

Shell and Bone Artefacts from the Emily Bay Settlement Site, Norfolk Island

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ABSTRACT. Amongst molluscan shell from the Emily Bay site were 40 specimens of fragmented bivalves, especially of *Gari livida*, which were examined for evidence of their use as artefacts. Experiments using modern specimens of the same taxa showed that it was impossible to define deliberate breakage sufficiently clearly to define shell tools on that criterion. Analysis of usewear by microscopic inspection of edges was the main discriminant adopted. In addition vegetable residues were identified on several edges. These means identified 19 pieces as tools, which had been used mainly for scraping soft materials. Two other tools were identified by morphology. A small assemblage of bone and marine ivory artefacts was also recovered from Emily Bay. Most were pieces of fishing gear.

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Shell artefacts

The shell artefacts referred to here are not of the formal kinds found throughout Oceania (Poulsen, 1970), but rather informal, flaked shell pieces. Fragments of worked shell appear in Pacific sites from early Lapita in the west (Spriggs, 1991; Kirch, 1987) to late sites in the east (Kirch, 1989), thus possessing a very wide geographic and temporal distribution. However, they have been considered to yield no information about cultural sequences and so little time has been devoted to their analysis. They have been described variously as worked shell, shell fragments, shell scrapers or shell knife fragments. Smith (1999: 284) notes that no

direct relationship between usewear and residues has been established for any of these artefacts. This paper attempts to address this issue by an examination of usewear and residues on the worked edges. No signs of deliberate modification or use were observed on any gastropod shell recovered from the site at Emily Bay. In contrast, all of the bivalve shell (40 pieces) was highly fragmented, often in ways which suggested deliberate human modification. In order to cast some light on the processes which might have been involved in shell modification at the site, experimental breakage was conducted with material from the same molluscan species, and the archaeological specimens were examined microscopically for edge wear and residues.

Shell breakage experiments. Breakage pattern experiments were carried out on modern specimens of the main bivalves in the Emily Bay assemblage, *Gari livida*, *Pinctada maculata* and *Maetra rufescens*. The experiments aimed to simulate the two main processes other than deliberate modification likely to have affected the shells. These are impact breaks and trampling. Impact breaks may have been caused either by meat extraction or shell discard processes, or by subsequent natural forces, such as storm damage. Secondly, there is the post-depositional effect of trampling over the site. Twenty bivalves were included in the breakage experiments (dropping shells onto a hard floor) and in experimental trampling. An additional five shells were snapped between thumb and forefinger to replicate deliberate breakage to form a clean working edge.

These experiments produced breakage patterns similar to those in the Emily Bay assemblage. Deliberate snapping between thumb and forefinger resulted in fracturing that could not be differentiated from that caused by discard throws (impact) or smashing to extract meat. Both snapping and impact forms of modification resulted in a segment retaining some portion of the original valve edge with a sharp internal edge (Fig. 1). Edges were very angular and sharp in *G. livida* and *M. rufescens* due to the tendency in these species for the material to split along cleavage planes in the shell structure. Without any further modification a very sharp working edge is thereby obtained. Previous shell flaking experiments (Cleghorn, 1977) had demonstrated that initial breakage of shell produced pieces that exhibited sharp

cutting edges needing no further modification, and that flake removals were unpredictable according to planes of weakness within the shell matrix. Both these findings were confirmed in our study.

Application of weight by crushing or trampling resulted either in shells with the valve intact but flakes removed along the margins, or a clean, lateral break separating the inferior and superior portions of the valve. These distinctive patterns are also illustrated in Fig. 1.

While these experiments produced all of the shell modification features apparent in the archaeological assemblage, it was not possible to distinguish clearly between the agencies in any particular case. Sharp working edges result from all agencies and it is not possible to demonstrate that deliberate breakage aimed at producing a working edge was responsible in most cases. Abrasion along edges is also not diagnostic as it might occur through the action of wind or water and sand. The only valves that can definitely be classed as tools are those that contain retouch and/or usewear other than slight abrasion along their margins. These experimental results conform with those found in earlier work (Spennemann, 1993: 80) on *Anadara* shell when the different strength of the shell structure for the species involved is taken into consideration.

