Cross-cultural interaction on Wuvulu Island, Papua New Guinea: the perspective from use-wear and residue analyses of turtle bone artifacts

Nina Kononenko\textsuperscript{a,b,}\textsuperscript{*}, Robin Torrence\textsuperscript{a,b}, Huw Barton\textsuperscript{c}, Ariane Hennell\textsuperscript{a}

\textsuperscript{a} SOPHI, University of Sydney, A14, Sydney, NSW 2006, Australia
\textsuperscript{b} Australian Museum, 6 College Street, Sydney, NSW 2010, Australia
\textsuperscript{c} School of Archaeology and Ancient History, University of Leicester, University Road, Leicester LE1 7RH, UK

\textbf{A R T I C L E  I N F O}

Article history:
Received 6 November 2009
Received in revised form 27 June 2010
Accepted 1 July 2010

Keywords:
Cross-cultural contact
Ethnographic museum collections
Use-wear
Residue analysis
Bone tools
Papua new Guinea
Hand-held microscope

\textbf{A B S T R A C T}

Recent studies have emphasized the importance of Indigenous producers and traders in the formation of ethnographic museum collections, but have found difficulty in finding concrete evidence for their active roles. A use-wear and residue study of turtle bone cleavers from Wuvulu Island, Papua New Guinea provides the opportunity to test whether objects that comprise a significant component of early collections were made specifically for sale, as hypothesized by contemporary observers in the late 19th century. Comparative studies of used and unused turtle bone artifacts from the Caroline Islands and Papua New Guinea identified differences between wear traces resulting from manufacture and use. Analyses of the Wuvulu turtle bone cleavers showed they had been heavily used prior to sale. Rather than produce artifacts to meet the high demand from German traders, the local people sold old, worn-out objects, many of which had been repaired. The study demonstrates that archaeological approaches to ethnographic museum collections can trace Indigenous agency within cross-cultural interaction. It also showcases the potential of use-wear and residue analytical techniques for the analysis of bone tools and the utility of digital, hand-held microscopes for the analysis of large artifacts.

\textsuperscript{*} Corresponding author at: SOPHI, University of Sydney, A14, Sydney, NSW 2006, Australia. Tel.: +61 2 93206332.
E-mail address: nina.kononenko@sydney.edu.au (N. Kononenko).

1. Introduction

Recent post-colonial historical scholarship has demonstrated the active role that Indigenous societies played in the creation of colonial societies (e.g. Poddar and Johnson, 2005). Having recognized that ethnographic museums are largely the product of colonial activities, research has begun to explore how the collections themselves can inform on the processes that framed cross-cultural negotiations involving objects (e.g. Thomas, 1991; Gosden and Knowles, 2001). Since the actual voices of the Indigenous actors are poorly represented in the historical record, many studies have emphasized the impacts of the collectors on museum collections (e.g. Dobres and Robb, 2000; Cochrane and Quanchi, 2007).

Archaeology has a potentially important role to play in correcting this imbalance in research on colonialism. The discipline's success with studying large-scale processes, material culture (which Gosden (2004) has argued persuasively is fundamental to colonialism), and the agency of people who produced objects and offered them for exchange (e.g. Dobres and Robb, 2000) should place it at the forefront of research on the role of Indigenous people in shaping museum collections. For example, Torrence (2000) showed that chronological changes in the size, decoration, standardization, and manufacturing methods of obsidian-tipped spears and daggers now housed in ethnographic museums reflect the active engagement of Admiralty Islanders in trading relations with Westerners throughout the past c. 150 years. Our case study of cross-cultural negotiation on Wuvulu Island, Papua New Guinea, beginning in the late 19th century, introduces new archaeological methods for reconstructing the role of Indigenous agency within early colonial settings. An investigation of use-wear traces, a technique most frequently applied to ancient stone tools, is used to evaluate whether turtle bone artifacts were specifically made for sale to Westerners. The paper also expands residue studies from stone to bone tools. A supplementary aim is to assess the utility of digital, low-power, hand-held microscopes for use-wear studies of large, bulky objects.

