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Changing Perspectives in Australian Archaeology, Part VIII

Burins, Bones and Base Camps: A Re-analysis of Aire Shelter 2, Glenaire, Southern Victoria

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ABSTRACT. Archaeological studies often conclude that some sites are neatly identifiable as base camps, stopovers or tool specific locales. Task reconstruction and interpretation of on-site activities affect our understanding of mobility patterns and subsistence and our ability to distinguish reconfigured land-use and population change. A re-analysis of Aire Shelter 2 is presented here to consider the potential of usewear and residue studies for evaluating site function, in the context of coastal wetlands in southwestern Victoria. Traces of use were found on 242 stone artefacts. Identified tools include finely retouched flint scrapers and snapped flakes with burin edges associated with graving bone. The usewear and faunal analyses indicate an atypical prehistoric assemblage that implies an alternative site function to that originally proposed. Rather than a base camp, the site is an infrequently used locale associated with hunting and the manufacture of bone points. Although theoretical reconstructions of land use suggest population contraction into winter base camps situated around coastal wetlands, there is no compelling evidence that such a site has been found at Aire Shelter 2, although nearby dune shell midden sites are likely candidates.

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Understanding site function is critical for interpreting land-use and Aboriginal settlement history. However, archaeological studies often create a false impression that some sites are neatly identifiable as base camps, stopovers, activity locations, transit camps or other tool specific locales. Attenbrow (2004: 219ff) was aware of this problem, especially when trying to identify residential bases, mobility and settlement patterns for the Mangrove Creek catchment. Scarcely one base camp could be identified, making interpretations of settlement and logistical mobility potentially problematic. How sites are classified affects our understanding of mobility patterns and subsistence and our ability to distinguish patterns of reconfigured land-use from the effects of population change. The site of Aire Shelter 2 provides an informative case study in which stone tool form and the nature of site function were dramatically re-evaluated after usewear and residue analysis. The site was one of the first excavated in the state of Victoria and the stone technology was commonly thought to be typical of later Australian prehistory. In particular, retouched flakes were thought to be exceedingly rare and the stone assemblage was regarded as amorphous, lacking distinctive tool forms.

About 2 km from the coast near the mouth of the Aire River, Cape Otway, southern Victoria (Fig. 1), Mulvaney

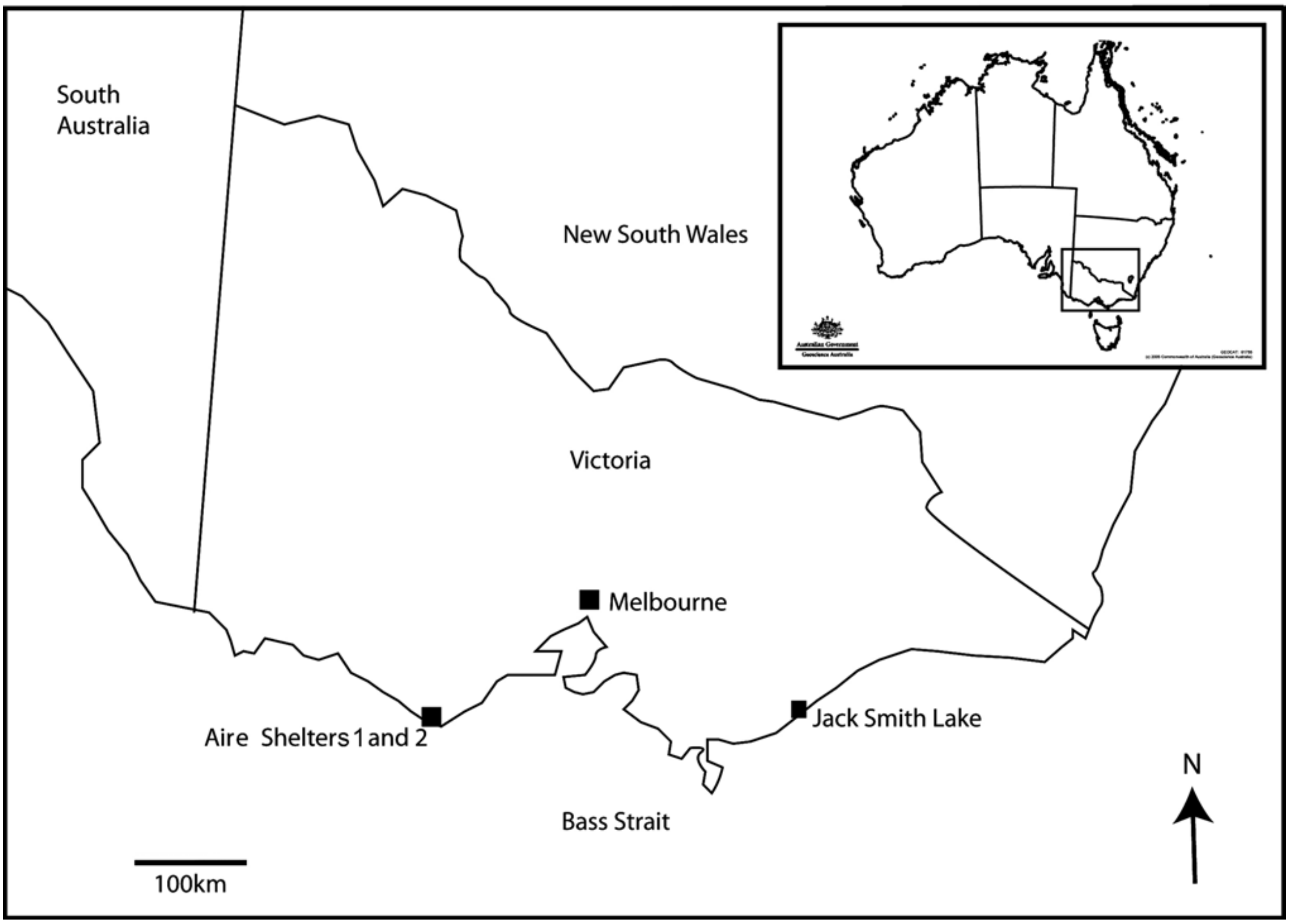

Figure 1. Location of Aire Shelters 1 and 2 in coastal Victoria, Australia.

(1962) excavated two rock shelters (Aire Shelter 1 and Aire Shelter 2), which overlook wetlands to the north. Richards (1998) notes there is no ethnography of Aboriginal people in Otway region, which lies within boundaries of the Gadubanud ("King Parrot") language or dialect (Clark, 1980: 185–192). Aire Shelter 2 revealed a relatively rich assemblage. The stone technology was characterized as typically unsophisticated compared with earlier time periods of Australian prehistory. For the first time in Victoria, controlled archaeological excavation provided a suite of faunal and stone material with a radiocarbon chronology. Aire Shelter 2 and its environs appeared on the Register of the National Estate (Mulvaney, 1982).

Dune limestone shelters provide an environment suitable for bone preservation. After excavating about half the deposit at Aire Shelter 2 (Fig. 2), Mulvaney found more than 50 bone artefacts along with 1500 pieces of flint in 2 m of stratified shell midden, nearly all above a radiocarbon age of 346—482 cal. BP (68% range), as discussed below. Mulvaney (1962) identified only eight stone "artefacts" (including one axe). His definition of "artefact" was clearly meant to indicate a tool (presumably a formal retouched type), in contrast with flakes. He argued that stone artefacts were less important than implements made of organic materials (like wood and bone) in recent prehistory, and proposed that the Aire Valley sustained Aboriginal camping grounds that were just as permanent as Spencer (1918: 114) had argued lay further inland. These debates are still with us (Richards, 1998), and a key issue is to identify the range of activities undertaken at specific sites.

The main aim of this paper is to re-consider site function for Aire Shelter 2 based on the results of a functional analysis of the stone artefacts and taking into account the available data. Specifically, I examine the hypothesis proposed by prior research that the faunal and lithic data from Aire Shelter 2 do indeed provide evidence of a hunter-gatherer base camp.

Research background

Since the study was completed 27 years ago, it is important to understand the research context at the time of the research and the limitations of the study. In 1981, I wanted to undertake a functional analysis of an entire Australian lithic assemblage employing the latest techniques of usewear and residue analysis (Fullagar, 1982). This was overly ambitious, and in the end the study focussed on one layer; and depended to a large extent on the tool-use experiments of others. The choice of Aire Shelter 2 as a case study for examining the potential of usewear and residues seemed obvious. Conventional typological techniques had provided little information about the technology or tool functions of the Aire Shelter 2 assemblage and revived interest in microscopic traces of use had recently been recognized in papers at a seminal conference in 1977 (Hayden, 1979). Although primarily based on my unpublished M.A. (Prelim.) thesis (Fullagar, 1982), I have updated the discussion based on more recent research.

The Aire Shelter 2 lithic assemblage was dominated by fine-grained flint (Figure 3) or marine chert found outcropping on the southern Australian coast, and Kamminga (1978) used this tool stone extensively in his Ph.D. thesis. The Australian flint is similar to the European flint that had recently been studied with success by Keeley (1980). Keeley was one of the first to rely largely on use polish viewed under

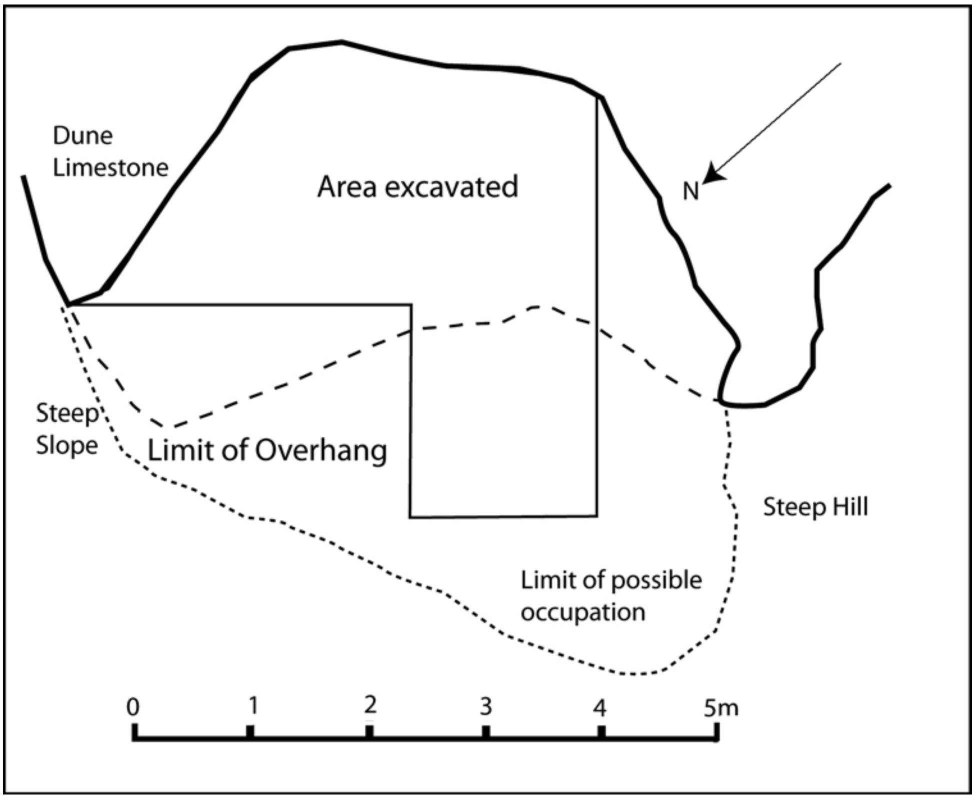

Figure 2. Aire Shelter 2 site plan (after Mulvaney 1962).

vertical incident light, and he defined polish types diagnostic of working particular materials such as wood, bone, skin and shell. A primary objective of my analysis was to explore the potential of this approach with an Australian assemblage in a palaeoecological setting. In addition, I wanted to assess the potential of studying organic residues on Australian stone artefacts and integrate these results with tool design and other contextual archaeological evidence.

Mulvaney's (1962) excavations covered an area of approximately 110 square feet (about 10 m^2) down to a depth of about 8 feet (2.4 m), comprising about half the estimated deposit (Fig. 2). I therefore assume that the recovered assemblage includes a representative sample of site contents.

Initial inspection of the artefacts indicated that the Aire River stone material was largely unwashed (making it suitable for studying both residues and usewear), and permission was granted to move the assemblage from the National Museum of Victoria (now Museum of Victoria) to microscope laboratories at La Trobe University. Kamminga (1978), who had compiled the first extensive set of tool use experiments in Australia, was available to supervise my study. Kamminga (1980), and others (e.g., Odell, 1977) were sceptical of exclusive reliance on polish interpretation at high magnification for determining tool function and encouraged a combination of high and low magnifications, different lighting conditions and SEM (Scanning Electron Microscopy). Therefore, timely access to a relatively recent, unwashed flint assemblage with well-preserved bone seemed to offer an excellent case study to evaluate possibilities.

A synthesis of local palaeoecological and archaeological

Table 1. Exploitation models.

		seasonality	Aire valley	Aire shelter 2
1	Lourandos, 1977a,b, 1980			
	Wetlands	all year	all year	in inclement weather [a]
	Coast	spring, summer		
	Open forest, savannah, grasslands	not known		
2	Coutts *et al*., 1978; Coutts, 1981a,b			
	Grasslands	spring, winter		
	Dense Woodland	autumn, summer		
	Dry Sclerophyll Woodland	summer		
	Coast	summer, autumn	summer, autumn	base camp with a wetland focus
3	Stuart, 1979; Head & Stuart, 1980			
	Closed Forest	summer		
	Tall Open Forest	summer		
	Open Forest/Woodland	summer		
	Coast	summer	summer	temporary camp with coastal focus
	Wetlands	winter	winter	coastal focus

[a] Lourandos (1980: 194)

Figure 3. Flint nodules in consolidated dune, cropping out in the Nene Valley, South Australia, 1985 (with Lesley Head).

work was also available to provide a history of the landscape and Aboriginal occupation in the Aire River valley and adjacent coast (Head & Stuart, 1980). Three exploitation models were initially considered (Table 1).

The previous research by Head and Stuart set the scene for my own because they had made proposals about settlement patterns in the local region. They had compiled comprehensive inventories of fauna and flora, including a plant food list based on local habitats. Despite difficulties in comparing data sets (there being little chronological depth or resolution in available archaeological excavations), Head and Stuart (1980) suggested that the evidence supported Aboriginal occupation of wetlands all year round with a constriction of movement in winter (cf. Lourandos, 1976). However, occupation was found to be most abundant and intensive along the coastal dunes, albeit on the wetland side. Head and Stuart (1980) imply that the coastal dune middens are the remains of the winter base camps.

Methods

Tool-use experiments. I undertook a limited number of tool-use experiments to provide confidence in identifying the main forms of usewear (polish, edge-rounding, scarring, striations) on flint recorded by others; and experience in recognizing diagnostic wear patterns from working wood, bone, highly siliceous plant and shell (Table 2, Figs 4, 5, 6). Following preliminary identification of graving tools in the Aire 2 assemblage, supplementary bone graving experiments were included. It nevertheless proved difficult for me to confidently distinguish the polish from graving bone in these brief (<10 minutes) experiments (Fig. 4). The experiments suggested that use polish as observed under vertical incident light at magnifications of about ×200 could form quite rapidly. It was also noted that edge fracturing and breakage could remove traces of polish and other usewear (as with the drilling experiment and possibly in the case of the dense

Table 2. Usewear was documented on a selection of 12 experimental flint tools.

tool-use experiment number	mode of use	material worked	edge angle (degrees)	time (minutes)	polish removed by cleaning
1	scraping	dense green wood	50	20	no
2	scraping	bone	50	20	yes
3	scraping	bone	90	10	yes
4	sawing	bone	50	5	yes
5	scraping	low density wood	70–80	15	yes
6	graving	bone	70	5	yes
7	graving	bone	115	6	no
8	graving	bone	80	3	yes
9	graving	bone	70	5	yes
10	graving	bone	90	5	yes
11	cutting	*Typha* reeds	35	10	yes
12	drilling	Cellana shell	45	5	no (broken)

wood scraper). Only the reed cutting experiment produced a very bright glossy polish easily visible at relatively low magnification.

Examination of artefacts. Artefacts had not been previously washed, so that adhering sediment was common. Examination proceeded in four stages.

1 Preliminary examination involved observations under a Wild M8 stereomicroscope (×10–×20); initial cleaning (including washing in warm tap water as required) to remove any loose sediment; and recording to document technological attributes.