Usewear analysis. Usewear on shell artefacts has been studied on a number of occasions (Attenbrow *et al.*, 1998; Barton and White, 1993; Cleghorn, 1977; Cooper, 1988; Fullagar, 1986; Fullagar *et al.*, 1992; Kamminga, 1982;

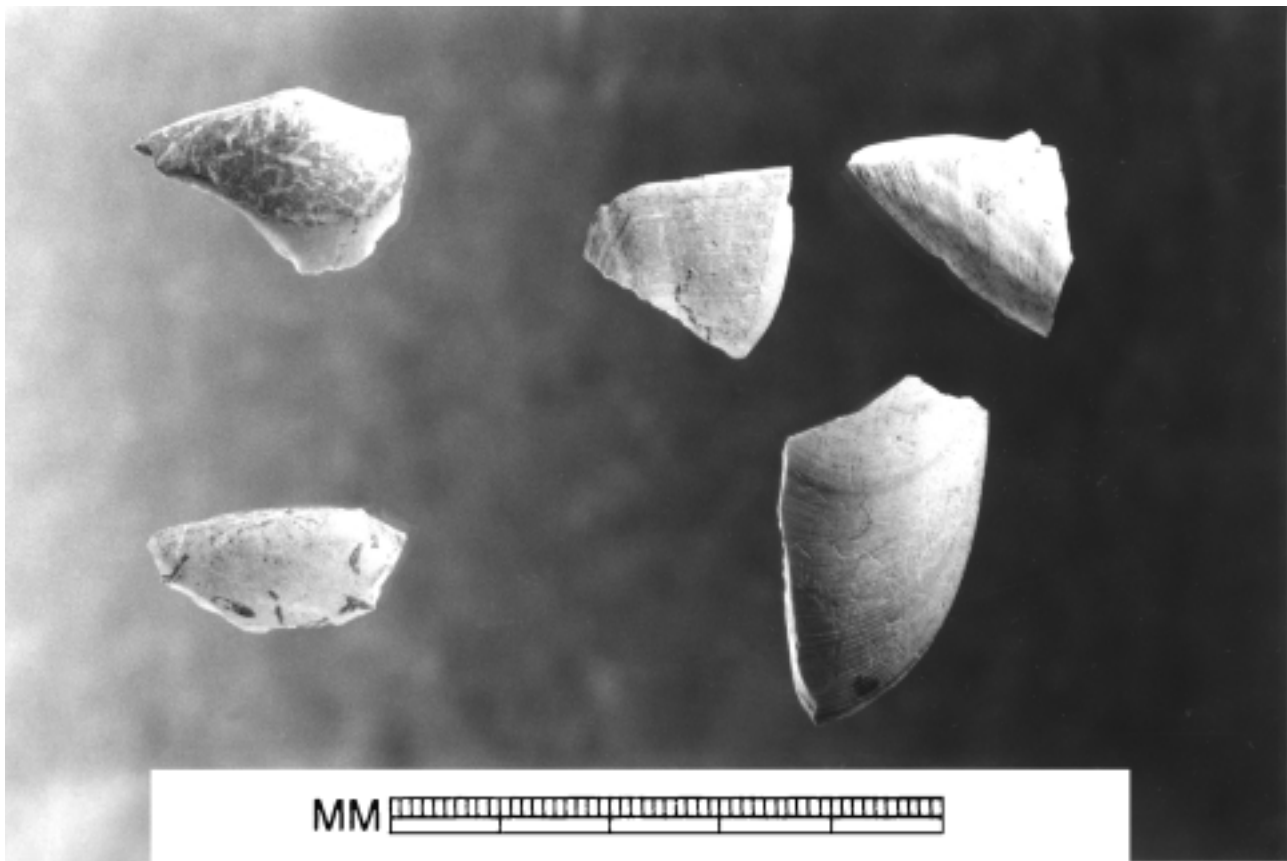


Figure 1. Shell breakage patterns. Examples (left) show typical damage from trampling in which the hinge remains intact and flakes are removed around much of the periphery. Examples (right) show typical snap patterns in which there are long, clean breaks and a portion of the valve edge remaining.