2. Indigenous agency on Wuvulu

The study examines turtle bone cleavers derived from Wuvulu Island (formerly Matty or Maty Island), a coral atoll located 150 km north of the New Guinea mainland (Fig. 1). During the late 1890s,
Wuvulu and neighboring Aua (formerly Durour) islands were the scene of a virtual collecting frenzy by German traders. Initially, objects collected on Wuvulu as part of a trip to search for plantation labourers were sent to the Berlin Museum following an agreement with the German New Guinea Company. The ethnology curator, Felix von Luschan, was fascinated because he noticed that the particular forms and styles of the Wuvulu objects, particularly turtle bone ‘clubs’ with multiple sharks’ teeth insets, were very similar to those from the Micronesian islands to the north rather than those of their closest neighbors in New Guinea. He therefore suspected the material culture might reflect a history of migration in the region. To stimulate research into the inhabitants of the island, he wrote an article with illustrations of key objects (von Luschan, 1895) and sent copies to representatives of several German trading companies operating in New Guinea. Although mainly focused on natural resources such as coconuts, which they struggled to get New Guinea islanders to supply in adequate quantities, this list of supposedly desired goods sent the traders scrambling to obtain objects they assumed would fetch good prices back in Europe (Buschmann, 2009: 41–43). When the trader and amateur ethnographer Parkinson visited the island in 1899, he was met by 110 canoes with 600 people eager to exchange local items for Western glass beads and metal tools. Both Parkinson (1999 [1907]: 184–185) and, more recently, Buschmann (2009: 123–124) have hypothesized that many of the artifacts collected in this period were specially made by the islanders to take advantage of this new market opportunity. In only a few years German museums, and eventually the general curios market, were flooded with turtle bone cleavers, wooden bowls, clubs, and spears from Wuvulu. Consequently, these are common objects in British auction catalogues of that period and are currently found in abundance in major ethnographic museums around the world (Hennell, 2009).

These Wuvulu artifacts, now largely hidden away in museums and ignored by ethnography, comprise an important source of data about how an Indigenous group responded to contact with Western commercialism, because they represent the concrete, material consequences of cross-cultural interaction. Von Luschan decried the activities of the greedy traders, stating that they had ‘deprived the poor people of thousands of artifacts... enough to supply all the museums of the world’ (Buschmann, 2009: 44). This view of Westerners stripping helpless Indigenous communities of all their valuable goods is widely shared in popular imagination, but only represents one side of the interaction (e.g. Thomas, 1991; Meleisea and Schoeffel, 1997: 140–143; Torrence, 2000: 107–110). Viewed hypothetically from the perspective of active Indigenous agents, however, the new markets offered great potential for profits as well as access to metal tools and other non-utilitarian goods that played an important role in local social spheres.

An archaeological analysis of the Wuvulu assemblages in museums can help monitor local reactions to turn of the century German trading opportunities. One way to access how the Wuvulu Islanders actually responded to contact with the outside world is to test the hypothesis posed by Parkinson and Buschmann that the goods offered were made specifically for trade. Two approaches are useful. Firstly, one can follow Torrence’s (2000) study of changes in standardization and simplification of objects through time; however, this approach requires large sample sizes and good chronological control. A second method is to use the presence/absence of microscopic wear traces and residues to assess whether the traded objects had been used prior to exchange. As part of a larger study of Wuvulu museum and auction catalogue assemblages, in this paper we focus on one widely traded type of object: turtle bone cleavers.

