	21.4	2	14.3	1	7.1
A14/1	18	6	33.3	8	44.4	3	16.7	1	5.6				
A14/2	21	5	23.8	7	33.3	6	28.6	3	14.3				
B12/1	5			3	60.0	2	40.0						
B12/2	50	8	16.0	12	24.0	25	50.0	5	10.0				
I13/1	16	2	12.5	9	56.3	4	25.0	1	6.3				
I13/2	74	13	17.5	33	44.6	22	29.7	4	5.4	2	2.7		
I13/3	2					2	100.0						

Table 13. Breakdown of Bomaderry bone into size classes per level.

	Total no.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
		0-9		10-19		20-29		30-39		40-49		50-59		60-69		70-79		80-89		90-99		100-109	
B3/2	70	21	30.0	20	28.6	15	21.4	9	12.8	2	2.9	3	4.3										
B4/2	766	339	44.3	272	35.5	77	10.1	48	6.3	16	2.1	7	0.9	3	0.4	3	0.4					1	0.1
B4/3	142	31	21.8	70	50.0	23	16.2	10	7.0	5	3.5			1	0.7							2	1.4
B5/2	696	203	29.1	259	37.2	93	13.4	55	7.9	41	5.9	19	2.7	12	1.7	8	1.1	5	0.7			1	0.1
B6/1	179	42	23.5	80	42.6	26	14.5	16	8.9	9	5.0	2	1.1	4	2.2								
B6/2	265	57	21.5	90	34.0	62	23.4	31	11.7	19	7.2	1	0.4	3	1.1	1	0.4	1	0.4				
C3/2	55	18	32.7	26	47.3	9	16.4	1	0.4	1	0.4												
C4/2	188	43	22.9	80	42.6	33	17.6	17	9.0	6	3.2	3	1.6	2	1.1	1	0.5	1	0.5			2	1.1
C4/3	6			2	33.3	3	50.0			1	17.7												
A6/7	112	31	27.7	37	33.0	15	21.4	8	12.6	14	2.9	3	2.7	2	1.8	1	0.9	1	0.9				
A13/3	351	115	32.8	142	40.5	50	14.3	15	4.0	12	3.4	10	2.8	3	0.9	3	0.9	2	0.6				

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