Spennemann, 1993; Toth and Woods, 1989). However, there has been relatively little systematic experimentation with shell and the interpretation of wear patterns can only be tentative until a more extensive range of studies is undertaken. In addition it is rare in archaeological reports for small, informal shell tool types to be recorded (Janetski, 1976; Lima *et al.*, 1986; Reiger, 1981; Schrire, 1982). In reports where these tools are pictured they appear similar to the modified shell pieces recovered from Norfolk Island (e.g., Lima *et al.*, 1986).

A search for both macroscopic and microscopic usewear was carried out on the shell artefacts from the Emily Bay site. Wear was defined as consisting of edge fracturing, striations and edge dulling or rounding, as defined by Kamminga (1982). These criteria were used to establish use, along with deliberate modification by flaking of an edge. Barton and White (1993) found that fractures on a shell matrix did not possess the clear characteristics of feather, snap and step fractures found on stone. A further complication results from the findings that edge rounding and striations have also been found to be the result of wave action (Spennemann, 1993; Claasen, 1998; Toth and Woods, 1989).

Analysis of the archaeological assemblage. All of the 40 pieces which appeared to have been artefacts were examined macroscopically and in magnifications up to about $\times 50$ using a Zeiss stereomicroscope. Since it is not possible to distinguish deliberate from natural processes in breakage,

the presence of usewear or retouch were required to class a specimen as a shell tool. Three artefacts had been formed by quite deliberate flaking and grinding irrespective of additional evidence of use. These atypical artefacts are pictured in Fig. 2.

Any artefacts that exhibited usewear traces were then examined at magnifications up to $\times 500$, using an Olympus metallographic microscope with vertical incident light. Sketches and observations of usewear were recorded for each shell. A combination of diagnostic use traces is necessary to distinguish usewear because of the impact of weathering on shell, which is more vulnerable than stone. Interpretations of shell artefacts as utilized tools have been classified into four levels of confidence dependent on the incidence of diagnostic traces and their combination with unstable thin edges which are prone to incidental damage:

- 0 possible use: shaping but no wear traces
- 1 possible use: rounding and scarring in combination with weathered or unstable edges
- 2 probable use: rounding and scarring
- 3 definite use: clear distinctive usewear

Following the usewear analysis, edges that showed use traces were examined for residue analysis. Survival of residues is uncommon in the archaeological assemblage. Films and fragments of unidentified plant tissue are present and starch grains were identified on two of the shell edges.