3. Turtle bone artifacts

The case study examined 11 objects from Wuvulu now housed in the Australian Museum and variously known as turtle bone cleavers or spatulas (Fig. 2, Table 1). Details about their history are poor, but they were mainly obtained from Australian dealers or collectors around the turn of the 20th century, approximately contemporary with the early German traders. Ten have wooden handles with a stepped groove into which a pleural (expanded rib) of a large sea turtle, cut to create a tang on one side, was carefully slotted to secure the blade: one blade is an unidentified hardwood similar to the species used in the hafts. In 8 examples, an iron nail was added to reduce the mobility of the blade. The cleavers were called vigo on Wuvulu and tawe, tigo and vigo on Aua (Hambruch, 1908: 60). Parkinson (1999 [1907]: 188) states that the tools were used to divide up a mass of pulped breadfruit (Artocarpus altillis) or swamp taro (Cyrtosperma merkusii) as part of food preparation. Oral history collected by Kristian Lagercrantz (personal communication) records they were used in the garden to cut the tops off swamp taro tubers, ensuring that all the waste was left behind as mulch. A cutting action seems the most likely since the blade is hafted parallel to the shaft, as for an axe.

Since Pacific sea turtles are currently protected under international legislation, it is not possible to conduct the experimental studies that are fundamental to the interpretation of ancient microscopic wear traces, especially on a type of material rarely studied previously. Following Frazier’s (2005: 370) suggestion, a comparative study of two similar types of turtle bone artifacts from ethnographic collections provided useful models. The first object from the Australian Museum comes from the Caroline Islands (Fig. 2E and F). Based on the hafting arrangement, at a right angle to the shaft, and the very obvious macroscopic edge damage, as well as similarity to published examples (e.g. Frazier, 2005: 370–371), it is assumed to have been used as a hoe. The second example (Fig. 3) was collected in the 1960s by an Australian naval officer (Meredith Hincliffe, personal communication). Due to significant changes in form and a major decrease in the size of the shaft from those made in the 19th century (cf. Hambruch, 1908: pl. 30), it is assumed to have been made for sale. The tool is quite important because the deliberate pointing and sharpening of the blades would have created obvious traces of manufacture that provide a useful contrast to the use damage sustained on the hoe.

4. Use-wear and residue methods

Frazier (2005: 370) notes that it could be difficult to identify deliberate human modification and use-wear on turtle bone, but his review was limited to macroscopic traces. Microscopic use-
wear analysis of bone artifacts has proved to be an excellent
method for distinguishing diagnostic traces of manufacture and
use (e.g. Barton et al., 2009). Following established methods for
stone artifacts (Fullagar, 2006), an integrated use-wear/residue
study was conducted using a combination of low and high power
microscopic analysis of the turtle bone artifacts and extracted
residues. The first stage was an assessment of edge damage using
magnification in the range of ×20 to ×100 provided by a Dino-
Lite™ (AM413ZT) digital, hand-held microscope mounted on
a rack (Dino-Lite™ MS35B) with multiple brackets that enable
wide scale movement and easy access. This approach was neces-
sary because these large, bulky artifacts are extremely difficult to
maneuver into a stable position on the stage of a conventional
microscope (Fig. 4). Secondly, an Olympus BX60M microscope
fitted with both vertical, incident and transmitted light sources
was used for magnifications ranging from ×100 to ×1000. An
extensive photographic record was made of all forms of surface
modification and residues in situ on the artifacts. Subsequently,
some starchy material was diluted in ultrapure water and trans-
ferred by pipette to glass slides for more detailed examination.

Fig. 2. Turtle bone cleavers from Wuvulu Island: (A) E24564, dorsal side; (B) E24564, ventral side; (C) E28623, dorsal side; (D) E28623, ventral side. Turtle bone hoe from the
Caroline Islands E28227: (E) dorsal side; (F) ventral side. The circles indicate location of close-up images in Figs. 4 and 6–10 (photos by Nina Kononenko).
5. Results

5.1. Standardization

The small size of our sample limits what can be said about the standardization, simplification and decrease in size typical in curios made for sale to Westerners (Torrence, 2000), but a few general observations based on the data in Table 1 are relevant. Artifact E73450 is the only object that fits Graburn's (1976: 15) predictions that tourist art must be understandable, portable and dustable and May’s (1977: 4) observation that small size is preferred. This cleaver has a very small handle made from a different and less dense type of wood than the others and the turtle bone, as evidenced by its width, is also much smaller. Unfortunately, use-wear analysis is not applicable since the blade has been broken.