2 Artefacts were then examined specifically for residues under the Wild M8 stereomicroscope (×12–×100) and other forms of usewear. Artefacts with no residues were set aside for further cleaning.

3 All artefacts without residues were cleaned with ethanol to remove greasy films that might obscure polished edges.

4 All artefacts were examined under an Olympus BHM reflected light microscope at various magnifications (×50, ×100, ×200, and ×1000). Use-polish was documented although diagnostic polish types were rarely identified with confidence. Records documented presence, distribution and form of striations, edge rounding, abrasion and polish.

The study focussed on usewear although residues were noted. At that time, I had insufficient experience to hazard more than possible residue identifications, with the exception of bone, which was abundant in the site and with which I had experimented in most detail.

Aire Shelter 2

Stratigraphy and dating. Aire Shelter 2 sediments consisted of sand and shell in five layers (Mulvaney, 1962): Layer 1 is a clean grey or yellow sand; Layer 2 is a compact grey black sand with charcoal and shell; Layer 3 is a grey ashy sand; Layer 4 is a clear yellow sand with a basal date on charcoal 370±45 (R-728); and Layer 5 is a yellow sand with ashy bands that is lying on decomposed rock (Fig. 7). The radiocarbon age in Layer 4 calibrates to a calendar age of 414±68 cal. BP (346–482 cal. BP with a 68% range) (using http://www.calpal-online.de/). The calcareous sand sediments appear to be typical of coastal middens in protected rock shelters along the western Victorian coast. In contrast with Aire Shelter I, also excavated by Mulvaney,

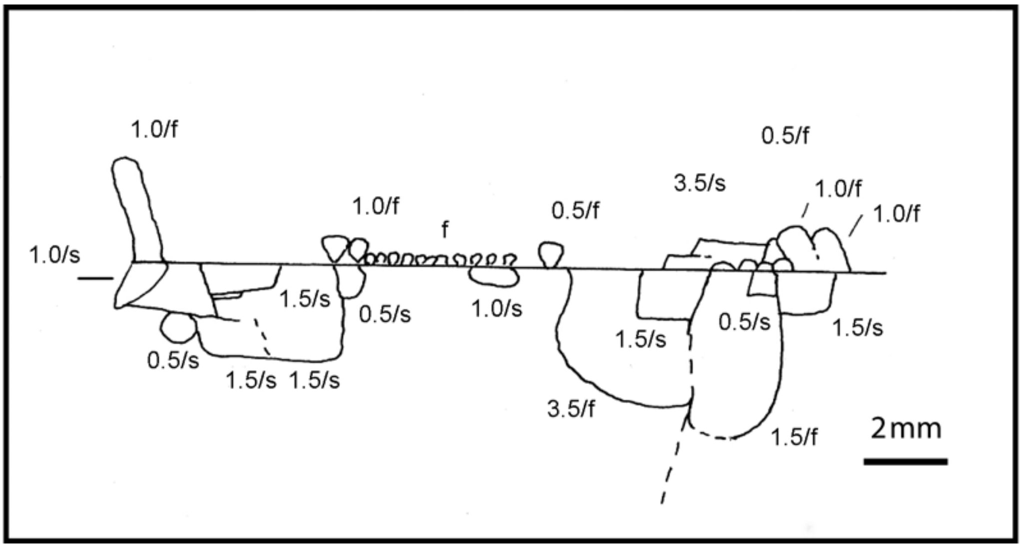

Figure 4. Flint experiment 1. Usewear on a scraper after 20 minutes of working dense wood. The numerator shows scar width in mm and the letters indicate terminations. f = feather termination; s = step termination.

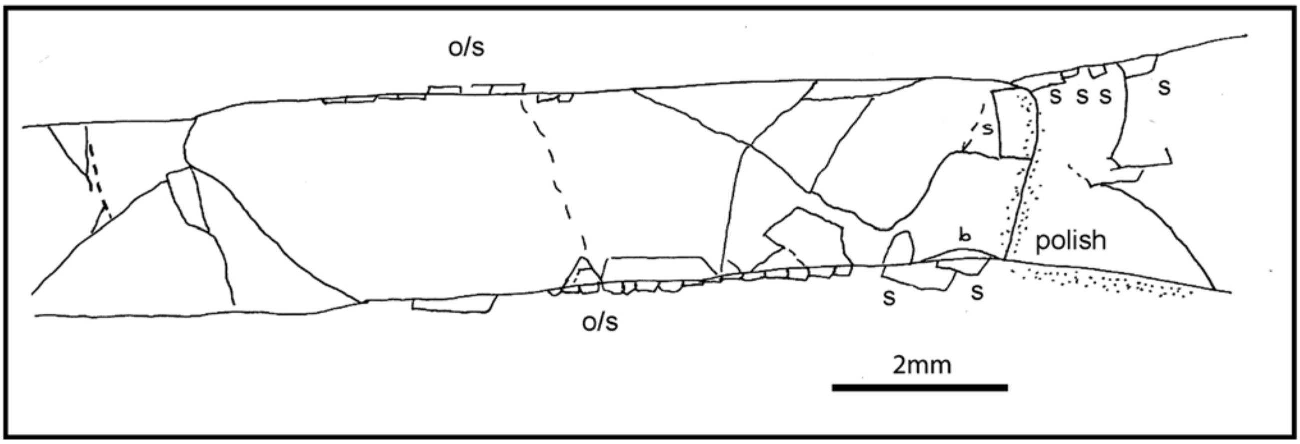

Figure 5. Flint experiment 3. Usewear on a burin used to grave bone for 10 minutes; *o/s* inidicates overlapping step scars.

Aire Shelter 2 was found to be intact with little disturbance from burrowing animals and with excellent preservation of bone.

Human remains. Finds included shell, bone and stone, and a human burial (Table 3). The human bones were found overlying, and not therefore part of, Layer 2, but there were no associated grave features (Mulvaney, 1962). David Clarke (Victoria Archaeological Survey), Johan Kamminga and Neville White (La Trobe University) re-examined these remains housed at the Museum of Victoria. The measurements and features indicated a young male in his early twenties, 168 cm tall, with no evidence of cremation, no tooth avulsion, no artificial deformation and no palaeo-pathology. Cause of death was unknown (Fullagar, 1982: 117–119).

Faunal remains. The abundance of shellfish was never documented in detail, although faunal data presented in Mulvaney (1962) indicate that *Brachidontes rostratus* and *Subninella undulata* are the only marine species present throughout the deposits. *Velesunio* sp. is only present in the earlier Layers (3, 4, and 5). *Brachidontes rostratus* and *Subninella undulata* are also the most common shellfish species at nearby sites recorded by Iain Stuart, and numerous excavations by the Victoria Archaeological survey (Coutts *et al*., 1976).

Identifications of other faunal remains were made with assistance from David Clarke (then Victoria Archaeological Survey), and Joan Dixon with her colleagues at the then National Museum of Victoria. Bones were identified to species and minimum numbers calculated (Table 4). The Minimum Number of Individuals (MNI) for each taxon suggests the consistent importance of birds and increasing importance of small mammals (Table 4). Eggshell is also present in Layers 2, 3 and 4 (Table 5). Bone, shell and bone are most abundant in Layer 2. All animals represented, including the dingo, could have been food sources (following Dawson, 1881 and Smyth, 1878), although several are likely to be the remains of scavengers and other predators. The evidence for eating snake is supported by Smyth (1878: 252) but not Dawson (1881: 96). Every habitat that could account for these animals can be found within a 2 km radius of the Aire Shelter 2 site.

The most numerous species by MNI is Pacific Black Duck (*Anas superciliosa*) of which there are 10 (Table 4). The only other bird species identified was Black Swan (*Cygnus atratus*), from fragile eggshell only. Ducks congregate along

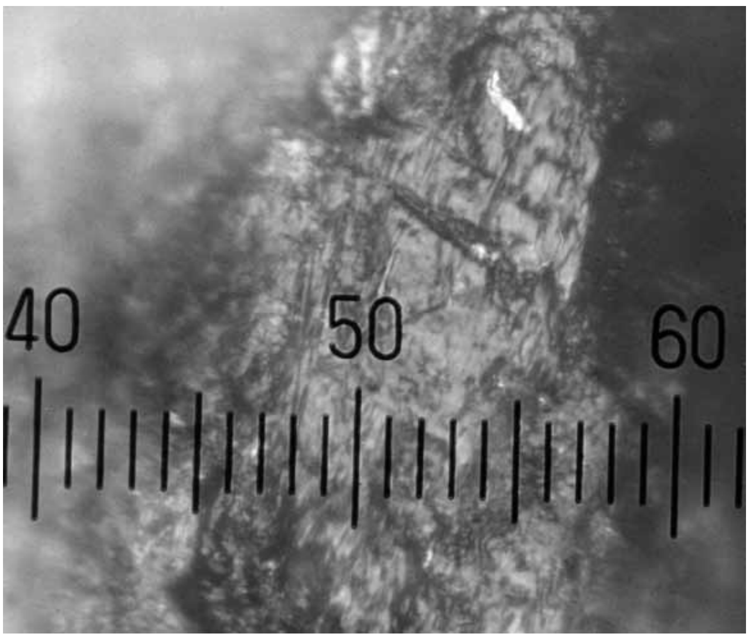

Figure 6. Use-polish, rounding and striations on the used bit of an experimental flint burin used for 15 minutes. Scale divisions are 0.01 mm.

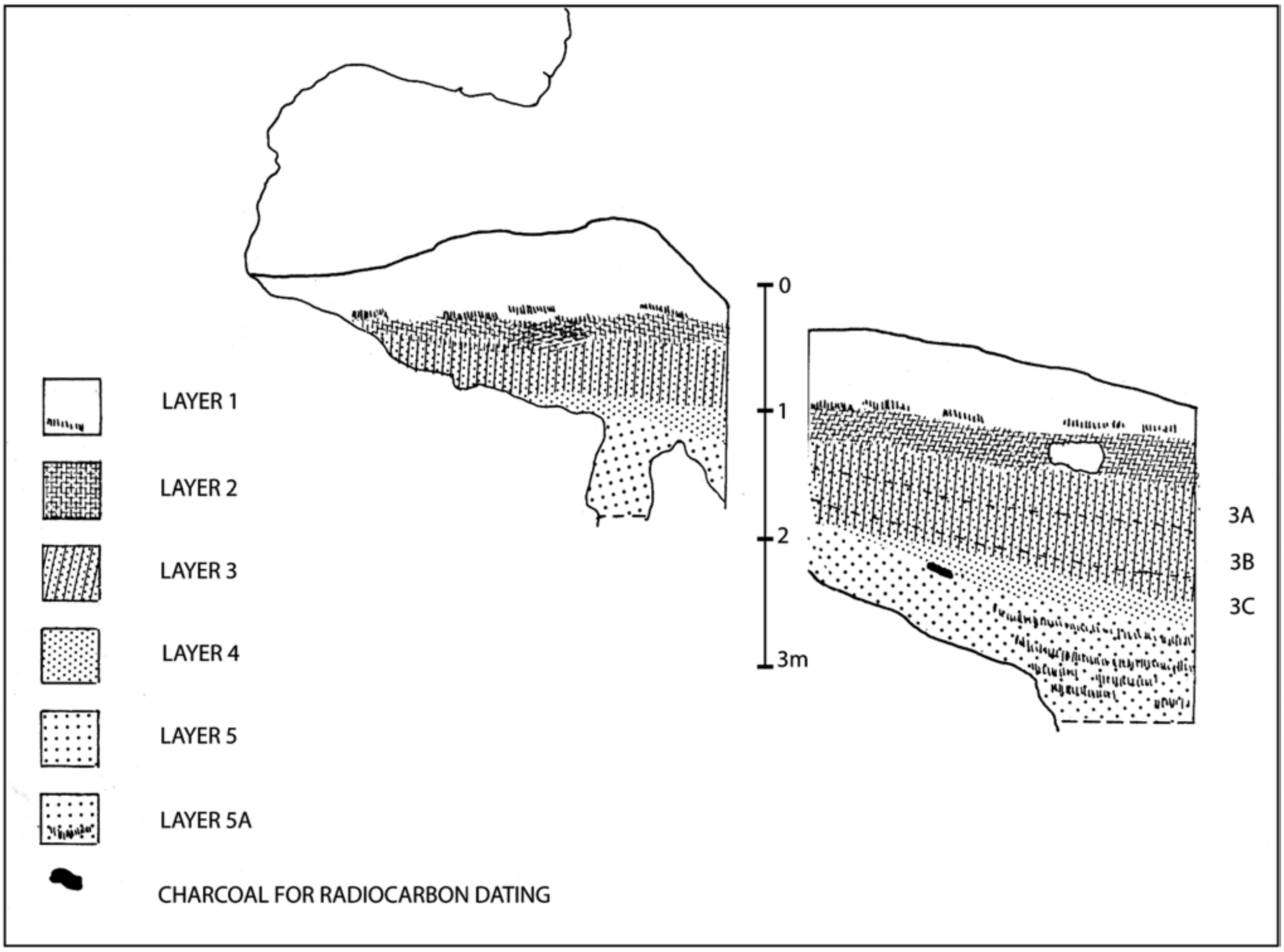

Figure 7. Aire Shelter 2: stratigraphic cross section (after Mulvaney, 1962: 6).

the coast in May and June (winter) although available at other times; swan egg is expected in winter; and the snake suggests a spring-summer occupation. Consequently, as judged by these seasonal indicators, the shelter could well have been occupied all year round (Table 6).

The frequency and composition of bones indicate relatively good preservation (pitting was the most common form of attrition) and suggest that whole carcasses were not brought back the shelter. Tooth marks are scarce (less than 1% bones). Only 74 whole bones out of a total of 1,135 were present (Table 6). The differential representation of anatomical components indicates selection of longer bird and mammal bone (Tables 7, 8).

Quantified data for other taxa also indicate that birds (specifically Black Duck) probably dominated the target species, despite numerous individual bone counts and a relatively high number of unidentified bones. The relatively high number of bird long bones suggests selection of these elements (Table 8). Similarly, the relatively high number of mammal long bones (most of which are not identifiable as to element) also suggests deliberate selection.

Five families of mammal were found: Macropodidae (kangaroos), Phalangeridae (possums), Petauridae (gliders), Peramelidae (bandicoots) and Dasyuridae (native cats). Also presented are Rodentia (native rats and mice) and Carnivora (dingo and seals). Pisces are represented by Labridae (parrot

Table 3. Aire Shelter 2, site contents; number of artefacts (mass, in grammes, indicated in parentheses). *P*, present, no other details available; *A*, absent; * 136 is the total weight (layers 3a + 3b + 3c) of layer 3; em-dashes indicate data unavailable.

contents	layer								total
	1	2	3a	3b	3c	4	5	5a	
flint implements	23	107	34	20	11	11	6	3	215
flint waste flakes	83	853	133	75	67	96	50	10	1367
flint cores	5	15	3	4	3	4	1	0	35
total flint	111(382)	975(6757)	170(539)	99(714)	81(514)	111(419)	57(139)	13(51)	1617(9515)
other stone	1	12		4	7	2	1	0	197
all stone	112	987	170	103	88	131	58	13	1814
bone tools	5	29	7	7	5	11	0	0	64
other bone	165	412	262	—	—	230	0	6	1075
all bone	160(120)	441(268)	281	(136)*		241(108)	0	6(2)	1129(634)
rock platform shellfish	P	P	P	P	P	P	P	P	P
sandy beach shellfish	A	A	A	A	A	A	A	A	A
freshwater shellfish	P	A	A	P	A	A	A	A	A

Table 4. Aire Shelter 2: bones from the excavation, with Minimum Number of Individuals (MNI) and estimates of animal live weights.

	live-weight (kg)	1	2	3	4	5	5a	total
Teleostomi								
Labridae		0	1	1	1	0	0	3
Reptilia								
Elapidae		1	—	1	1	0	0	3
Aves								
Anas superciliosa	1–5	1	3	3	3	0	0	10
Marsupialia								
Macropus giganteus	>40	0	0	0	1	0	0	1
Macropus rufogriseus	15–20	0	1	2	0	0	0	3
Wallabia bicolor	15–20	0	1	0	0	0	0	1
Thylogale billordierii	5–10	0	2	1	0	0	0	3
Macropidae indet.								
Trichosurus vulpecula	1–5	1	0	1	0	0	0	2
Pseudocheirus peregrinus	<1	1	1	1	1	0	0	4
Petaurus australis	<1	0	1	1	0	0	0	2
Petauridae indet.								
Isoodon obesulus	1–5	1	0	0	0	0	0	1
Antechinus stuartii	<1	1	0	0	0	0	0	1
Sminthopsis leucopus	<1	1	0	0	0	0	0	1
Rodentia								
Rattus fuscipes	<1	1	2	1	0	0	0	4
Rattus lutreolus	<1	3	0	0	0	0	0	3
Mastacomys fuscus	<1	3	0	0	0	0	0	3
Carnivora								
Canis familaris	15–20	0	1	0	0	0	0	1
Neophoca cinera	>100	0	1	0	0	0	0	1
Arctocephalus doriferus	>100	1	1	0	0	0	0	2
total		15	15	12	7	0	0	49

fish), and Reptilia by Elapidae (snakes). The ratio of land mammal bone to bird bone increases through time, and is probably associated with increased frequency of worked bone linked to the selection of bone for bone point production (Table 9). The null hypothesis, that the relationship between bird bones and non-bird bones was due to sampling error alone, was rejected at the 0.01 level of significance (χ^2 = 177.22, d.f. = 3).