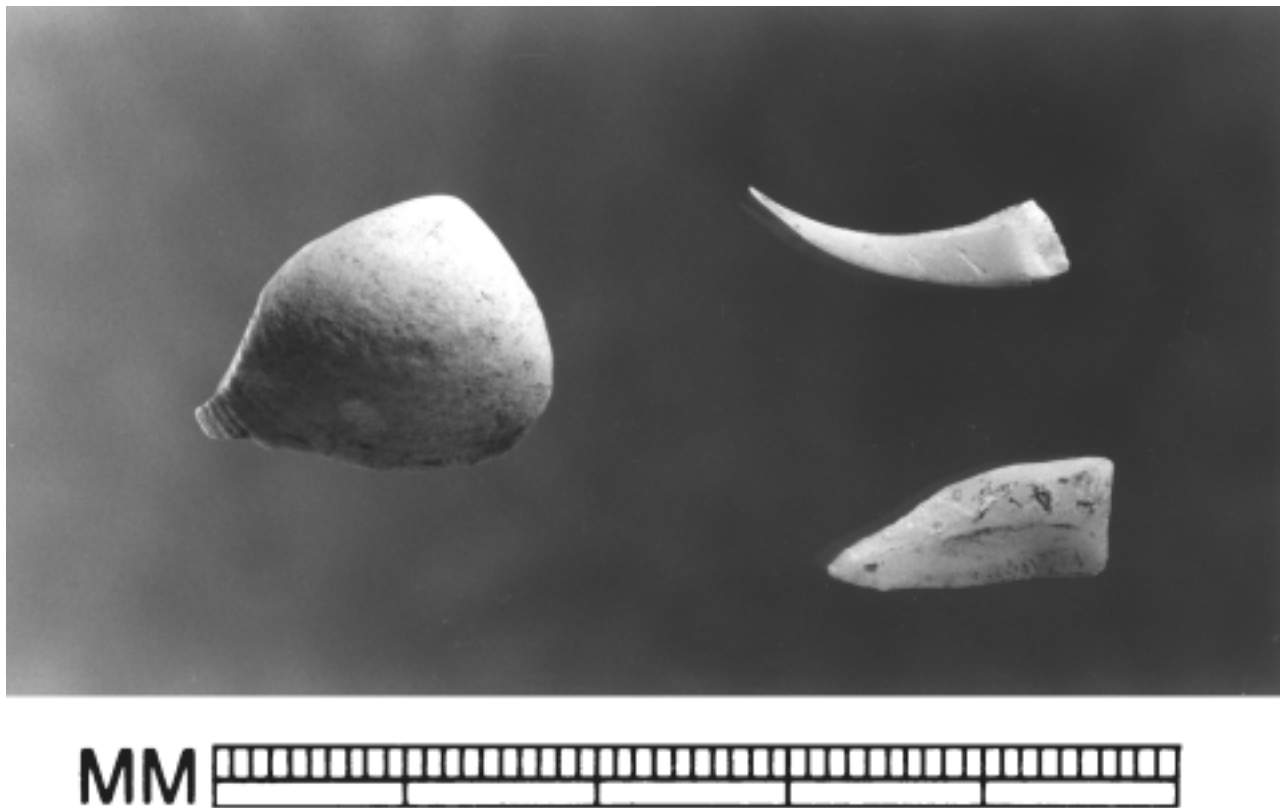


Figure 2. Atypical shell artefacts.

Table 1. Shell artefacts from Emily Bay settlement site.

Trench/Square/ Spit	species	use class	type of usewear and modification	weight (g)	length (mm)
EB96:10 A2/1	<i>G. livida</i>	1	All margins removed to get semi crescentic shape.	0.1	15.2
EB96:10 A2/2	<i>M. rufescens</i>	2	Slight rounding and denticulate edge on 7.3 mm length.	0.9	19.8
EB96:10 A2/2	<i>M. rufescens</i>	3	Section of usewear along lateral shell edge 13.4 mm length with scarring and rounding of edge.	2.2	31.6
EB96:10 A2/4	?	3	Section of usewear along lateral shell edge 24.5 mm length with striations and rounding of margins.	2.7	30.4
EB96:10 A3/1	<i>G. livida</i>	1	14.6 mm section of usewear on one edge consisting of bending fractures, striations and edge dulling (not yet rounding) 5.3 mm notch in process of formation as result of use.	0.6	17.7
EB96:10 A5/1	<i>G. livida</i>	2	18 mm section of usewear on right lateral edge consisting of fractures, striations and edge dulling on ventral face. Starch grains present.	1.1	30.9
EB96:10 A5/1	<i>G. livida</i>	1	One margin has section of usewear 16.7 mm long with striations, one step fracture and edge dulling on ventral face.	0.5	17.4
EB96:10 A5/1	<i>G. livida</i>	1	Striations and edge dulling on one margin 10.5 mm length on ventral face.	0.9	20.9
EB96:10 A6/1	<i>M. rufescens</i>	1	Section of usewear on left lateral margin consisting of three step fractures, striations and edge dulling for a length of 10 mm on dorsal face.	0.6	16.3
EB96:10 B5/1	<i>G. livida</i>	1	Denticulate edge on two sides of segment.	1.2	26.5
EB97:23 D9/6	<i>G. livida</i>	3	All sides show use fractures, striations and edge rounding on ventral face. Residues present consist of plant fibres, roots and starch grains.	2.6	30.7
EB97:23 D10/3	<i>G. livida</i>	2	On ventral face on left lateral margin are unifacial step fractures, striations and edge dulling along a 24.5 mm length.	2.0	29.3
EB97:23 D11/3	<i>G. livida</i>	1	Rounding and scarring on lateral margins.	0.7	22.8
EB97:23 D12/1	<i>G. livida</i>	1	Lateral edge has striations and edge rounding for a length of 21.9 mm on ventral face.	2.7	33.7
EB97:23 D13/4	<i>Anapella cycladea?</i>	0	Atypical. Umbo intact but all margins have been shaped (probably by flaking and then smoothing) to form a sharp protrusion.	1.1	17.9
EB97:23 E12/3	<i>G. livida</i>	2	Right lateral margin has bifacial striations and the left lateral margin has five step fractures from use on the ventral face.	1.03	25.5
EB97:23 E12/3	<i>G. livida</i>	0	Atypical. Segment with no valve edge shatter removals leaving central triangular tab section. Smoothing and shaping have occurred on all margins to form pointed shape. Then segment has been snapped. Suggest distal point of larger artefact.	0.2	14.7
EB97:23 F13/3	<i>G. livida</i>	2	Segment with no valve edge remaining with three shatter removals leaving central triangular tab section. Outer edges have been smoothed and three flakes removed on butt. Usewear is evident on right lateral margin with step fractures and edge rounding. A notch 6.14 mm wide is forming from use on this margin.	1.1	26.7
EB97:24 A5/2	<i>G. livida</i>	1	Rounding on one margin on ventral face.	0.4	14.4
EB97:23 G8/3	<i>G. livida</i>	1	Rounding.	0.5	22.0
EB97:24 B3/1	<i>G. livida</i>	1	Rounding.	0.4	23.0