The remaining tools are certainly large and sturdy enough to have been functional. In addition, the handles and the blades are not standardized and therefore do not fit the prediction for production of trade (Table 1). The large variation in size is more similar to what one might expect from a group of tools made and used by a range of individuals. There may, however, be two ‘types’ among the sample. Group I (E24564, E28623, E28624, E49697, E57281, E73451) has larger hafts and uses turtle bones that are broader and thicker than Group II (E24563, E32851, E73451), although a larger sample might fill in the complete range. In contrast, the lengths of the blades are highly variable and there is no clear association between blade length and the two groups. The wide range in the size of turtle bone cleavers in the Australian Museum collection is also reflected in artifacts illustrated in the historic auction catalogues (e.g. Webster, 1901: 12). In summary, then, the size data do not support the hypothesis that the turtle bone cleavers were made especially for sale in response to the ‘resource boom’ stimulated by the German traders.

5.2. Manufacture

The results of the use-wear/residue study summarized in Table 1 demonstrate that the turtle bone cleavers were heavily used before their sale to Westerners. The major forms of surface

![Fig. 3. Hafted turtle bone spear from Wuvulu Island produced for sale in the 1960s: (A) dorsal side; (B) ventral side. The circles indicate locations of images in Fig. 5 (photos by Nina Kononenko).](image)
alteration observed under low and high power magnification included (1) different intensities of edge damage; (2) striations that varied in terms of their direction, width and depth; and (3) polishes of varying intensity (cf. Semenov, 1964). Before use could be positively identified, it was important to discern which of the microscopic traces were directly related to manufacture of the blades. For this task, the study of the 1960s tool was important because it illustrates the kinds of striations associated with cutting and abrasion during intentional modification of the turtle bone during manufacture.

As shown in Fig. 5A, the first stage of manufacture was the preparation of the working edge angle by making a diagonal cut down from the ventral side across the bone. This action transects the outer smoother side of the bone to reveal the porous, coarse inner surface at the distal cut end of the bone. Next, this surface was roughly abraded, as indicated by characteristic striations that are deep, have a consistent profile, and are arranged in a set of very closely spaced, parallel lines that extend from the edge up over the cut surface (Fig. 5A). To finish off, the edge was sharpened with fine abrasives that left behind a dense group of short, parallel striations oriented diagonally to the working edge, and that overlay the deeper and longer, rough abrasions. These lie within a well-defined strip parallel to the edge. Typically the rough and fine abrasions are oriented at slightly different angles to each other (Fig. 5B).

contrast, as seen in Fig. 5C, the smoother dorsal side required only finer abrasion for sharpening the edges and the tips. Using insights gained from the nature and position of striations on the 1960s turtle bone artifact, four slightly different stages of manufacture could be reconstructed for the Australian Museum’s Wuvulu turtle bone cleavers.

1. A cutting edge with a V-shaped profile at an angle of c. 30–45° was formed at one end of the bone by cutting, slicing, or chopping down from the ventral side (e.g. Fig. 2B and D).
2. The rough, inner surface of the distal end of the ventral side was smoothed, probably with course-grained abrasives (see dense pattern of deep striations in Figs. 6A and 8A), while at the

Fig. 4. Microscopes: (A) hand-held Dino-Lite™ microscope mounted on stand enables easy access to large artifacts (E28227); (B) despite creative techniques as shown here, it is not always possible to obtain an adequate view of large artifacts using a typical high power microscope, such as this Olympus BX60M (photos by Robin Torrence).

Fig. 5. Close-ups of hafted turtle bone spear from Wuvulu Island produced for sale in the 1960s: (A) dorsal side (see Fig. 3A) with manufacturing traces by abrasion (> 50); (B) ventral side (see Fig. 3B) with manufacturing traces by abrasion (> 50); (C) dorsal side (see Fig. 3A) showing abrasion under high magnification (> 100) (photos by Nina Kononenko).
same time the cutting edge was roughly sharpened by rubbing
in a parallel (Fig. 8A) or slightly diagonal direction (from left to
right or opposite) as shown in Fig. 6A.