Analysis of the faunal remains indicate the people occupying the shelter hunted duck, kangaroo, wallaby, thylogale as well as some low numbers of other animals. Of significance here is the high number of modified mammal bones which, although largely of indeterminate species, are relatively thick specimens and probably derive from kangaroo and wallaby. Given the relatively high proportion of modified bones (bird and mammal), I argue that these taxa were most likely targeted for the production of bone artefacts.

Table 5. Aire Shelter 2: Black Swan (*Cygnus atratus*) egg shell.

layer	weight (g)	%
1	0	0
2	14.6	71.0
3	1.6	8.0
4	4.1	20.0
5	0	0
5a	0.2	1.0
total	20.5	100

Bone artefacts. In the Aire Shelter 2 bone assemblage, there are 17 simple uni-points and 15 complex uni-points and 12 bi-points identified in the bone assemblage (Fig. 8). There were also three broken tips, probably deriving from spatulate uni-points. Of the pieces of graved bone 13 blanks had been cut with grooves, but otherwise unmodified (Figs 9, 10). Graved bone makes up a significant proportion of bone by weight and number for each layer, and there is good correlation between graved bone and mammal bone, bone points and all bone, graved bone and all bone, and between graved bone plus points and mammal bone. There is a lower correlation between bird bone and modified bone (Tables 9, 10, 11).

Two techniques were employed by the Aboriginal occupants of Shelter 2 to manufacture bone points. First, the groove and splinter technique involved graving an outline on long bones (mostly macropod tibias) with a burin tip, gouging and splitting with stone wedges (Figure 11) to detach a blank (the bone splinter), and grinding with local sandstone, calcarenite or dune limestone blocks to shape and sharpen the points. Second, snapping and splitting technique involved breaking the ends of long bones, splitting the bone longitudinally and then grinding to shape the bone tool tips.

The nature and function of the Aire Shelter 2 bone points has been further investigated by Webb (1987) who determined that only one bone tool (a spatula point from a macropod fibula found in Layer 3) could be assigned a definite function based on her extensive experimental study of usewear and residues: wedging shellfish from rocks. Other bone points were assigned a few possible/probable functions including fish hooks, piercing dry skin, and

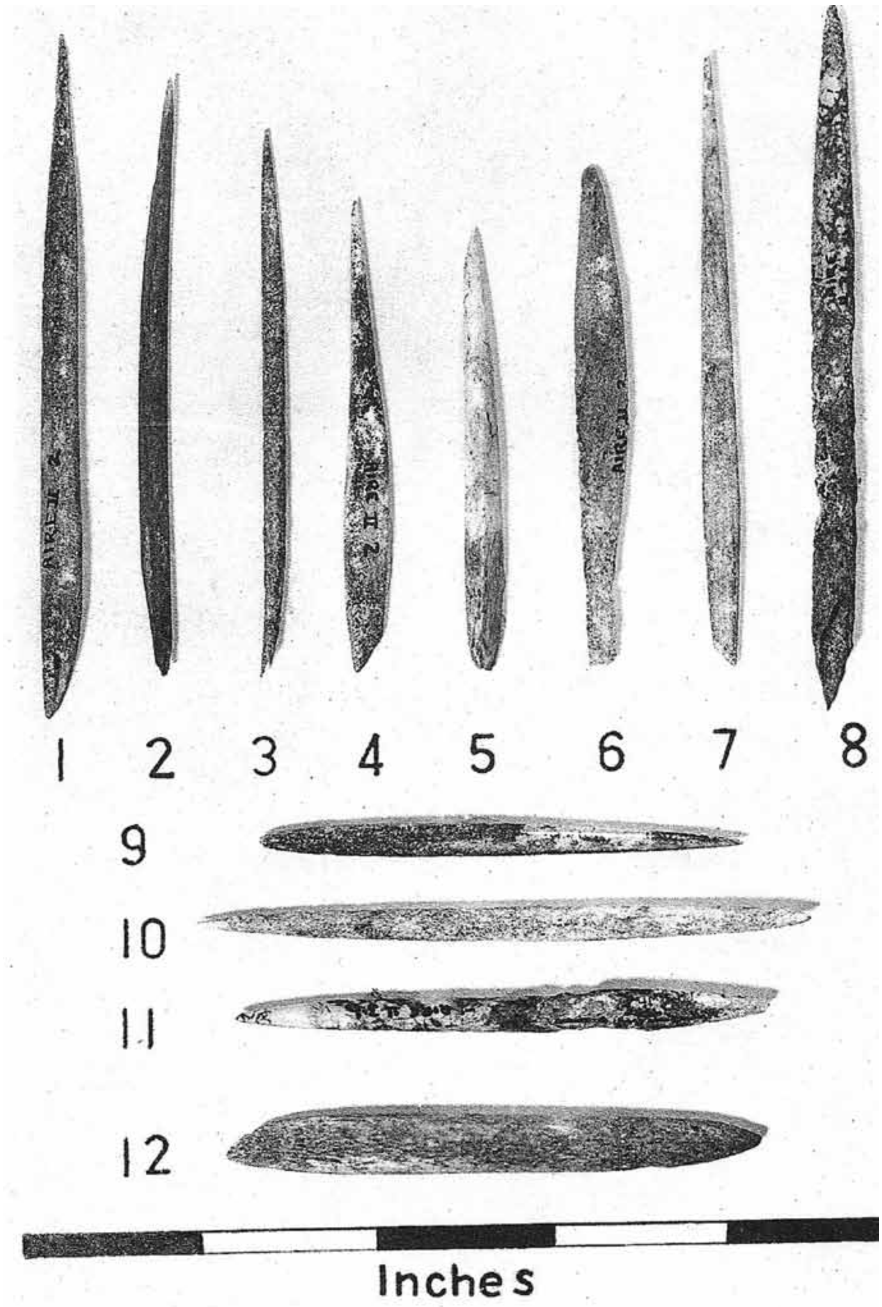

Figure 8. Aire Shelters 1 and 2: bone artefacts (reproduced from Mulvaney, 1962: plate III, with permission from the author and the *Proceedings of the Royal Society of Victoria*).

stabbing mammals, all with a relatively low rate of breakage. In contrast with other bone point assemblages, Aire Shelter 2 does not have good evidence for the extensive use of bone artefacts. Webb (1987: 81) concluded that these factors supported the hypothesis that certain layers represented "specialist bone-tool manufacturing activity" at the site.

In summary, the faunal evidence suggests sparse food remains from marine, rainforest, wetland and lightly wooded habitats. Shellfish abundance could not be reliably estimated because the remains had not been collected and no quantitative data were available. Pacific Black Duck (*Anas superciliosa)* may have been the most common target. Analysis of the bone artefacts indicates an industrial site function, specifically the manufacture of bone points which is particularly prevalent in Layer 2. Bone points are shown to have a variety of functions that probably include: shellfish wedge, skin and bark scrapers, fish hook/gouge, skin awls and tools for piercing flesh (possibly projectile armaments or daggers). However, the presence of grooved bone, the low incidence of breakage and the low frequency of developed usewear indicate a bone point manufacturing locale.

Stone artefacts. I recorded 1769 flakes and fragments and 45 cores (total 1814) in the Aire 2 stone artefact assemblage. There are difficulties reconciling this total with the lower estimate (1790) published by Mulvaney (1962). Discrepancies in the figures are best accounted for by bag breakage, my inclusion of even the smallest fragments, and counting errors, but these are unlikely to have an impact on the functional analysis of stone tools.

Of a total of 1814 analysed stone specimens, 242 flakes and fragments had traces of use on 324 edges (Tables 12, 13) and one out of 45 cores (Table 14) had traces of use on two edges. Although a variety of tool stone is present, the assemblage is dominated by flint, easily obtained from the adjacent coast a few kilometres to the south. A few cores had

Table 6. Aire Shelter 2: seasonality indicators and behaviour of Black Swan (*Cygnus atratus*) and Black Duck (*Anas superciliosa*) (after Gaughwin, 1978).

name	*Cygnus atratus* Black Swan	*Anas superciliosa* Black Duck.
habitat	Large, permanent lakes fresh or brackish. Estuaries.	Found wherever there is water; fresh, brackish or saline.
breeding season	Winter but varies with rainfall. Nest on land, on islands or among swamp vegetation. Clutch size up to 10, average 5.5 eggs.	Mainly spring. July-October in extreme South. Nine eggs.
congregation	Summer—main moult period. On small islands of lakes etc., dense congregations may occur. Gather in thousands.	Largest congregation on coast in May–June. Otherwise in smaller groups, pairs or singly.
average weight	6270 g (males) and 5100 g (females).	1114 g (males) and 1025 g (females).
feeding	Algae and weeds.	Dredging, stripping, and filtering. Seeds, crustaceans, molluscs, and insects.
nesting	Mound of reeds in shallow water or on islands.	Ground, stumps, trees, limbs, thick *Melaleuca* ti-tree, *Xanthorrhea* sp.
moulting	After breeding.	Pre-nuptial, post nuptial.
additional comments	Widespread across whole continent in locations with standing water. Moult and are unable to fly after breeding season.	Very wary, alert. Very compact in flocks.
archaeological evidence	Aire Shelter 2, Glenaire: egg shell.	Aire Shelter 2, Glenaire: tibia, carpometacarpal, bill.

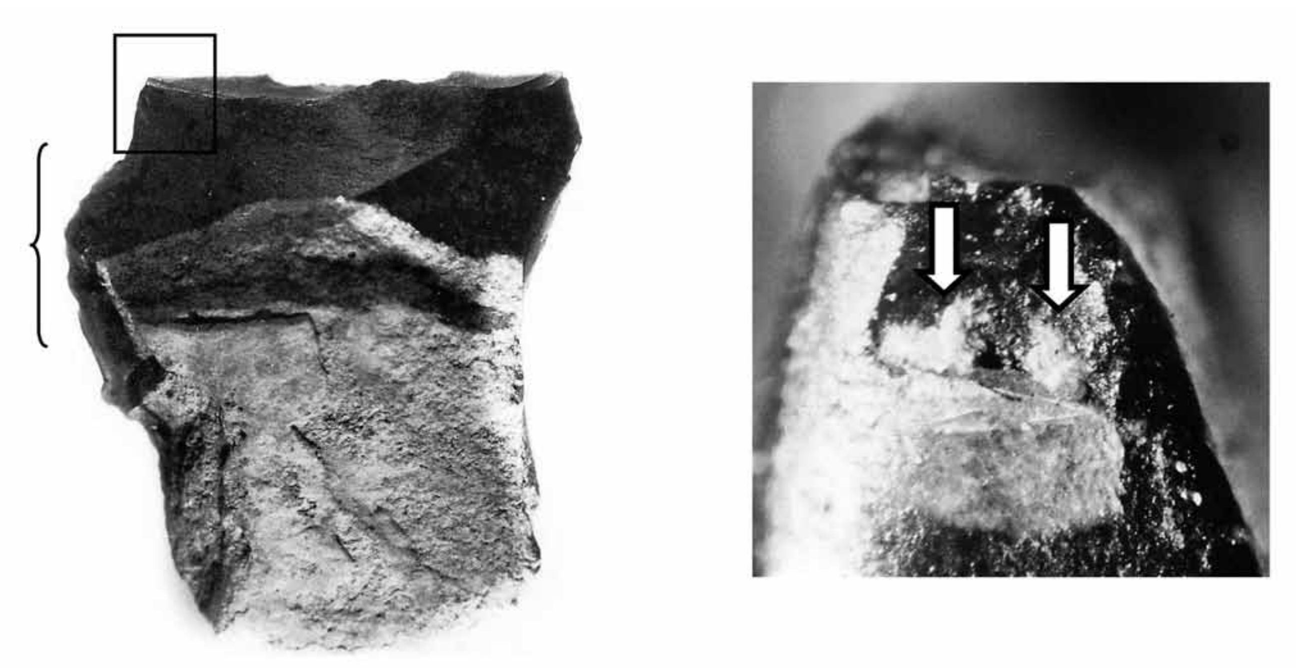

Figure 9. Aire Shelter 2, layer 2: burin (artefact 85, length 2.4 cm). Left: area of dorsal retouch (inside the bracket) and step scar and rounding on the snapped burin edge (within the rectangle). Right: detail of area within the rectangle with the white bone residue in the base of the step fracture indicated by arrows. Note the edge rounding and small flake scars on the used edge.

Table 7. Aire Shelter 2: frequencies of animal taxa present; *wt* weight (g).

	layer 1			layer 2			layer 3			layer 4			layer 5	
taxa	no.	wt	whole bone	no.	wt	whole bone	no.	wt	whole bone	no.	wt	whole bone	no.	wt
Teleostomi														
Labridae	0	0	0	1	0.15	0	1	0.29	0	2	0.82	1	0	0
unidentified Teleostomi	6	0.63	3	41	4.95	9	23	1.82	4	13	1.8	3	0	0
Reptilia														
Elapidae	20	3.16	20	0	0	0	3	0.31	3	2	0.18	2	0	0
Aves														
Anas superciliosa	2	1.2	0	10	5.77	0	9	4.72	0	7	5.35	0	0	0
unidentified bird	22	23.75	0	112	35.97	2	129	37.05	4	116	35.87	0	0	0
Marsupialia														
Macropus giganteus	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macropus rufogriseus	0	0	0	1	0.42	1	3	3.66	0	0	0	0	0	0
Wallabia bicolor	0	0	0	1	0.41	0	0	0	0	0	0	0	0	0
Thylogale billardierii	0	0	0	14	13.08	1	3	1.6	0	0	0	0	0	0
unidentified macropod	8	1.75	1	19	8.31	1	6	9.01	0	1	0.26	0	0	0
Trichosurus vulpecula	4	8.59	0	0	0	0	1	0.47	0	0	0	0	0	0
Pseudocheirus peregrinus pereginus	3	0.12	3	1	0.45	0	1	0.21	0	1	0.25	1	0	0
Petaurus australis	1	0.34	0	3	0.8	0	2	0.91	0	0	0	0	0	0
Petauridae	0	0	0	0	0	0	1	0.11	0	1	0.1	0	0	0
Isoodon obesulus	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antechinus stuartii	1	0.01	0	0	0	0	0	0	0	0	0	0	0	0
Sminthopsis leucopus	1	0.01	0	0	0	0	0	0	0	0	0	0	0	0
Rodentia														
Rattus fuscipes	1	0.01	0	3	0.3	0	2	0.18	0	0	0	0	0	0
Rattus lutreolus	6	0.5	0	0	0	0	0	0	0	0	0	0	0	0
Mastocomys fuscus	8	1.9	0	0	0	0	0	0	0	0	0	0	0	0
unidentified Muridae	39	2.43	5	3	0.15	2	0	0	0	0	0	0	0	0
Carnivora														
Canis familiaris	0	0	0	1	1.85	0	0	0	0	0	0	0	0	0
Neophoca cinera	0	0	0	1	5.29	0	0	0	0	0	0	0	0	0
Artocephalus dociferous	3	42.19	0	3	8.9	0	0	0	0	0	0	0	0	0
Pinnipedia	0	0	0	1	2.65	1	0	0	0	0	0	0	0	0
unidentified Mammalia	115	32.82	6	188	173.8	0	97	75.25	1	65	59.75	0	6	1.5
unidentified bones	0	0	0	38	4.24	0	0	0	0	32	2.49	0	0	0
totals	160	119.6	38	441	267.5	16	281	135.6	12	241	108.3	7	6	1.5

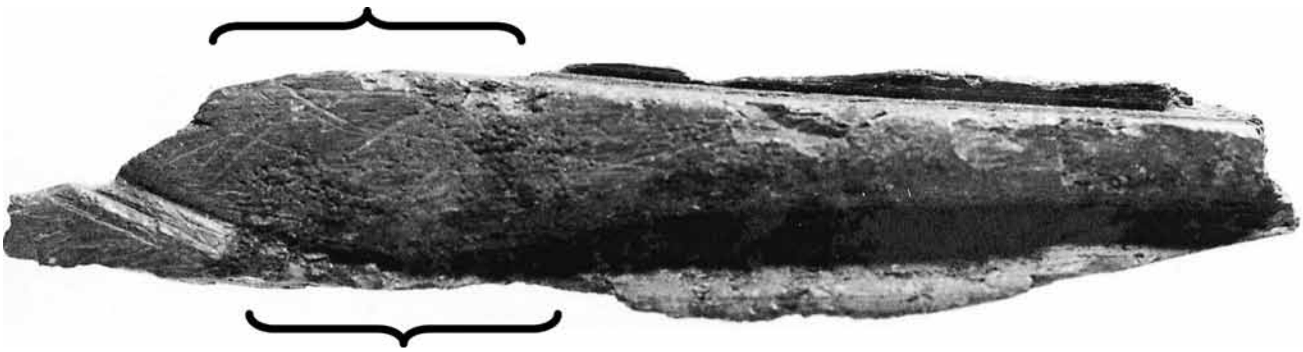

Figure 10. Aire Shelter 2, layer 2: bone point rejected during manufacture using groove and splinter technique, length 5 cm. Traces of chopping from bipolar wedging to remove the blank are visible within the areas indicated by the brackets.