Results and discussion. Of the 40 shell pieces, 19 exhibited signs of usewear. The results of the usewear study along with residue results, are listed in Table 1. Two other artefacts shaped by deliberate flaking and grinding were highly weathered making identification of use impossible; in Table 1 they have been classed as exhibiting no usewear traces (Use class 0), but due to their unnatural shape remain classed as artefactual.

The patterns of usewear observed would be produced mainly by scraping (Fullagar, 1986; Kamminga, 1982). In the modification of the valves, the dorsal or ventral edge of one lateral margin on the inferior portion of the valve appeared to be the preferred working edge with the umbo or hinge area of the valve being completely removed with two or more breaks leaving a segment with a sharp working edge for use. All the artefacts result from the opportunistic use of fractured material and, as discussed previously, this material could have been deliberately fractured, or removed from a midden where it had been fractured by natural processes such as trampling or midden deflation. Due to the shell microstructure of *Gari livida*, the most common species for artefact construction, fracturing occurs along

horizontal planes of weakness within the shell matrix, resulting in sharp working edges with acute edge angles that need no further modification. This species seems to have been deliberately sought as a raw material, possibly for that reason. These artefacts are pictured in Fig. 3.

Small, opportunistically-made shell artefacts are seldom reported in the archaeological literature (apart from their presence), so the study of this artefact class is limited. Lima *et al.* (1986) found that the majority of artefacts at Ilha de Santana were broken valves with sharp edges. They found by experiment that these artefacts were highly efficient for scaling fish, but no usewear or residue studies were carried out on the archaeological assemblage. Fish scaling is a possibility for the Norfolk Island assemblage as the small size of the artefacts and the light degree of fracturing on their margins indicates that no hard materials were worked with them. Reiger (1981) describes shell artefacts from South Florida which also functioned as cutting and scraping implements. As stated previously these artefacts are commonly reported for the Pacific (Best, 1984; Kirch, 1987, 1989, 1993; Poulsen, 1967; Smith, 1999) where they are usually ascribed to food preparation. The working of tubers



Figure 3. Typical shell artefacts, shown in dorsal view.