3. Further sharpening using finer abrasives applied in the
opposing direction to stage 2 was applied to the ventral edge
(Fig. 6A).

4. Finally, to increase the sharpness of the edge, the dorsal side of
the tool was roughly abraded, as shown by a narrow region of
the inner surface of the bone located close to the tool edge and
the presence of long, deep striations that are parallel or slightly
offset to the edge (Figs. 2A, C and 7A).

5.3. Use-wear

The Caroline Islands hoe (Fig. 2E and F) illustrates the types of
wear expected for a tool used in contact with a relatively loose, but
course and abrasive substance, like soil. To begin with, striations
preserved under the polishes show that the hoe was made in
a similar way to the cleavers, but that the fourth stage (abrasion)
had been omitted. In terms of use-wear, both sides bear intensive
damage, including a number of shallow, small (2.0 × 0.5 mm)
and medium (6.0 × 1.0 mm) scars whose edges and contours have
subsequently been intensively rounded through use (Figs. 9A and
10A). Both sides of the surface are characterized by a very bright,
well-developed polish with a leveled or flattened surface
9A and B and 10B). Numerous and densely packed striations
oriented perpendicular to the edge are present on both sides of the
tool. The polish, together with a dense net of long, deep, thin
striations oriented perpendicular to the edge that stretches up to
about 70 mm from the edge, are especially prevalent on the dorsal
side of the tool (Fig. 9A). The distribution of the wear traces
indicate that during the thrusting action into the soil, the dorsal
side experienced more intensive contact than the ventral side, as
would be expected from use as a hoe.

Edge damage, striations and polish from use on all the 9
complete turtle bone cleavers demonstrate that all except one were
also intensively used (Table 1), but differences in the nature and
distribution of striations and polish indicate that the cleavers had
a different function from the Caroline Islands hoe. The nature of the
scars, striations and polish indicate that the tools were used for
cutting/slicing/chopping relatively soft plant materials, such as
starchy tubers or fruits, a use consistent with the ethnographic data
summarized previously. Unlike the hoe edge, damage on the
cleavers is light to moderate, as illustrated by the numerous
microscars (<1.0 × 1.0 mm) and only rare small to medium-sized
scars (Figs. 6A and 8A). Extensive edge rounding (Figs. 6B and 8B)
occur together with well-developed, smoothed polish, but both
are not as leveled or flattened as on the hoe. Striations created
during use are numerous and wide ranging in character. They have variable depths and widths and, although all are oriented diagonally to the working edge, several directions occur that sometimes cross each other (Figs. 6B, 7B and 8B). In contrast to the hoe, the wear attributes are spread more widely on the ventral side of the cleaver, demonstrating that it experienced more intensive resistance from material processed than the dorsal side of the tool, a pattern consistent with a cutting tool.

Although the character of the striations and polishes varies slightly, the wear patterns on the wooden blade (E73451) derived from the same behaviors as for the turtle bone artifacts (Table 1). Scars on the edge of the tool have a slightly different appearance due to the structure of the wood: the edges are irregular and the profiles stepped. Secondly, the striations tend to be quite long, deeper and have a rougher character. Thirdly, the intensive polish has a domed character: i.e. it sits on top of the surface. Finally, although it was intensively used, there is no evidence for re-sharpening of this tool, perhaps suggesting the advantage of turtle bone over wood as a raw material.

From the pattern and layering of striations, it is clear that all but one of the cleavers had multiple episodes of use, re-sharpening and then re-use. For example a pattern of coarse grain striations running parallel to the edge that formed during initial manufacture of the tool can be observed in Fig. 8A. These are overlain by several series of additional groups of striations that relate to multiple episodes of use and re-sharpening. Sharpening created striations that are generally thinner and consistently parallel to each other and in this case are perpendicular to the edge (as opposed to Fig. 10A where they are diagonal). The edges of these striations have been rounded and smoothed by the subsequent use of the tool. In contrast, striations formed during the last use of the tool are fresher, deeper, more irregular in size and shape, and have a patchy distribution.