Table 8. Aire Shelter 2: distribution of bones by anatomical component; the asterisk (*) indicates tooth marks on one bone from each class.

higher taxa	taxa	component	all bone no.	all bone whole	modified bone uncertain	modified bone graved	modified bone cut blank	modified bone uncut	modified bone tool
Teleostomi	Labridae	dentary	1	0	1	0	0	0	0
	unidentified	vertebra	1	1	0	0	0	0	0
		rib	8	8	0	0	0	0	0
		spine	8	0	0	0	0	0	0
		facial	24	0	0	0	0	0	0
Aves	*A. superciliosa*	tibia	4	0	0	0	0	0	0
		carpometacarpal	5	0	0	0	0	0	0
	unidentified	digit	1	1	0	0	0	0	0
		claw	1	1	0	0	0	0	0
		long bones	110	0	0	0	2	0	0
Marsupialia	*M. rufogriseus*	rib	1	1	0	0	0	0	0
	W. bilcolor	incisor	1	1	0	0	0	0	0
	T. billardieri	facial	5	0	0	0	0	0	0
		vertebra	1	0	0	0	0	0	0
		ulna	1	0	0	0	0	0	0
		carpal	1	1	0	0	0	0	0
		humerus	1	0	0	0	0	0	0
		tibia	2	0	0	0	0	0	0
		fibula	1	0	1	0	0	0	0
		metatarsal	1	0	0	0	0	0	0
	Macropodidae	incisor	1	0	0	0	0	0	0
		rib	6	0	0	0	0	0	0
		scapula	1	0	0	0	0	0	0
		vertebra	1	0	0	0	0	0	0
		clavicle	1	0	0	0	0	0	0
		innominate	*2	0	0	0	0	0	0
	Macropodidae	tibia	7	0	0	0	0	0	0
	P. peregrinus	maxilla	1	0	0	0	0	0	0
	P. australis	dentary	1	0	0	0	0	0	0
		molar	1	0	0	0	0	0	0
		ulna	1	0	0	0	0	0	0
Rodentia	*R. fuscipes*	maxilla	2	0	0	0	0	0	0
		dentary	1	0	0	0	0	0	0
		vertebra	1	1	0	0	0	0	0
	Muridae	innominate	1	0	0	0	0	0	0
		metapodial	1	1	0	0	0	0	0
Carnivora	*C. familiaris*	rib	1	0	0	0	0	0	0
	N. cinera	incisor	1	0	0	0	0	0	0
	A. doriferus	frontal	1	0	0	0	0	0	0
		incisor	2	0	0	0	0	0	0
	unidentified	teeth	2	0	0	0	0	0	0
unidentified mammals		rib	26	0	0	0	0	0	0
		vertebra	1	0	0	0	0	0	0
		long	*138	0	4	22	11	2	14
		tabular	21	0	0	0	0	0	0
totals			441	16	6	22	13	2	14

a high proportion of cortex, suggesting flint was transported as relatively complete nodules (perhaps after removing a few flakes to test quality). Studies by L. Scott Virtue (pers. comm.) indicate that the average weight of nodules we collected during 1982 on the adjacent beach is 194.5 g. An estimate of the total weight of excavated flint (9512.5 kg) suggests that collection of about 50 flint nodules could account for all the flint from the excavations (about 50% of the estimated total floor space), of which about 70% came from Layer 2.

Table 9. Aire Shelter 2: analysis of modified bone, and abundance of birds versus land mammals.

	layer 1	layer 2	layer 3	layer 4	total
modified bird bone counts (%)	2 (10)	2 (2)	3 (2)	2 (2)	
all bird bone counts	21	122	138	123	404
modified bird bone weight g (%)	1.63 (7)	0.85 (3)	0.55 (1)	4 (10)	
all bird bone weight g	24.99	25.05	41.77	41.22	133.03
modified land mammal bone counts (%)	11 (8)	50 (22)	25 (22)	9 (13)	
all land mammal bone counts	136	233	114	68	551
all modified land mammal bone counts (%)	17.71 (21)	81.18 (38)	33.96 (37)	5.02 (7)	
all land mammal bone weight g	85.95	216.4	91.23	67.79	461.37
all bird : total bone counts %	13	34	55	64	
all land mammal : total bone counts %	87	64	45	36	
	100	100	100	100	
all bird: total bone weight %	23	10	31	38	
all land mammal: total bone weight %	77	90	69	62	
	100	100	100	100	
total bird + land mammal bone counts	157	355	252	191	955
total bird + land mammal bone weight g	110.94	241.45	133	109.01	594.4

Functional Analysis of Stone Tools

The artefacts in Layer 2 identified as utilized were subjected to detailed study that included illustration and documentation of utilized edges (e.g., Fig. 12). Appendix 1 presents details of the results. Artefacts in Layers 1, 3, 4 and 5 were subjected to less intense microscope analysis aimed at identifying retouch, utilized edges and likely mode of use (Fig. 13). Nine classes of tools were recognized on the basis of how the edges were used. The analysis considered the motion used, but also took into account the worked material. I classified the function of many artefacts as "uncertain," because the wear traces, although undoubtedly from use, were insufficiently developed and I could not identify the residues taxonomically.

I distinguished between scarring from usewear and retouch from hard hammer percussion on the basis of qualitative experiments that indicated hard hammer retouch caused larger flake removals with distinct focal points/cones of percussion. I identified 42 retouched edges on 33 individual artefacts in Layer 2 (Appendix 1). My estimated number of retouched flakes excludes retouch that may have been caused by pressure flaking since there was insufficient time to undertake appropriate experiments.

Graving tools. Two classes of graving tools were identified: burins and nosed gravers. Unlike the burins defined by McCarthy (1976: 38), burins from Aire Shelter 2 do not have backing retouch, but are identified by the presence of a burin spall and use scarring on the dihedral edge. Four burins were found in Layer 2 (including artefact 85, Fig. 6). Nosed gravers were made by retouch to form two adjacent concavities in plan-view, or notches (Fig. 12, artefact 13).

Usewear patterns on burins used for graving bone include hinge and feather fractures on the burin bit and slight step fracturing along the dihedral edge; those used for scraping

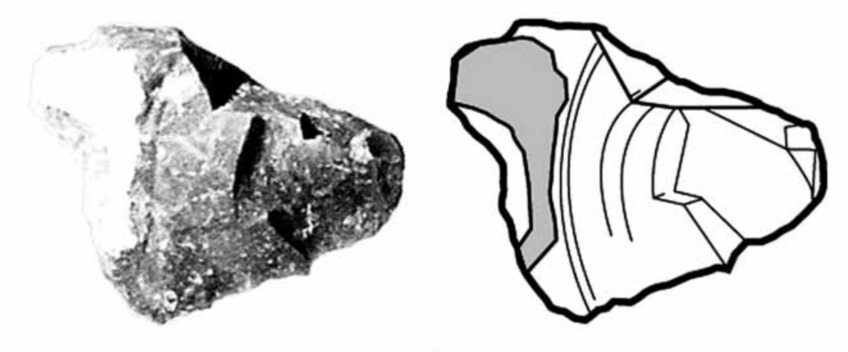

Figure 11. Aire Shelter 2, layer 2: flint wedge (artefact 33). Left: bipolar damage (scale is 1 cm). Right: sketch of artefact 33.

Table 10. Aire Shelter 2: correlation of bone classes.

	bone tools	blanks plus graved bone	all modified bone	
bird	0.690	0.110	09.44	Pearson's ***r***
	0.156	0.443	0.282	significance
land mammal	0.710	0.980	0.890	Pearson's ***r***
	0.146	0.008	0.057	significance
bird + land mammal	0.990	0.860	0.980	Pearson's ***r***
	0.004	0.071	0.011	significance

Table 11. Aire Shelter 2: distribution of bone tools and blanks; *GS* number of bone specimens with Groove and Splinter technique.

tool class	layer 1 n	layer 1 GS	layer 2 n	layer 2 GS	layer 3a n	layer 3a GS	layer 3b n	layer 3b GS	layer 3c n	layer 3c GS	layer 4 n	layer 4 GS
simple unipoint (n = 17)	0	0	1	0	4	3	2	1	4	3	6	4
complex unipoint (n = 15)	2	1	8	7	0	0	3	2	0	0	2	2
simple bipoint (n = 4)	1	1	2	2	1	0	0	0	0	0	0	0
complex bipoint (n = 8)	1	1	2	2	1	1	2	2	1	1	1	1
broken point (n = 3)	1	1	1	1	1	1	0	0	0	0	0	0
cut blank	0	0	13	13	0	0	0	0	0	0	0	0
uncut blank	0	0	2	2	0	0	0	0	0	0	0	0
all bone tools and blanks	5	4	29	27	7	4	7	5	5	4	11	9
all stone gravers	4		39		6		2		2		1	

bone generally have more crushed edges and more feather fractures relative to hinge terminations (Stafford, 1977: 245). Despite unequivocal evidence of use, I was unable to confidently distinguish polish features diagnostic of bone working (suggesting that as for my experiments each tool was not used for very long). Unless distinct bone or wood polish is present (Keeley, 1980: 42, 49), the type of fractures on their own are not diagnostic of graving a particular material (Kamminga, 1978: 268; Odell, 1978: 323–341). I argue that bone working is most likely because fractures are consistent with working a hard material (wood or bone); bone residues occur within scars on a few burin bits (Fig. 8); and numerous bones have graving marks (Fig. 9).

Table 12. Aire Shelter 2: all utilized flakes and fragments by raw material and mode of use. Flint accounts for 88.8% of total count.

tool stone	mode of use	1	2	3a	3b	3c	4	5	5a	totals
flint	bipolar	2	5	0	0	0	0	0	0	7
flint	nosed graver	4	34	5	2	1	1	2	0	50
flint	burin	0	4	1	0	1	0	0	0	6
flint	scraper	8	58	20	7	5	5	2	2	107
flint	drill	1	4	0	0	0	1	0	0	6
flint	cutting	0	5	0	3	0	1	0	0	9
flint	haft	0	1	0	0	0	0	0	0	1
flint	adze	2	4	0	0	0	0	0	0	6
flint	uncertain	5	52	12	9	7	6	2	1	98
flint	no. edges	28	167	38	21	14	14	6	3	291
flint	no. pieces	23	107	34	20	11	11	6	3	215
quartz	awl	0	1	0	0	0	0	0	0	1
quartz	graver	0	1	0	0	0	0	0	0	1
quartz	uncertain	0		0	0	0	0	1	0	1
quartz	no. edges	0	2	0	0	0	0	1	0	3
quartz	no. pieces	0	2	0	0	0	0	1	0	3
quartzite	scraper	0	0	0	0	0	1	0	0	1
quartzite	no. edges	0	0	0	0	0	1	0	0	1
quartzite	no. pieces	0	0	0	0	0	1	0	0	1
sandstone	hammer-stone	1	5	3	2	1	0	0	0	12
sandstone	mortar	0	2	1	0	0	0	0	0	3
sandstone	pestle	0	1	1	0	0	0	0	0	2
sandstone	uncertain	0	4	1	2	2	1	0	0	10
sandstone	no. edges	1	12	6	4	3	1	0	0	27
sandstone	no. pieces	1	9	4	4	2	1	0	0	21
trachyte	hatchet	0	0	0	1	0	0	0	0	1
trachyte	no. edges	0	0	0	1	0	0	0	0	1
trachyte	no. pieces	0	0	0	1	0	0	0	0	1
limestone	scraper	0	1	0	0	0	0	0	0	1
limestone	no. edges	0	1	0	0	0	0	0	0	1
limestone	no. of pieces	0	1	0	0	0	0	0	0	1

total no. used flakes and fragments 242
total no. unused flakes and fragments (see Table 13) 1527
total no. cores which includes one utilized core with two tool edges (see Table 14) 45
total no. specimens examined (cores, flakes and fragments) 1814
total no. utilised edges (324 on flakes and fragments plus two on cores) 326

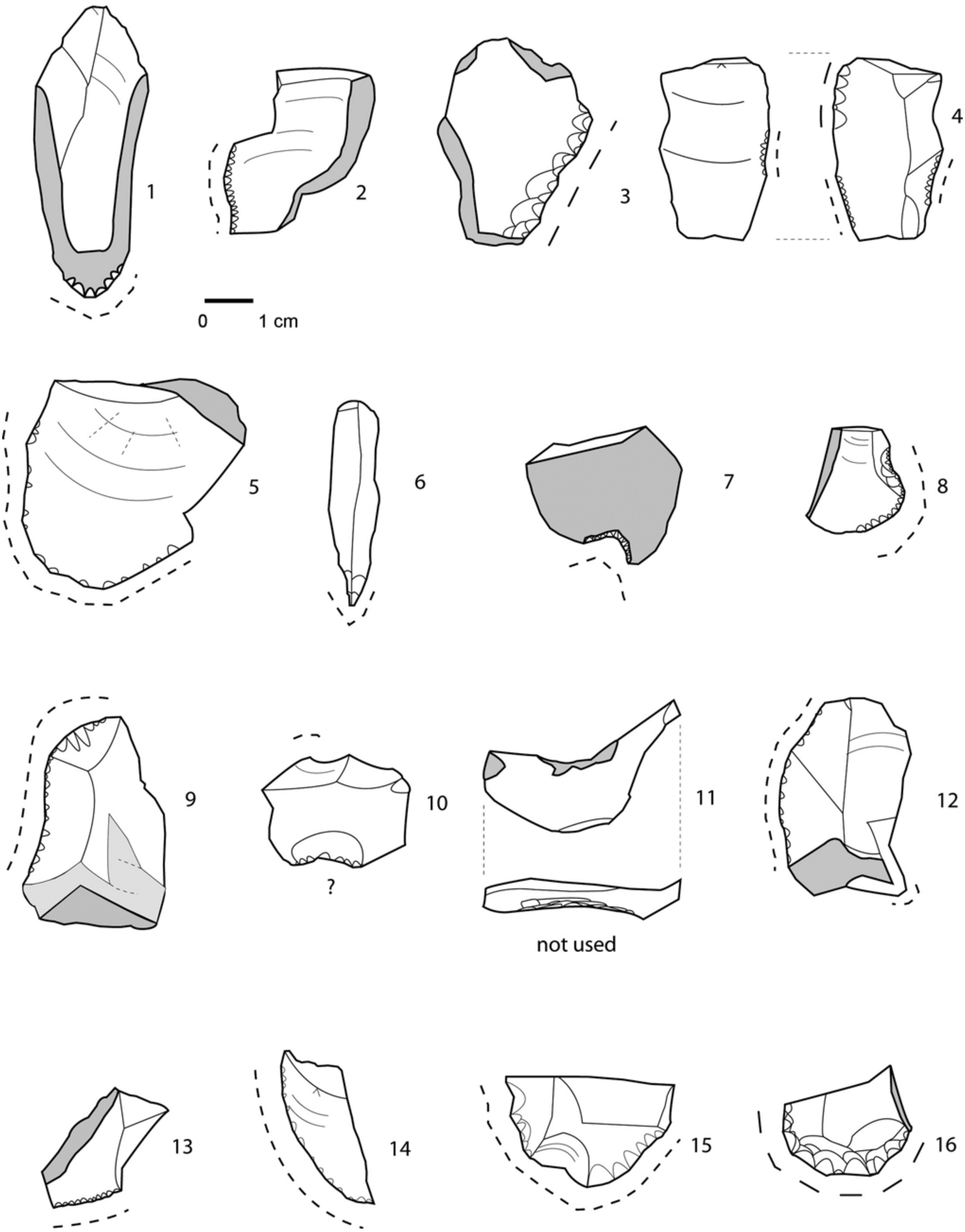

Figure 12. Aire Shelter 2, layer 2: selected stone artefacts. A small dashed line indicates usewear and a large dashed line indicates retouch/edge sharpening and usewear. Shading indicates cortex. The scale is 1 cm. With the exception of no. 6, which is quartz (cf. Fig. 17), all artefacts are of flint. Numbers correspond with those in the Appendix. Scrapers: 1–5, 8, 9, 13–16; awl: 6; uncertain: 7, 10; graver and knife: 12; unused: 11.