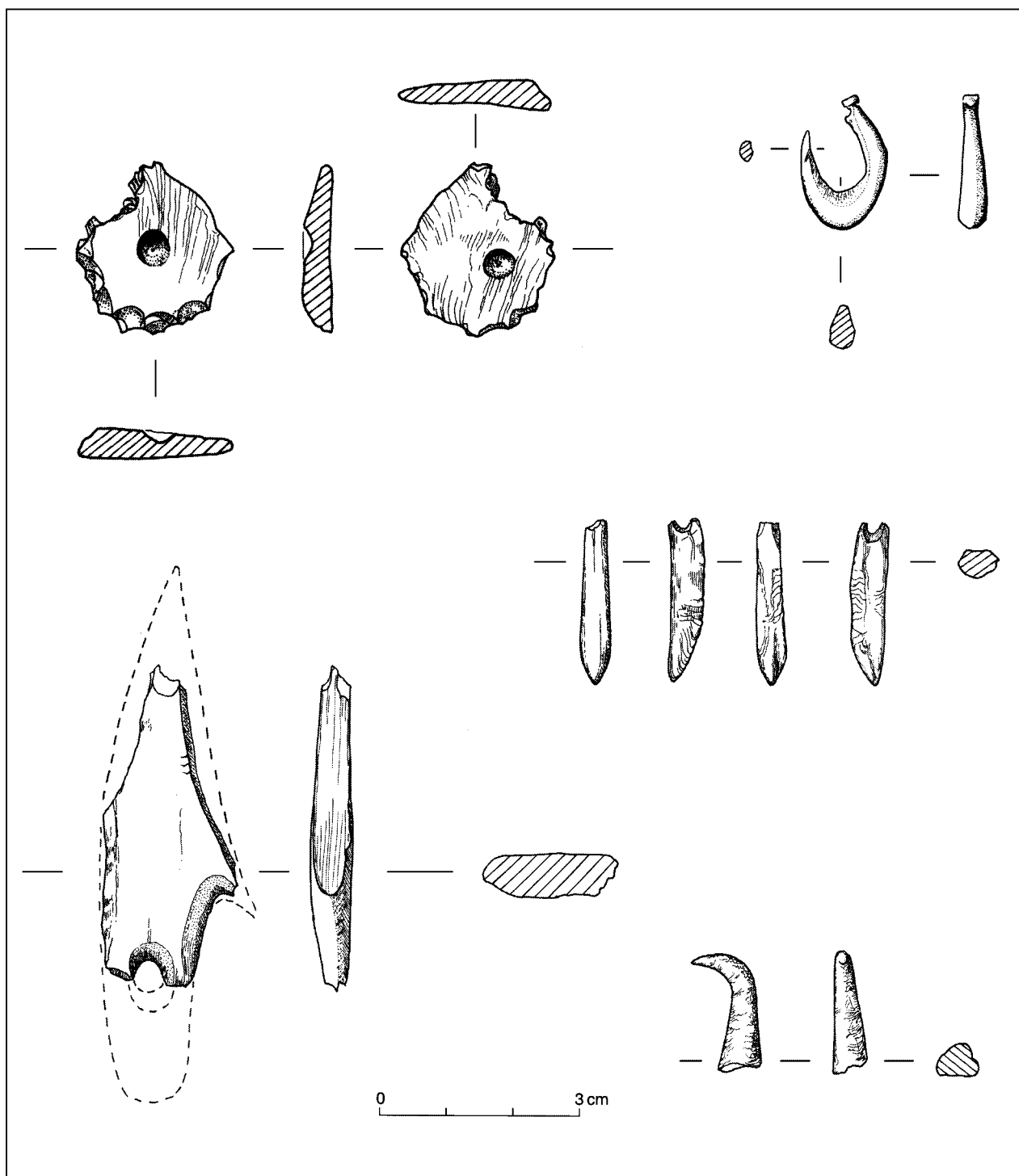


Figure 4. The bone artefacts from Norfolk Island (clockwise from top left): the fishhook tab, the ivory rotating hook, the drilled awl or pendant, the broken hook point, the broken harpoon.

or other soft vegetable products is another possibility for the Emily Bay assemblage and the presence of starch residues on two of the working edges of artefacts lends support to this suggestion. Unfortunately, it was not possible to identify the starch grains to a particular taxon.

The 19 shell pieces which exhibited use traces were found in Trenches EB96:10, EB97:23 and EB97:24. The majority of the artefacts were located in EB96:10, especially in the uppermost spit (Table 2), where they appear to be associated

mainly with the oven feature in Squares A5-A6-B5 and the rubbish pit feature in Square A2. In EB97:23 shell artefacts were located mainly in the central part of the excavation, where deeper cultural stratigraphy suggests high levels of discard. The general distribution of shell tools near ovens and rubbish dumps suggests discard after use. The relatively high concentration in EB96:10 might represent a particular activity area in the site.

Table 2. Shell tool distribution in Emily Bay settlement site.

spit	trench		total	percent
	EB96:10	EB97:23		
1	7	1	9	42.9
2	2	—	3	14.3
3	—	6	6	28.6
4	1	1	2	9.6
5	—	—	—	—
6	—	1	1	4.8
total	10	9	21	
percent	47.6	42.9	9.5	

Bone and ivory artefacts

Four of the five bone artefacts recovered from the Norfolk Island excavation are components of a typical Polynesian fishing kit. These are, a complete one piece fishhook in marine ivory, a partially worked fishhook tab, a broken hook point, and a harpoon point. The fifth bone artefact is a bone awl or pendant. Artefacts are shown in Fig. 4.