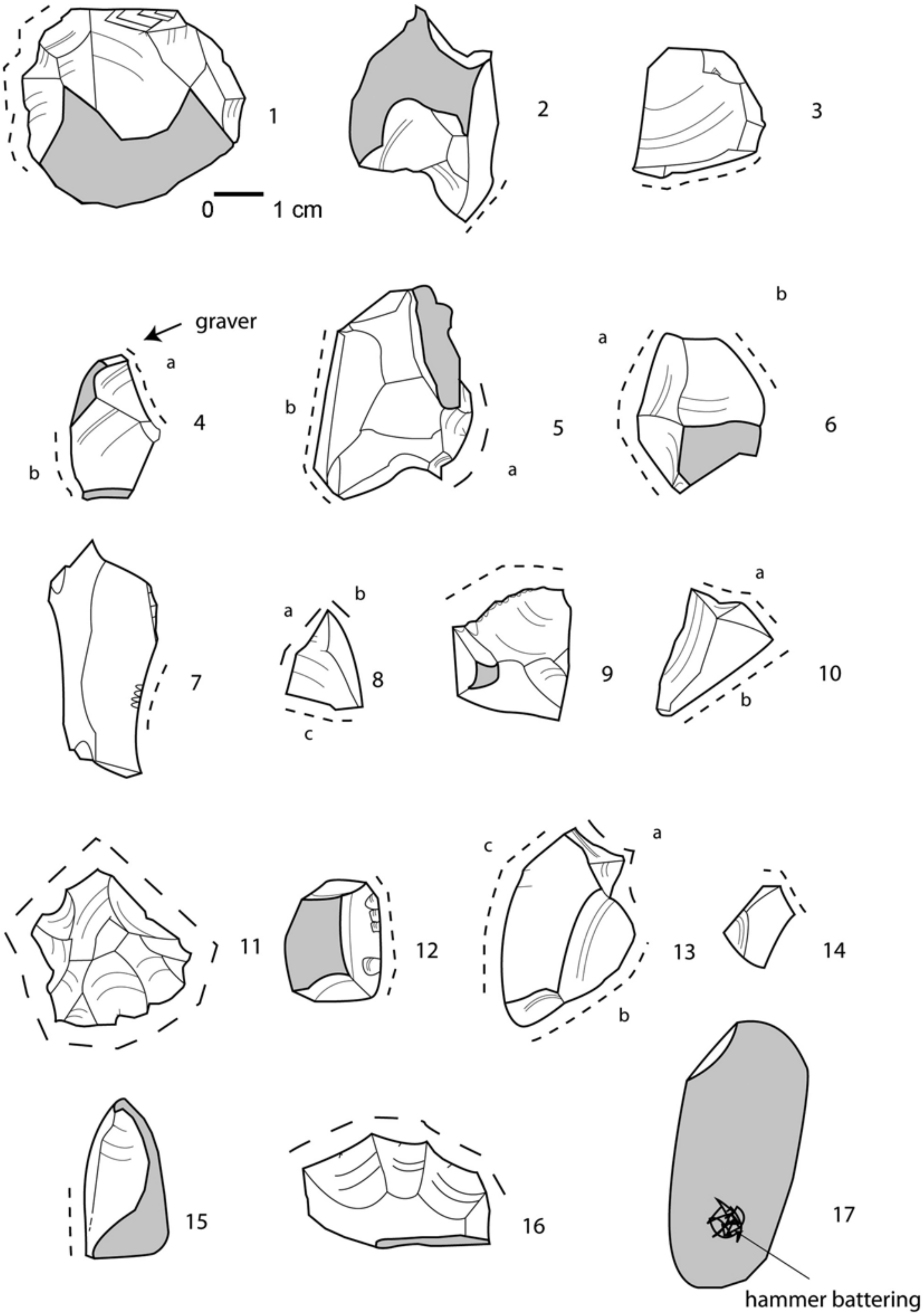

Figure 13. Aire Shelter 2, layer 1: selected stone artefacts. A small dashed line indicates usewear and a large dashed line indicates retouch/edge sharpening and usewear. Shading indicates cortex. The scale is 1 cm. Artefacts in layer 1 were not examined in the same detail as artefacts in layer 2. All artefacts are flint flakes with scraping/cutting functions except 17 (hornfels hammerstone), 4 (flint graver) and 8 (flint drill bit); 13 is a flint notched scraper with graving usewear.

Bipolar damage on artefacts. Three artefacts with bipolar damage in Layer 2 were utilized as wedges. Two (artefacts 33 and 34) have bulbs and platforms with subsequent bipolar damage. Artefact 33 (Fig. 11), for example, is a light grey flint flake with 5% cortex and a clear bulb and platform. Adjacent to the proximal end are a central percussion ridge with rounded prominences, bilateral step scars, and internal cracks or "clefts" with un-detached flakes. Similar bipolar damage is on the directly opposed edge. The wear traces are not due to manufacture nor is the piece a core. The rounding, scars and cracks probably results from wedging and is consistent with the damage on bone splinters (also from Layer 2) from which graved points have been removed (Fig. 8). This groove and splinter technique is described in other parts of the world (most famously at Star Carr by Clark [1954: 60, 183–184]), and Keeley's (1980: 46) experiments affirm the efficiency of the technique for splitting bone and the distinctiveness of the usewear pattern.

Table 13. Aire Shelter 2: distribution of all unutilized flakes and fragments by raw material. Flint accounts for 89.5% of total count.

material	layers								totals
	1	2	3a	3b	3c	4	5	5a	
flint	83	853	133	75	67	96	50	10	1367
quartz	1	12	15	14	7	11	15	9	84
quartzite	0	5	1	1	0	0	0	0	7
sandstone	6	28	4	1	3	1	0	0	43
limestone	0	2	0	0	1	0	0	0	3
limonite	4	0	0	0	0	0	0	0	4
travertine	0	1	0	0	0	0	0	0	1
basalt	0	1	0	0	0	0	1	0	2
horfels	0	2	0	0	0	0	0	0	2
silcrete	0	0	1	0	0	0	0	0	1
trachyte	0	0	0	7	0	0	0	0	7
felspathic sediment	0	0	0	2	0	0	0	0	2
greenstone	0	0	0	0	0	3	0	0	3
uncertain	1	0	0	0	0	0	0	0	1
totals	95	904	154	100	78	111	66	19	1527

Scrapers. Fifty-eight scraping edges were identified on 51 different flint specimens in Layer 2 (Table 12). I determined that 42 of these scrapers had distinct retouch from hammerstone percussion on 33 specimens, in addition to usewear (Appendix 1). Scraping different material produces a wide range of fracture patterns with considerable overlap (Kamminga, 1978: 211). Edge damage is usually produced more on the lower, contact face of the tool, although the upper face often sustains fracturing and perhaps commonly from scraping the tool on the backstroke (Kamminga, 1978: 206–207, 209). Many of the scrapers had edge damage on the bulbar surface, which was characteristically composed of small regular bending and feather fractures, some indistinguishable from fine retouch. Most scrapers had bifacial damage. It is sometimes not possible to distinguish retouch from utilization, especially with thinner edge angles where bending fractures are naturally more common. A more extensive experimental program is required in order to evaluate scar size and fracture type on retouched flakes.

Not all the artefacts identified as scrapers were retouched in terms of my definition (see above). Given my identification of many more retouched flakes, compared with the low incidence of retouch identified by Mulvaney (1962), I asked Paul Ossa (then at La Trobe University) to check my identification of retouch on a selection of scrapers with usewear and/or retouch, using European morphological typology in which he was expert (Table 15). Ossa identified retouch on 44 specimens including two examples of *raclette* retouch (very fine, continuous, abrupt retouch on thin flakes). Ossa's classification of retouch on 44 specimens is in contrast with my estimate of 33 and Mulvaney's estimate of only one with secondary retouch. I concluded that identification of intentional retouch was problematic without microscopic study and that Mulvaney's study grossly under-estimated the number of retouched flakes.

Multi-functional tools were defined as having a variety of tool combinations. If edges are used as the tool unit, the assemblage contained 22 side scrapers, eight end scrapers, nine denticulates and six gravers. Whether these types matched their utilitarian functions was not further investigated because most polishes were not distinctive enough without much more study. Two scrapers from Layer 2 (artefacts 35 and 90) had distinctive polish that most likely matches the very early stages in formation of phytolith polish (Figs 14, 15).

Knives and saws. Five pieces designated as cutting/sawing tools had small bending fractures within which one could observe smaller step fractures. The damage pattern, though similar to wear from a bone saw formed a much thinner working edge, < 1 mm, (Kamminga, 1978: 153). Generally the cutting edges are of low spine plane angles, falling within Kamminga's (1978: 76) angle classes I and II: 15–35°. Typically, bending fractures form on these edges, but well smoothed surfaces and edge rounding, together with the above factors, probably indicate sawing soft wood (Kamminga, 1978: 199).

Adzes. Only four adzes were identified in Layers 1 and 2. Artefact 37, made of dark flint with about 5% cortex, is a good example. It is a flake with both a bulb and a platform, and two edges have use-wear. The proximal end has pronounced, heavy bifacial fracturing with slight rounding and a dull polish. The distal end has been retouched, and has very slight rounding. The heavy damage on the proximal end could only be consistent with hafting the distal end. That is, it is unlikely that a hand held tool could sustain damage of this kind (Kamminga, pers. comm.; cf. Mulvaney, 1975: 125, hafting concept), and the fracturing is certainly unlike bipolar damage. The distal end displays wear consistent with hafting (very slight rounding from movement in the haft) and retouching to secure the flake. No residues are present. It is likely that this implement was hafted for use as an adze.

Table 14. Aire Shelter 2: distribution of cores by raw material.

stone	layers								total
material	1	2	3a	3b	3c	4	5	5a	
flint	5	15	3	4	3	4	1	0	35
quartz	0	0	1	2	1	4	0	1	9
quartzite	1	0	0	0	0	0	0	0	1
total	6	15	4	6	4	8	1	1	45

Table 15. Aire Shelter 2: analysis of scraper types by Paul Ossa.

class no.	artefact/scraper class	count	notes
1	side scraper, micro	2	
2	straight	5	
3	concave	1	
4	convex	8	
5	irregular	1	
6	graver	4	
7	end scraper micro	1	
8	end scraper	7	
9	backed side blade	1	
10	denticulate	5	
11	nosed scraper, micro	1	
12	nosed scraper	1	
13	beak and side scraper	1	composite tools
14	10 and 2	1	composite tools
15	10 and 4	1	composite tools
16	10 and 8	1	composite tools
17	10 and 6	1	composite tools
18	2 and 4	1	composite tools
19	10 and 6 and 4	1	composite tools
20	utilised flake	2	
21	flake	2	no macroscopic evidence of use
22	chunk	1	no macroscopic evidence of use
23	truncated flake	1	no macroscopic evidence of use
24	blunted flake	1	no macroscopic evidence of use
total number of scrapers		51	

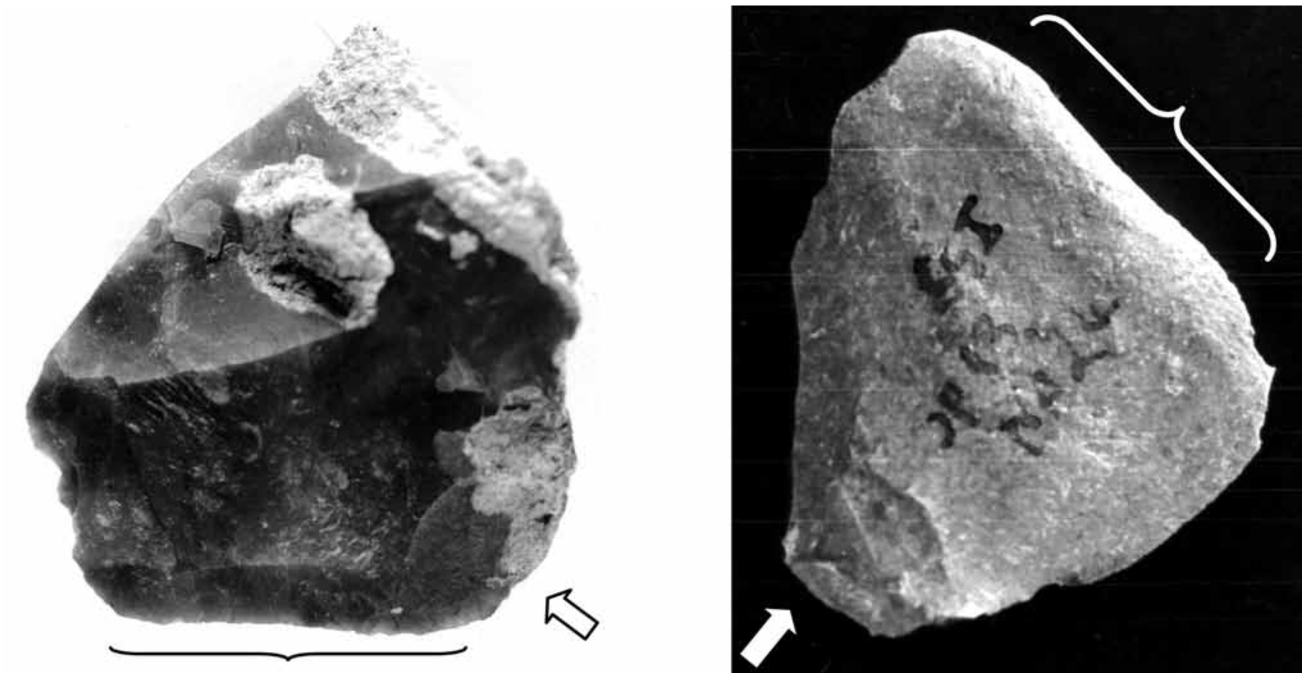

Figure 14. Left: Aire Shelter 2: flint artefact 90, with unretouched, straight, utilized tool edge 119 (2 cm long) on left lateral margin (within bracket). See Appendix for details and Fig. 15 for image of usewear. Right: Great Glennie Island: unretouched flake with polished edge about 2 cm long (within bracket). The arrows show the directions of each hammer blow to detach the flakes.

Drills. Drills were found in Layers 1 (n = 1), 2 (n = 4) and 4 (n = 1). Distinctive wear patterns on drills are partly the result of the shape of the bit, but very broad bits have been noted elsewhere (e.g., Kamminga, 1978: plate 104). Tip snapping is a common, but not diagnostic feature of drilling, and all drills were identified by the characteristic fracturing of various types oriented along the edges leading to the apex (Kamminga, 1978: 203). Evidence for drilling shell was noted, but the material worked could not be identified from the fracture patterns on the stone tools, although a small shell had both drilling and puncture marks (Fig. 16).

Awls. A possible quartz awl was identified (Fig. 17). Slight crushing at the tip and a spall removed from the apex may indicate use as an awl rather than as a drill (Kamminga, 1978: 149). Diagnostic features of awl use include striations emanating from the apex, but these were not observed in this case.

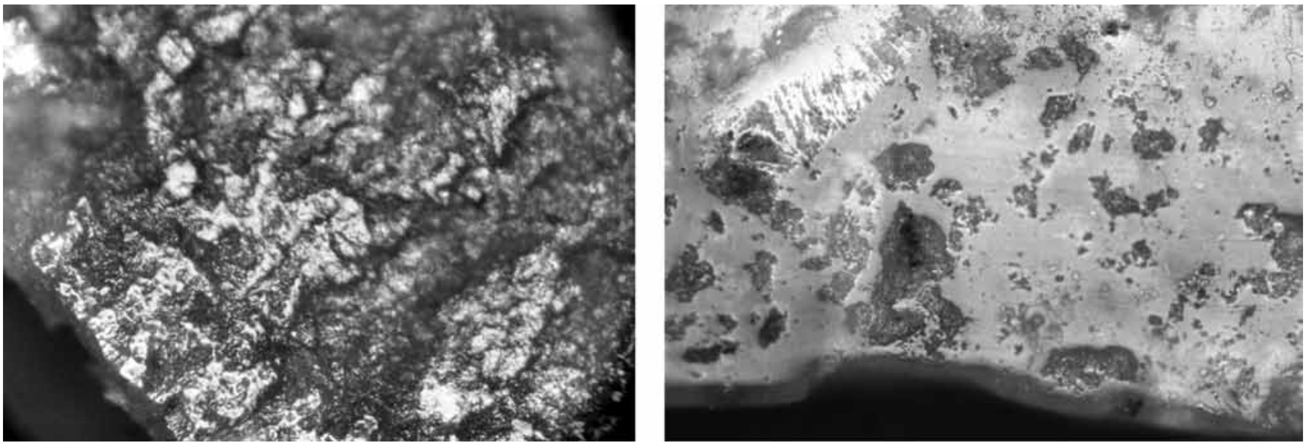

Figure 15. Left: Aire Shelter, layer 2. Unretouched flake (artefact. 90) with use polish. Right: Great Glennie Island. Unretouched flake with more developed use-polish of a similar kind.

Hatchet head. A broken edge ground hatchet from Layer 3B was identified by Mulvaney (1962: 9) as of classic Windang type, made on a split, waterworn cobble preserving cortex on the dorsal surface of the hatchet head, and flaking and light grinding along the utilized edge (Fig. 18). No other edge ground hatchets or fragments were found.

Grinding and pounding stones. Twelve hammerstones, three mortars and two pestles were identified on the basis of discrete surfaces or edges. Layer 2 contained five hammerstones, one mortar, and one pestle. One mortar and pestle from Layer 3A fit remarkably well (Fig. 19). An "uncertain" class included ground or otherwise modified artefacts which did not fit into the other categories. An attempt was made to look for the bevelled pounders recorded by Lourandos (1980: 266–269) at Cape Otway, but none were identified.

Uncertain. A large number of flaked stone artefacts could not easily be classified into functional classes, generally because the fractures were not diagnostic (e.g., bending fractures) and because of insufficient experimental data on polish formation. Often it was not possible to determine with certainty whether a tool was used for heavy duty scraping or for adzing, probably because these two modes of use probably overlap considerably since the forces at work are similar. In these cases, the tools were classified as having an uncertain mode of use.

Cores, flakes and fragments. Forty-five cores were identified on the basis of the presence of negative bulbs of percussion and the absence of positive bulbs of percussion: 35 of flint, nine of quartz and one of quartzite (Table 14). In Layer 2 there are 15 cores, all of flint, with an average weight of 20.2 g. The average number of discrete platforms is 3.9 per core.

Waste flakes included the following tool stone: flint, quartz, quartzite, sandstone, limestone, limonite, travertine, basalt, hornfels, silcrete, trachytes, felspathic sediment and unidentified beach cobbles. Waste flakes were divided into flakes and fragments (defined as having neither bulbs of percussion nor platforms). The most common flaked material was flint with 1,367 flakes and fragments. The ratio of fragments to waste flakes varied throughout the stratigraphic layers from 30% to 54%, and was 38% overall. In Layer 2, 274 (30%) waste flakes were broken. Blades (flakes with lengths more than twice the width) were rare (n = 56, 7% of the 842 flakes).

Hard hammer percussion seems to have been the most common manufacturing technique. Analysis of cortex suggests selectivity of flakes with a smaller area of cortex for use as tools (21% average compared with 33% on average for waste flakes), although a higher proportion of tools (62%) had cortex compared with waste flakes (48%). Cortex is probably not a key variable for tool selection. Since 46% of flint tools were fragments (lacking a distinct bulb and platform), there seems to be a high incidence of breakage, no

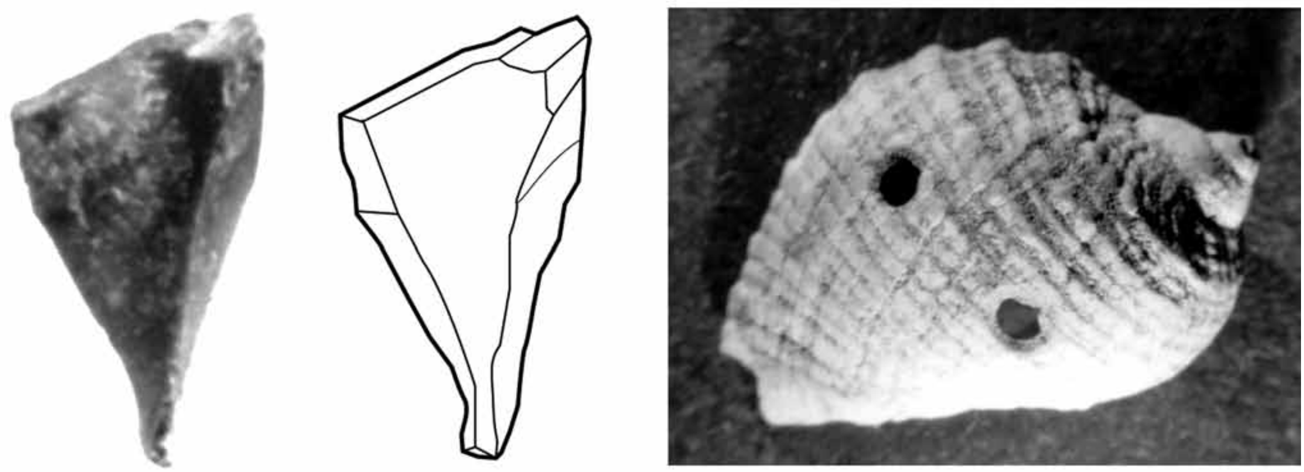

Figure 16. Aire Shelter 2. Left: drill (artefact 35). Right: shell with drilled hole (centre) and puncture marks. The shell about 2 cm long.

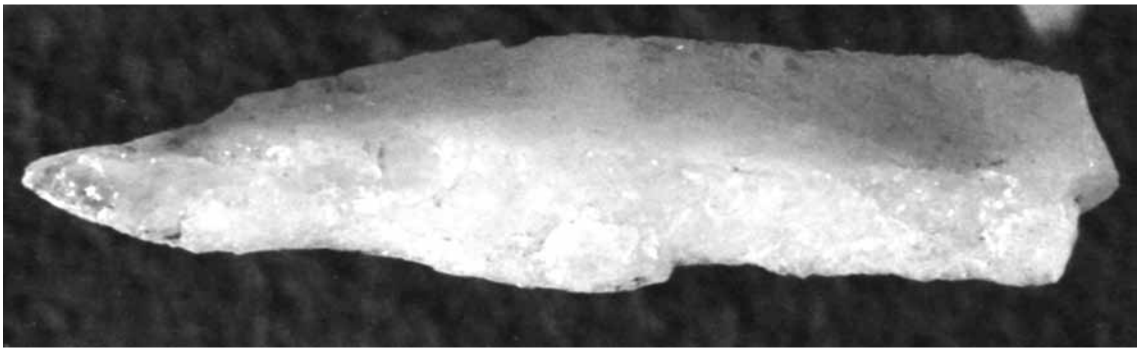

Figure 17. Aire Shelter 2, layer 2: quartz awl (cf. Fig. 12.6). Length 4 cm.

doubt in part due to the presence of inclusions. Some of the breakage was deliberate (e.g., production of burins). Edge shape was a more important criterion for tool selection than flake morphology.

Summary. Compared with the original macroscopic study, which yielded seven flaked tools, microscopic use-wear analysis recognized 291 utilized tool edges on 215 pieces of stone in Layer 2. Fine retouch was identified on 44 scrapers. Among the stone tools was a bone working toolkit that comprised burins, gravers, bipolar artefacts (used as wedges), presumably used with wooden or bone billets. Woodworking tools were also indicated by a variety of scrapers, adzes and the stone hatchet. Plant processing is shown by the cutting and scraping implements with phytolith polish and also suggested by the grinding stones. Some of the limestone implements have been used for pounding. Flint drills (and a possible drilled shell) indicate a toolkit for the manufacture of shell artefacts, possibly ornaments. It is possible that some flint scrapers were used for skin working, but a detailed set of experiments and further study of microscopic residues is required to test this proposition, because working on thin marsupial skin produces only faint wear traces on flint tools (Kamminga, 1982).

The activities indicated by the stone artefacts reflect outcomes from the collection of about 50 nodules of flint (each about 200 g) over several hundred years (perhaps only a few small collection episodes per year), with tasks linked to bone, wood, shell and skin. Bone working appears to be the most important industrial activity. Sparse food remains suggest only ducks (MNI = 10) from the lake, and shellfish (nearly all from the rocky coast) were consistently collected and brought back (along with a few other small animal remains) into the shelter. The faunal analysis indicates selection and processing of mammal long bones, probably remains of locally hunted macropods.

Bone points are the most common tool types. Webb (1987) identified several probable functions, including fish gouges and skin working, but also demonstrated that relatively few bone tools were used, a feature which supports the proposition that manufacture of bone points was the dominant activity at Aire Shelter 2.

Discussion

What site function is indicated by the re-analysis of faunal and lithic assemblages from Aire Shelter 2? The site contents reflect a relatively rapid rate of accumulation in the last few hundred years. Quantification of shellfish abundance has not been estimated, although Mulvaney (1962) provided some shellfish species represented in each layer and only noted "numerous" shells in Layer 2. Total MNI counts (49) indicate ten birds, eight macropods above 5 kg, three fish, with three seals and a dog in the most recent levels. About 50% of the site sediment was excavated, and even if we double the MNI, faunal remains at this site reflect much smaller scale camping episodes than the vast middens visible on the coastal dunes (Head & Stuart, 1980). The entire cultural assemblage suggests low intensity of occupation and is inconsistent with base camp or semi-permanent occupation compared with the larger sites on the dunes. Faunal evidence from Aire Shelter 2 does not support a hypothesis for a base camp occupied over a long period. Instead, the data fit the proposal that site was a temporary camp, probably associated with small scale hunting trips by small groups.

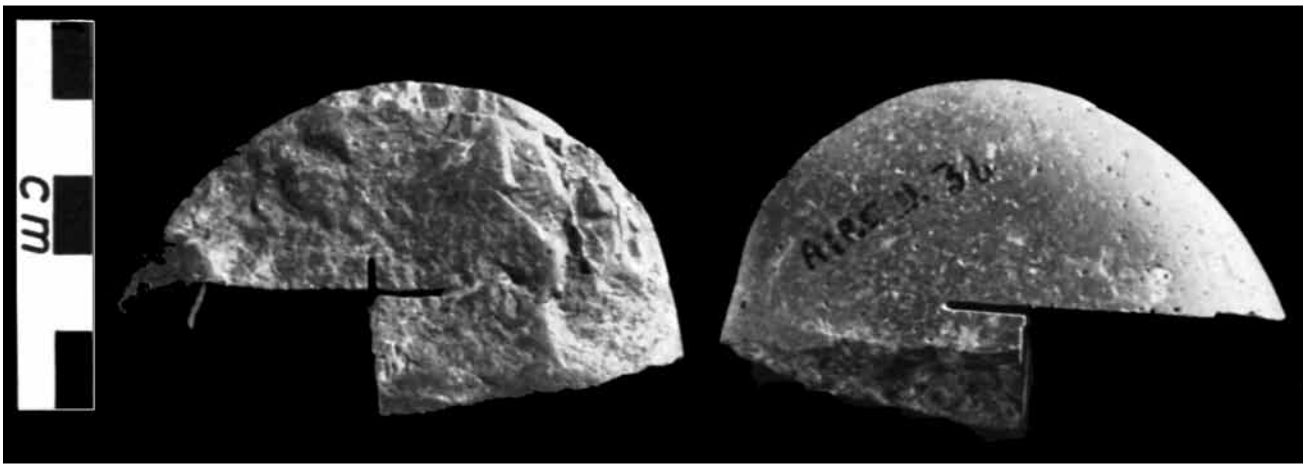

Figure 18. Aire Shelter 2, layer 3B: Windang hatchet head. A 2 × 1 cm section was cut to identify the trachyte rock type, which is unknown in the Otway area.

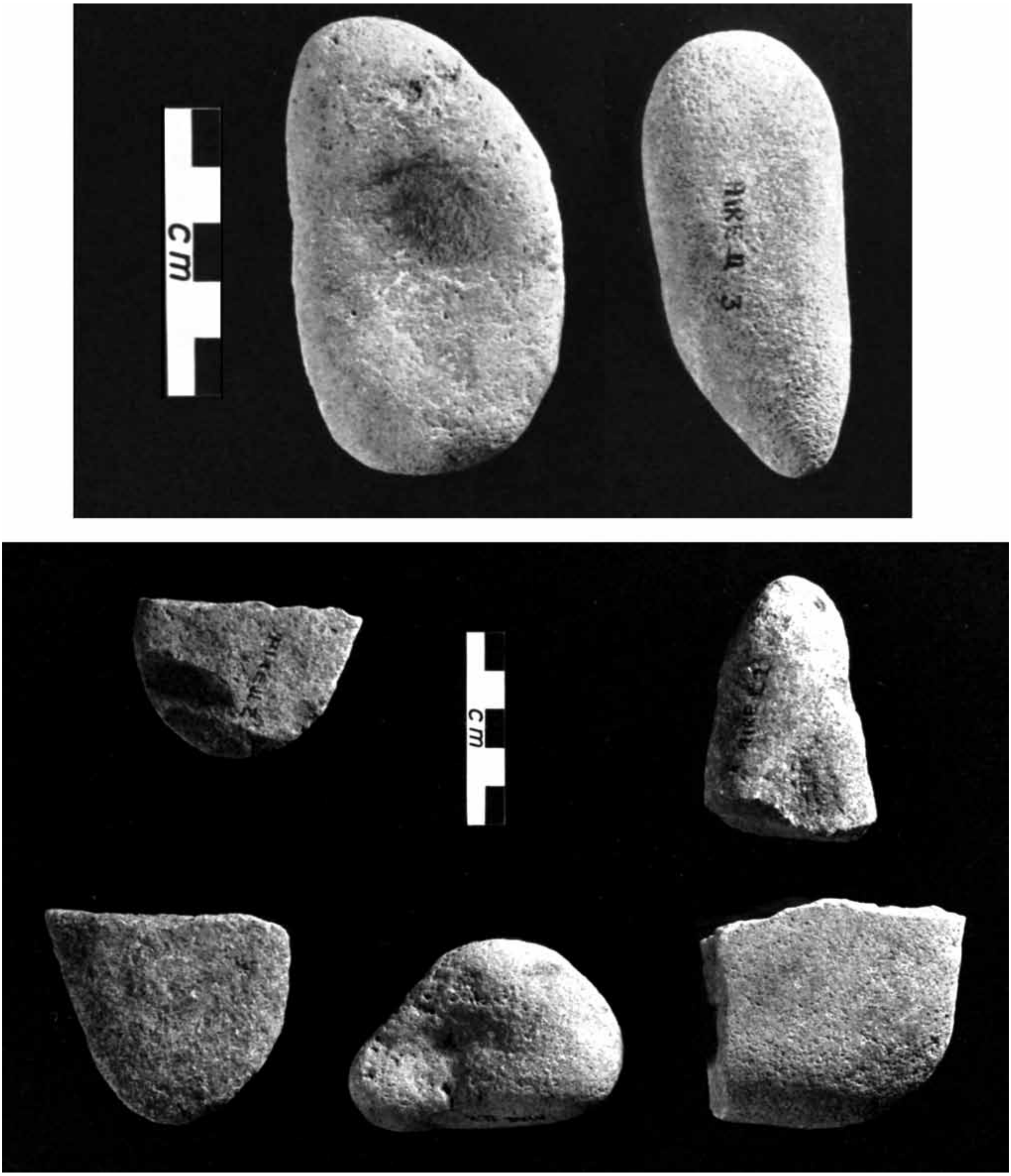

Figure 19. Aire 2, layer 3A: calcarenite mortars and pestles.