The complete one piece fishhook from Trench EB97:23 (C13 Spit 1) has been made from marine ivory, exhibiting enamel traces on the outer surface of both point and shank. It is therefore from a tooth smaller than any in a large whale, such as Sperm whale, and resembles in form and size the two seal ivory fish hooks recovered from Sandy Bay, in the Auckland Islands (Anderson and O'Regan, 1999). The most probable source of the material is a tooth from the elephant seal skull found, fragmented, in EB97:24.

The hook is a Type D one-piece hook in the New Zealand classification of Hjarno (1967; see also Anderson and Gumbley, 1996), with a sub-circular form, incurving tip and typical knobbed head. Such hooks have a rotating action and are typical of bait fishing in relatively deep water (Reinman, 1970; Allen, 1996). However the point incurve is relatively slight and the hook would not fit into the rotating class in the Sinoto (1991) classification of Hawaiian hooks, in which the line of point curvature intersects the shank. Measurements of the shank length (18.5 mm), and point length (15.4 mm), both taken at right angles to the base, and the width (13.0 mm) taken from the outer edge of the shank to the outer edge of the point parallel to the base at the widest part of the hook, also show that it falls outside the rotating hook ratios for Marquesas and Societies assemblages, established by Sinoto (1967: 354). It is more typical of Cook Islands and New Zealand forms.

The bone fishhook tab from Trench EB96:11 (Square A2 Spit 2) shows drilling around the perimeter, by which the tab was cut from a larger piece of bone, and an initial drill hole in the centre. Had the process continued, the centre would have been drilled out and a single, probably sub-circular hook, then formed by filing. This is a very typical style of hook manufacture in East Polynesian sites, especially in New Zealand. The bone has not been positively identified, but it may be from the elephant seal remains.

The point from Trench EB97:24 (Square Y1 Spit 2) is difficult to interpret definitively. It could be either the incurved tip of a point leg from a large one-piece or

compound bait hook, or a trolling lure point similar to those in barracouta lures (Anderson, 1981). The latter seems less likely from the expansion of the basal part of the point. This is more probably indicative of a bait hook, suggesting that some large hooks had also been used at Norfolk Island.

The bone harpoon point from EB96:11 (Square A1 Spit 2), is almost complete from the distal point to midway through the eye through which a line would have been attached. The artefact has a well formed barb and measures 19.3 mm across at that point. It is 45.5 mm in length. The harpoon point is constructed from turtle bone. It is a toggling form, intended to rotate once it had struck fast and detached from the shaft. Toggling harpoons are typical items of early East Polynesian material culture (Sinoto, 1970: 116–117).

There is a bone awl, or possibly a pendant, from EB97:24 (Square Y1 Spit 1). It is broken through the eye-hole. Bone awls are a common East Polynesian artefact type. The material has not been identified, but appears to be mammalian.

Conclusions

From the Emily Bay site on Norfolk Island a small assemblage of shell and bone artefacts was recovered. Shell tools were defined here by the presence of usewear traces, rather than the morphology of the shell pieces alone, as experiments suggested that sharp shell pieces suitable as tools could be created accidentally as well as deliberately. Of 40 shell pieces that might have been tools, 19 were confirmed by usewear and two were suggested by shape. The usewear suggests mainly scraping, but of what is difficult to tell. Fish scaling and vegetable scraping are possibilities, the latter function also suggested by starch residues left on the working edges of two pieces. The relative prominence of flaked shell tools at Emily Bay may reflect the scarcity of other materials needed to carry a sharp edge, such as quartz, chert or obsidian, none of which occur locally. There are basalt flake and blade tools, but shell was evidently preferred for some tasks.

The bone artefacts include a marine ivory one-piece fish hook, possibly made from an elephant seal tooth, a turtle bone harpoon point and several other pieces, including a fish hook tab. The assemblage is typical of early East Polynesian material and particularly reminiscent of items found in New Zealand.

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