On the other hand, the stone assemblage is not typical. The assemblage is characterized as amorphous because there is little evidence of intentional shaping of either flakes or cores into standardized forms. However, the assemblage is comprised of an uncommon frequency of utilized tool edges, many shaped by delicate secondary retouch. Nevertheless, retouch of tool edges has hardly exhausted the tools, with generally low intensity use of each tool. Parry and Kelly (1987) describe less formalized core production and expedient stone technologies for relatively mobile hunter-gatherers and more sedentary people who do not move residential base camps or logistical locations (special activity locales/transit camps) over long distances. The presence of coastal flint suggests Aire Shelter 2 is more likely associated with residential/base camps to the south, on the coast about 2 km away, than further inland to the north.

Activities represented include a minor component of diverse food consumption from hunting and a major component of replacement, repair and maintenance of diverse material cultural items, bone point production being the most abundant. In her analysis of Layer 2 bone points, Webb (1987) found that eight were possibly unused and there was a high proportion of debitage (63%). She also noted that the frequency of breaks is low (38%) compared with other bone point assemblages analysed. Diagnostic evidence for use of bone points for skin working was not found in any of the layers, and only one bone point in the entire assemblage was assigned a definite function: wedging shellfish off rock. Webb's (1987: 80) conclusion is that the Aire Shelter assemblage was a manufacturing site. These findings contrast with her usewear and residue analysis of Currarong bone, for which Webb (1987: 79) concluded that Lampert's (1971) interpretations were generally supported: smaller bone points were used for spearing fish, and larger points were used for skin scraping (but not as awls, as suggested by Lampert).

Rather than a semi-permanent base camp, the technological and faunal remains suggest that Aire Shelter 2 is more likely to have functioned mainly as a winter shelter used in the course of hunting/collecting expeditions, notably for ducks and eggs, both of which are most abundant in winter. Small meals were consumed at the shelter and various items of gear were replaced, repaired or otherwise maintained. A dominant activity appears to have been the collection of long bones specifically to manufacture bone points with scrapers and burins. The activities in Layer 2 could well represent craft activities undertaken within a shelter where hunters observed or waited for small mammal prey from a vantage that overlooks the wetlands (cf. Binford, 1978). The site certainly affords both seclusion and shelter from rain.

Burins are a technologically distinctive artefact form or implement type in Australia, and have been noted in several parts of northern and southern Australia (see review by Kamminga, 1982: 91–93). Clarkson (2007: 112) reports that burins or burinate retouch are particularly common in Wardaman assemblages from northern Australia. Hiscock (1993) describes a form of burinate retouch for the Hunter Valley.

The function of burins in Australia was reviewed by Kamminga (1982: 91–93), who examined 143 specimens from nine archaeological sites microscopically (mostly under a stereo-microscope with oblique incident light). He found usewear on only eight specimens, although the usewear was insufficiently developed to determine function with confidence. Moreover, most burin edges lacked usewear of any kind—a similar situation to that found for backed microlithic artefacts, which also often lack distinctive usewear. The scarcity of diagnostic usewear on these artefact classes visible under stereomicroscopes has been an impetus for the use of metallographic microscopes with vertical incident light, and the application of residue analysis in order to determine tool function (e.g., for backed artefact function: Robertson *et al*., 2009; Fullagar *et al*., 2009). Although not in the same technological class of stone tools, impact burins have also been interpreted as a distinct form of usewear on projectile points (Clarke, 1979), and have been noted in other functional studies (e.g., Akerman *et al*., 2002; McDonald *et al*., 2007).

The presence of burins together with a "groove and splinter" bone graving technology at Aire Shelter 2 has a parallel in Eastern Victoria. Flenniken and White (1985: 145–147) provide clear photographs of the Jack Smith Lake burins. Fullagar (1985) examined ten burins from Jack Smith Lake for Hotchin (1982), who analysed Aboriginal sites in the Gippsland Lakes region for his Ph.D. (Hotchin, 1990). The Jack Smith Lake burins and grooved bone (e.g., Hotchin, 1990: 153–154) were reported in association with both *Donax* middens dating to the last 500 years, and in association with older estuarine shell (*Ostrea angasi* and *Anadara trapezia*) middens, some dating between 3,000 and 4,000 years old (Hotchin & May, 1984: 16).

In contrast with the Aire Shelter 2 burins, which have minimal re-sharpening, Jack Smith Lake silcrete burins have several phases of re-sharpening characterized by large numerous burin spalls (see illustrations in White & Flenniken, 1985). The usewear, despite being formed on a different kind of tool stone, resembles the patterns on the Aire Shelter 2 tools and is therefore likely to indicate a similar function (Fig. 20). The double-notched scrapers preserve usewear on the protruding "nose" indicating sawing/cutting/graving. Although I did not observe diagnostic bone polish, I suggest that these double-notched scrapers were used to cut deeper into the grooves, once burins had delicately initiated the line of cut. The evidence from the Aire Shelters and the Jack Smith Lake middens provides compelling evidence that carefully manufactured burins and snapped flakes for working bone were present in Aboriginal tool kits of the Late Holocene.

Conclusions

The Aire Shelter 2 bone assemblage is dominated by evidence for the manufacture of bone points, along with a minor component of the remains of food scraps. Through time, land mammal bone becomes more common and this correlates well with the incidence of bone point production. Bone points had a variety of functions, but the incidence of use was relatively low compared with other sites where usewear has been undertaken (Webb, 1987).

The stone assemblage has far more retouch than originally described by Mulvaney (1962), although it is mostly fine retouch and often overlaps in size with usewear. Nevertheless, the amount of retouch and usewear on each tool is generally low and consistent with relatively brief episodes of use, minimal re-sharpening and rapid discard. Some implements (like a few bone points) were used along the nearby coast (for fishing and gathering shellfish), and a broken hatchet head may have been used further afield, but for the most part the tools were most likely used on-site. As predicted by Mulvaney (1962), a significant proportion of flakes and fragments was utilized as tools for a variety of functions including woodworking and bone working. Burins and many scrapers were most likely used for grooving bone as the first stage in the production of bone points.

The small size of the site (relative to extensive middens on the coastal dunes), the high proportion of utilized flakes, the remnants of worked bone and the relatively low incidence of bone use suggest that Aire Shelter 2 was not itself a base camp, but a special purpose locale where bone points were manufactured, probably in association with targeting specific resources from the adjacent lake and swamps (swan eggs and ducks). Binford's (1978) observations and analysis of activities at the Mask Site (a Nunamiut hunting stand) suggest a plausible interpretation for Aire Shelter 2 as a place where incidental craft activities (bone point manufacture) were associated with the key function of the site, which was to afford secluded and sheltered observations of prey. More permanent base camps were probably located along the coastal dunes, perhaps associated with hut-pit structures of the kind identified at Seal Point and in Tasmania (Lourandos, 1997: 214, 258).

A review of settlement models by Richards (1998) suggested alternative scenarios involving either residential moves parallel to the coast or residential moves between much further inland and coast. If Aire Shelter 2 is not a residential base, the site contents (e.g., shellfish) suggest connections with a coastal base camp. There is also support

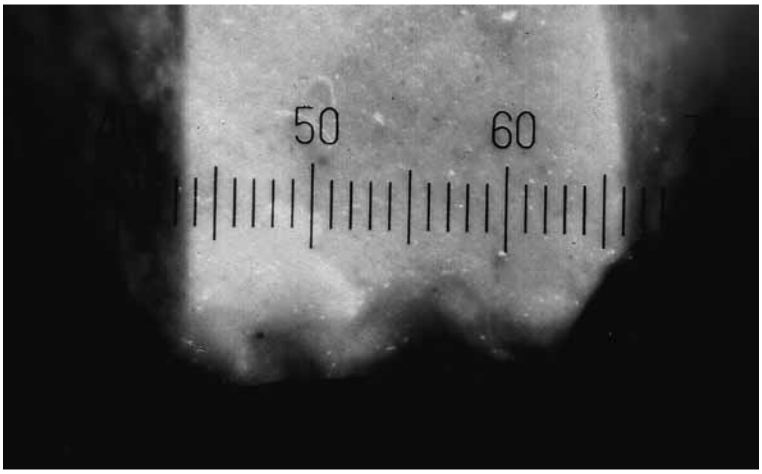

Figure 20. Jack Smith midden: usewear on the used burin edge (artefact 1010). Note the two small flake scars and the very marked edge rounding. Scale divisions are 0.1 mm.

for seasonal movements and provisioning of place (transport of flint nodules from the coast about 2 km away). Further study is required to assess whether the Aire Shelter 2 indicates an activity locale associated with higher residential mobility than in earlier phases of Victorian prehistory, as argued by Witter (Richards, 1998), or reduced residential mobility focussed on coastal or more distant inland base camps.

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Appendix 1. Aire Shelter 2, Layer 2. Utilized stone artefacts. *b*, bending scars; *c*, cleft; *DF*, dark coloured flint; *f*, feather termination scars; *h*, hinge termination scars; *LF*, light coloured flint; *M*, tool identified by Mulvaney; *Q*, quartz; *s*, step termination scars.

artefact number	type	cortex %	inclusions	bulb	platform	hinge	fragment	length mm	width mm	thickness mm	weight g	platform thickness mm	platform angle °	manufacture damage	tool edge number	mode of use	fractures	striations	polish	rounding	residues	extent	spine plane angle °	specific degrees °	notch retouch	comments
1	LF	30	Y	Y	Y	N	N	56	21	6	7	5	80		1	scraper	f,b,s	Y	Y	Y	Y	22	10	75		dense material
2	DF	30	N	Y	Y	Y	N	56	22	11	8.3	7	65		2	scraper	f,s	N	Y	Y	N	15	75	75		dense material
3	DF	50	Y	N	N	N	Y	38	29	10	10.4	na	na		3	scraper	f,b,s	N	Y	Y	N	12	50	65	Y	dense material
4	LF	0	Y	N	N	N	Y	38	18	8	5.6	na	na		4	scraper	n	N	Y	Y	N	20	50	65	Y	dense material
															5	scraper	f,b,s	N	Y	Y	N	35	40	75		medium material
															6	scraper	f,s	N	Y	Y	N	10	40	60		medium material
5	LF	5	Y	Y	Y	Y	N	37	40	9	12.5	8	128		7	scraper	f,s	N	N	N	N	5	50	50		
6	Q	0	N	N	N	N	Y	38	9	5	1.2	na	na		8	awl	f,s	N	N	Y	N	5	6	40		
7	DF	50	N	N	N	N	Y	29	27	7	6.1	na	na		9	uncertain	f,s	N	Y	Y	N	12	53	81		
8	DF	20	N	Y	Y	Y	N	20	P	4	2.1	2	74		10	scraper	f,b,s	N	Y	Y	N	34	10	76		yielding material
9	LF	25	Y	Y	Y	N	N	40	27	16	11	6	57	Y	11	scraper	f,b,s,h	N	Y	Y	N	29	40	50		
10	LF	0	N	N	N	N	Y	20	29	10	6.2	na	na	Y	12	uncertain	s	N	Y	Y	N	2	60	60		
12	DF	15	Y	Y	Y	N	N	38	24	5	6.2	6	62	Y	13	cutting	f,b	N	N	N	N	44	33	33		
															14	graver	f,b,s,h	N	Y	Y	N	46	50	50		
13	LF	20	N	N	N	N	Y	30	15	16	4.7	na	na		15	scraper	b,s	N	N	Y	N	13	49	49		
14	LF	0	Y	Y	Y	N	N	33	12	8	1.9	10	110		16	scraper	b,s	N	N	N	N	10	50	50		
15	DF	15	Y	N	N	N	Y	34	21	15	8.3	na	na	Y	17	scraper	b,s,f	N	N	Y	N	18	76	76		
															18	scraper	f,s	N	N	Y	N	16	63	63		
16	DF	10	Y	Y	N	N	N	Y	24	19	8	4.5	na		19	scraper	f,b,s	N	Y	Y	N	38	50	60	Y	
18	DF	50	Y	Y	Y	N	N	38	19	10	7.3	7	105	Y	20	scraper	f,s	N	N	Y	N	27	95	95		
19	DF	50	Y	Y	Y	N	N	33	25	7	5.3	5	115	Y	21	scraper	f,h	N	Y	Y	N	20	65	65		
20	LF	0	Y	N	N	N	Y	26	17	9	3.5	na	na	Y	22	uncertain	f,s	N	Y	Y	N	17	80	80	Y	
22	DF	0	Y	Y	Y	N	N	34	23	8	8.4	3	120	Y	23	uncertain	h,s	N	N	N	N	14	20	80		
															24	uncertain	h,B	N	N	Y	N	10	20	80		
24	DF	1	Y	Y	Y	Y	N	20	17	3	1.3	2	100	Y	25	cutting	b,f	N	Y	Y	N	15	30	80		medium material
															26	cutting	b,f,s	N	Y	Y	N	18	20	80		
25	DF	5	N	N	N	N	Y	35	25	9	9	na	na		27	scraper	b,f,s,h	N	Y	Y	N	36	70	70		
26	LF	40	Y	N	N	N	Y	33	25	11	6.9	na	na	Y	28	uncertain	b,f,s	Y	Y	Y	N	2n	80	80		
27	DF	0	Y	N	N	N	Y	26	14	7	2.3	na	na	Y	29	scraper	b,s	N	N	N	N	20	40	80		
															30	graver	s	N	Y	Y	N	4	40	80		

Appendix 1 [continued]. Aire Shelter 2, Layer 2. Utilized stone artefacts. *b*, bending scars; *c*, cleft; *DF*, dark coloured flint; *f*, feather termination scars; *h*, hinge termination scars; *LF*, light coloured flint; *M*, tool identified by Mulvaney; *Q*, quartz; *s*, step termination scars.

artefact number	type	cortex %	inclusions	bulb	platform	hinge	fragment	length mm	width mm	thickness mm	weight g	platform thickness mm	platform angle °	manufacture damage	tool edge number	mode of use	fractures	striations	polish	rounding	residues	extent	spine plane angle °	specific degrees °	notch retouch	comments
28	DF	5	Y	Y	Y	N	N	27	27	8	6	7	92	Y	31	uncertain	b,f	N	N	Y	N	16	40	70		
															32	uncertain	b	N	Y	N	N	20	30	80		
29	LF	0	N	N	N	N	Y	23	17	8	2.7	na	na	Y	33	cutting	b,f,s	N	Y	Y	N	21	35	70		
33	LF	5	Y	Y	Y	N	N	34	23	7	4.8	3	110	Y	34	bipolar	f,b,s,h	N	N	Y	N	30	15	75		wedge
															35	bipolar	s,h,f	N	N	Y	N	10	15	75		
34	DF	15	Y	Y	Y	N	N	22	15	6	1.8	3	110	Y	36	graver	b,s	N	N	Y	N	3	70	70		burin
															37	uncertain	b,h,s	N	N	Y	N	5	10	50		
35	DF	5	Y	Y	Y	N	N	25	16	5	1.9	3	115	Y	38	drill	b,f	N	Y	Y	N	21	44	50		
															39	scraper	b,h,f	N	Y	Y	N	Z2	50	50		phytolith polish
36	DF	5	Y	Y	Y	N	N	22	15	6	1.7	5	118	Y	40	uncertain	b,f,s	N	Y	Y	N	20	75	75		
															41	uncertain	b,h,f	N	Y	Y	N	19	60	60		
															42	scraper	b,f,h	N	Y	Y	N	5	30	30		
37	DF	5	Y	Y	Y	N	N	17	20	6	2.6	1	110	Y	43	adze	s,f,h	N	Y	Y	N	38	60	60		
															44	haft	s,b	N	Y	Y	N	25	40	40	Y	not use fractures
38	DF	20	N	N	N	N	Y	23	29	6	4.5	na	na		45	uncertain	b,h,f	N	Y	Y	N	32	33	33		
39	LF	0	Y	N	N	N	Y	37	16	9	4.1	na	na	Y	46	uncertain	h	N	Y	N	N	7	50	50		
40	DF	50	Y	N	N	N	Y	25	28	13	8.9	na	na		47	graver	s,h	N	Y	Y	N	17	60	80	Y	
															48	uncertain	f	N	Y	Y	N	14	60	80		
41	LF	15	Y	N	N	N	Y	27	13	5	2.3	na	na		49	graver	s	N	Y	Y	N	22	50	70		
															50	uncertain	b,h,s	N	Y	Y	Y	5	50	70		
42	LF	40	Y	Y	Y	N	N	27	40	13	13	2	105	Y	51	scraper	h,s	N	Y	Y	N	46	70	70		
44	LF	25	Y	Y	Y	N	N	33	33	13	13.5	2	110	Y	52	bipolar	h,s	N	Y	Y	N	30	60	60		wedge
															53	bipolar	f,s	N	Y	Y	N	18	60	60		
															54	scraper	h,s	N	N	N	N	18	85	85		used on cortex
45	DF	0	Y	N	N	Y	N	31	14	5	2.2	na	na		55	graver	b,s	N	Y	Y	N	4	90	90	Y	burin
															56	scraper	b,s	N	Y	Y	N	51	35	35		
46	DF	5	Y	Y	Y	Y	N	27	20	7	3.4	6	100		57	uncertain	b,h,s,f	N	Y	Y	N	25	55	55		worn out graver
															58	uncertain	b,h,8,f	N	Y	Y	N	25	40	40		
47	DF	10	Y	N	N	N	Y	23	13	5	1.2	na	na		59	uncertain	b,f,s	N	N	Y	Y	20	70	70		
48	LF	0	Y	N	N	N	Y	23	12	11	2.7	na	na	Y	60	scraper	f,s	N	Y	Y	N	9	70	70		dense wood scraper

Appendix 1 [continued].

49	DF	40	Y	N	N	N	Y	26	16	6	2.9	na	na		61	uncertain	s	N	Y	N	N	17	70	70		phytolith polish
															62	graver	N	N	N	Y	N	4	40	40		
50	DF	15	Y	Y	Y	N	N	20	15	4	1.2	5	125		63	uncertain	b	N	N	Y	N	16	10	10		
51	LF	30	Y	Y	Y	N	N	36	24	12	8.8	6	125		64	scraper	f,h,s	N	N	Y	Y	51	60	75	Y	
															65	drill	f	N	N	Y	N	4	40	40		
52	LF	5	Y	N	N	N	Y	32	32	Y	14	15.7	na	N	66	scraper	b,s	N	Y	Y	N	28	80	80		
															67	scraper	b,h,s	N	Y	Y	N	47	65	65	Y	
53	LF	0	Y	Y	Y	N	N	32	23	12	7.8	9	130		68	scraper	b,h,f,s	Y	Y	Y	Y	45	50	70	Y	
56	LF	5	Y	N	N	N	Y	26	19	5	3	na	na		69	cutting	b,s	N	N	Y	N	23	20	20		
															70	graver	s	N	N	Y	N	10	15	75		
57	DF	40	Y	N	N	N	Y	46	37	17	28.1	na	na	Y	71	graver	h,f,s	N	Y	Y	N	24	80	80	Y	burin
58	DF	0	Y	Y	Y	N	N	23	40	13	11.1	12	120	Y	72	graver	N	N	Y	Y	N	4	80	80		
															73	graver	N	N	Y	Y	N	4	80	80		
															74	graver	N	N	Y	Y	N	4	80	80		
															75	graver	N	N	Y	Y	N		80	80		
															76	scraper	s,h,f	N	Y	Y	N	20	80	80		
															77	scraper	s,h,f	N	Y	Y	N	35	80	80		
59	LF	50	Y	Y	Y	N	N	26	30	16	9.5	11	115	N	78	scraper	b,s	N	Y	Y	Y	38	70	70		
															79	graver	N	N	Y	Y	N	4	70	70	Y	
															80	graver	N	N	Y	Y	N	4	70	70	Y	
60	LF	40	Y	Y	Y	Y	N	34	36	8	8.3	8	112	N	81	scraper	f,b,s	N	Y	Y	N	26	35	35		
61	DF	30	Y	N	N	N	Y	40	35	16	13	na	na	N	82	graver	N	N	Y	Y	N	6	47	47	Y	
															83	graver	s	N	Y	Y	N	8	60	60	Y	
															84	graver	f,s	N	Y	Y	N	8	60	60	Y	
62	LF	0	Y	N	N	N	Y	36	32	18	4.5	na	na	Y	85	graver	f	N	Y	Y	N	8	70	70	Y	
															86	graver	h,f	N	Y	Y	N	16	80	80	Y	
63	DF	10	Y	Y.	Y	Y	N	30	30	11	9.8	9	115	Y	87	scraper	b,s	N	Y	Y	N	39	30	80		
64	DF	40	Y	N	N	N	Y	38	26	17	12.6	na	na	Y	88	scraper	f,h	N	Y	N	N	21	80	80		
															89	graver	h,f	N	Y	Y	N	6	60	60	Y	
65	LF	5	Y	Y	Y	Y	N	23	26	7	3.8	6	110	Y	90	uncertain	b,f	N	Y	Y	N	21	35	70		
66	LF	0	Y	Y	Y	N	N	27	20	6	2.8	2	95	Y	91	uncertain	s	N	Y	Y	N	20	30	30		
67	DF	0	Y	N	N	N	Y	26	17	5	2.4	na	na	Y	92	uncertain	b,s	N	Y	Y	N	21	70	70		
68	LF	50	Y	N	Y	N	N	30	30	8	5.5	6	106	Y	93	uncertain	b	N	Y	Y	N	21	42	42		
69	LF	20	N	Y	Y	Y	N	30	31	9	10.4	7	120	Y	94	graver	b,s	N	Y	Y	Y	5	10	70		
70	LF	10	Y	N	N	N	Y	31	26	11	6.9	na	na	N	95	graver	S	N	Y	Y	N	5	30	30	Y	
															96	graver	b,s	N	Y	Y	N	6	50	50	Y	
															97	graver	s	N	Y	Y	N	4	50	50	Y	
															98	adze	s,h	N	Y	Y	N	22	50	50		heavy damage
71	DF	10	Y	Y	Y	N	N	20	15	4	1	2	100	Y	99	uncertain	b,s	N	Y	Y	N	21	10	90		
73	LF	0	Y	N	N	N	Y	33	25	11	7	na	na	N	100	uncertain	f,s,h	N	Y	Y	N	32	55	55		
74	LF	0	Y	N	N	N	Y	22	13	8	12	na	na	Y	101	uncertain	h,s	N	Y	Y	N	10	25	90		
75	LF	0	Y	Y	Y	N	N	21	16	4	1.2	2	90	Y	102	uncertain	b,s	N	Y	Y	Y	31	10	90		possibly worn graver

Appendix 1 [continued]. Aire Shelter 2, Layer 2. Utilized stone artefacts. *b*, bending scars; *c*, cleft; *DF*, dark coloured flint; *f*, feather termination scars; *h*, hinge termination scars; *LF*, light coloured flint; *M*, tool identified by Mulvaney; *Q*, quartz; *s*, step termination scars.

artefact number	type	cortex %	inclusions	bulb	platform	hinge	fragment	length mm	width mm	thickness mm	weight g	platform thickness mm	platform angle °	manufacture damage	tool edge number	mode of use	fractures	striations	polish	rounding	residues	extent	spine plane angle °	specific degrees °	notch retouch	comments
76	LF	0	Y	Y	Y	Y	N	23	23	6	3.2	6	120	Y	103	scraper	s	N	N	Y	N	22	90	90	Y	
															104	uncertain	b,h,f,s	N	Y	Y	N	9	60	60		
															105	uncertain	s,f	N	N	Y	N	22	30	60		
78	DF	15	Y	N	N	N	Y	28	28	10	7.2	na	na	Y	106	bipolar	s	N	Y	Y	N	16	45	70		hertzian cones, wedge
															107	graver	b,s	N	Y	N	N	7	60	65	Y	hertzian cones, wedge
															108	graver	b,s	N	Y	Y	N	4	70	70	Y	hertzian cones, wedge
79	DF	50	Y	N	N	N	Y	43	32	9	10.2	na	na	Y	109	scraper	b,s	N	N	Y	N	37	50	50		
															110	graver	b,s,h	N	Y	Y	N	8	30	80	Y	
80	LF	0	N	Y	Y	Y	N	16	19	5	1.4	5	120	N	111	graver	s	N	Y	N	N	4	30	60	Y	patina
															112	uncertain	b,f,s	N	Y	Y	N	8	30	50		
83	DF	10	Y	N	N	Y	N	25	14	10	1.5	N	N	Y	113	uncertain	b	N	N	Y	N	15	10	10		
84	DF	50	Y	N	N	N	Y	20	12	5	1.1	na	na	N	114	scraper	f,b,s	N	N	N	N	14	50	50		broken tool edge
85	DF	50	N	Y	N	N	Y	25	21	8	3.8	na	na	Y	115	uncertain	b,h,f	N	Y	Y	N	15	52	52		
															116	graver	s,f	Y	Y	Y	Y	5	90	90		burin, bone residue
86	LF	0	Y	Y	Y	N	N	25	20	10	4.6	4	120	Y	117	uncertain	b	N	Y	Y	N	23	45	45		
88	LF	1	Y	N	N	N	N	20	16	5	1.2	na	na	Y	118	uncertain	b,h,s	N	N	Y	N	5	10	60		
90	DF	15	Y	Y	Y	Y	N	32	41	12	12.1	5	112	Y	119	scraper	b,h,f	Y	Y	Y	N	24	60	60		phytolith polish
91	DF	10	Y	Y	Y	N	N	23	30	6	3.8	6	120	Y	120	scraper	b,s	N	N	Y	N	18	10	60		
92	LF	5	Y	N	N	N	Y	30	15	12	5	na	na	Y	121	scraper	b,s	N	N	Y	N	14	75	75		
															122	scraper	s,f,b	N	N	Y	N	20	50	70		
															123	graver	b	N	Y	Y	N	5	50	60		
93	LF	10	Y	Y	Y	N	N	17	27	3	1.5	2	100	Y	124	uncertain	b	N	N	Y	N	14	10	10		
94	DF	0	Y	Y	Y	N	N	21	28	4	2.4	3	105	Y	125	uncertain	h	N	N	Y	N	4				possible burin
															126	scraper	b,s,h	N	Y	Y	N	18	10	40		
															127	scraper	s	N	Y	Y	Y	14	10	70		
															128	graver	b,s,h	N	Y	Y	N	6	30	30		
96	LF	0	Y	N	N	N	Y	21	15	6	1.7	na	na	N	129	scraper	b,s	N	Y	Y	N	27	30	70		
98	DF	20	Y	N	N	N	Y	26	15	7	2.4	na	na	N	130	uncertain		N	N	Y	N	13	50	70		
99	LF	5	Y	N	N	N	Y	25	15	8	2.4	na	na	N	131	uncertain	b,s	N	Y	Y	N	14	40	60		
															132	scraper	b,s	N	Y	Y	N	17	60	60		

Appendix 1 [continued].

100	DF	5	Y	N	N	Y	N	20	9	6	1	na	na	N	133	uncertain	b,s	N	Y	Y	N	11	15	70		
101	LF	40	Y	Y	Y	N	N	21	18	8	2.1	5	115	Y	134	uncertain	b	N	Y	Y	N	21	40	40		
102	DF	0	Y	Y	Y	Y	N	30	22	11	5.7	2	125	Y	135	scraper	h,s,f,b	N	Y	Y	N	30	70	70	Y	
103	LF	20	Y	Y	Y	Y	N	20	34	11	9.3	13	127	Y	136	scraper	b,s	N	N	Y	N	26	70	70		
104	DF	0	Y	Y	Y	Y	N	27	20	8	4.5	7	105	Y	137	scraper	b,f	N	Y	Y	N	32	20	70	Y	yielding material
105	LF	5	Y	Y	Y	N	N	35	37	12	15.7	4	120	Y	138	scraper	b,s	N	Y	Y	N	30	50	70	Y	M
															139	uncertain	—	N	Y	Y	N	4	40	40		M possible graver
106	LF	5	N	Y	Y	N	N	30	17	6	3.5	1	115	Y	140	scraper	b,h.s	N	Y	Y	N	20	80	80	Y	M
107	LF	0	N	N	N	N	Y	18	9	6	1.1	na	na	N	141	scraper	s,b	N	Y	Y	Y	12				possible resin
109	DF	20	Y	N	N	Y	N	35	29	11	9.1	na	na		142	scraper	b,s,c	N	Y	N	N	21	50	70		wedge
															143	scraper	b,s,c	N	N	N	N	51	40	40	Y	wedge
															144	graver	—	N	N	Y	N	6	30	70		
															145	graver	—	N	N	Y	N	8	50	70		
110	LF	0	Y	Y	Y	N	N	19	21	6	2.2	8	125	Y	146	uncertain	b	N	N	Y	N	8	40	50	Y	possible graver
112	LF	0	Y	Y	Y	N	N	32	30	8	8.6	4	100	Y	147	uncertain	b,s	N	N	Y	N	23	50	70		possible graver
114	LF	0	Y	Y	Y	N	N	24	24	5	2.2	4	105	Y	148	uncertain	b	N	N	Y	N	10	10	10		
															149	graver	b,s	N	Y	Y	N	12	20	70		
119	LF	0	N	N	N	N	Y	27	32	11	6.7	na	na	Y	150	scraper	f,s,h,c	N	N	Y	N	12	45	70		possible adze
122	LF	0	N	Y	Y	N	N	24	12	7	2.2	4	100	Y	151	drill	f,b	N	N	Y	N	4	30	30		
															152	scraper	f,h,s	N	N	Y	N	14	62	62		
123	LF	0	Y	N	N	N	Y	21	8	6	1	na	na	Y	153	uncertain	b	N	N	Y	N	2	20	60		possible graver
124	LF	0	N	N	N	N	Y	20	8	5	0.5	na	na	N	154	uncertain	b,s	N	N	Y	N	23	50	60		patina
125	LF	0	Y	N	N	N	Y	24	13	5	2	na	na	Y	155	uncertain	s	N	Y	Y	N	8	100	100		
															156	uncertain	s,b	N	Y	Y	N	12	80	80		
126	LF	5	Y	Y	Y	Y	N	26	15	5	2.3	6	110	Y	157	uncertain	b,c	N	Y	Y	N	8	20	40		
127	LF	0	Y	N	N	N	Y	15	11	4	0.7	na	na	N	158	scraper	f,h,b,s	N	Y	Y	N	12	72	72		
128	DF	40	Y	N	N	N	Y	40	32	16	15.5	na	na	Y	159	scraper	b,s,h	N	Y	Y	N	18	70	70		
															160	uncertain	b,s	N	Y	Y	N	8	70	70	Y	
129	LF	5	Y	N	N	N	Y	37	30	15	14.3	na	na	Y	161	graver	b,s	N	Y	Y	N	10	60	80	Y	
															162	graver	f,c	N	Y	Y	N	10	90	90	Y	
130	LF	0	Y	N	N	N	Y	55	52	18	44.2	na	na	Y	163	scraper	s,f,h,b	N	Y	Y	Y	114	60	60		red/yellow ochre
131	Q	60	N	N	N	N	Y	39	20	31	25.7	na	na	Y	164	graver	s	N	N	Y	N	9	55	70	Y	crushing
132	DF	5	Y	N	N	N	Y	37	25	15	12.8	na	na	Y	165	adze	s,c	Y	N	Y	N	101	70	80	Y	
133	DF	0	N	N	N	N	Y	25	13	4	1.4	na	na	N	166	uncertain	b	N	N	Y	N	8	10	10		
134	LF	0	Y	N	N	N	Y	38	23	12	11.3	na	na	Y	167	adze	s,c	N	N	Y	N	88	65	65	Y	patina
135	LF	0	Y	Y	Y	Y	N	20	33	5	3.3	3	115	Y	168	drill	h,s	N	Y	Y	N	6	10	60		crushing
136	DF	5	Y	Y	Y	N	N	23	42	27	34.3	20	120	Y	169	graver	s,b	N	Y	Y	N	8	50	70	Y	