5.4. Residues

Concentrations of starchy plant residues, including starch granules, raphides, cellulose and other tissues, were abundant on the hoe and all the cleavers (e.g., Fig. 11). Unlike on the hoe, where they might be derived from soil adhering to the artifact, the residues on the cleavers were clearly associated with use. The starchy residues were frequently found in immediate proximity to the working edge and were embedded and concentrated within natural pits in the irregular surface on the ventral side (e.g., Fig. 11).
middle), so they are also unlikely to have resulted from contamination from subsequent handling, packaging or storage by the collectors, traders, auctioneers, etc. who later transported and sold them to the Australian Museum.

Preliminary comparison of the starch granules on the tools with modern reference material shows they are more similar to modern reference material of swamp taro (*C. merkusii*) than breadfruit (*A. altilis*). The maximum dimension of 28 starch granules derived from three water extractions from artefacts E24564 and E28623 range in size from 8 to 19 μm with a mean of 11.5 (SD = 2.4). They are hemispherical with one to three large concave facets. Granules within the *C. merkusii* reference material (*N* = 50) have a mean size of 11.4 μm (SD = 2.3) and a range of 2.3 to 16.4 μm. They are also generally hemispherical in shape and usually have several large concave facets that form in the plant cell, producing clustered semi-compound granules of three to four grains; these normally break apart during sample preparation. The starch granules within the flesh of *A. altilis*, breadfruit, are broadly similar in form to *Cyrtosperma* although the reference material is smaller (*N* = 50) with a mean size of 6.9 μm (SD = 1.6) and a range of 3.3 to 10.2 μm. The granules are also hemispherical in form, but display greater faceting, resulting in larger numbers of polygonal and semi-polygonal forms (Fig. 11).

Turning to the new methodology employed in this study, the digital portable microscope greatly facilitated access to the large surface areas of these irregularly shaped tools, especially because the lens can be easily moved to new positions, rather than having to manipulate the object itself as with a conventional microscope (Fig. 4). With the microscope mounted on a stand, a wide range of magnifications (in our case ×10 – ×100) and lighting conditions can be obtained relatively easily. The especially large field of view at low magnification greatly facilitates study of manufacturing traces, such as the chopping/cutting actions to create the edge and various degrees of abrasion. On turtle bone, edge rounding and scarring, deep striations, and well-developed polish are all clearly visible under the low magnification of the portable microscope (Figs. 6A, 7A, 8A, 9A and 10A). In contrast, the texture, distribution and specific characteristics of polish require higher magnifications (Figs. 6B, 7B, 8B, 9B and 10B). The analysis of striations to differentiate use actions from different episodes of re-sharpening cannot be successfully achieved with low magnification alone (cf. Figs. 7A, B, 8A and 7b).

6. Discussion

Despite the admittedly small size of the study sample, the integrated study of use-wear traces and starch residues significantly challenges the Parkinson/Buschmann hypothesis that Wuvulu islanders were producing objects for sale. Instead of new artifacts made in response to market demands, all the 10 complete turtle bone cleavers from the late 19th/early 20th century Wuvulu Island that are now housed in the Australian Museum collection, as well as one example with a wooden blade, were heavily used, probably for harvesting swamp taro, prior to their barter to European traders and collectors. The variable size of the tools together with their various life histories of use and re-sharpening also suggest that they were made for individual use rather than mass produced. It therefore appears that the islanders were selling off

![Fig. 10. Turtle bone cleaver from Wuvulu E28623, ventral side. (A) Traces of multiple re-sharpening characterized by deep, dense, wide, parallel and diagonal striations. The edge is intensively rounded and damaged by scars (∼50). (B) Close-up of area circled in (A) illustrating well-developed, flattened polish with densely packed thin, long, perpendicular striations and some crossed striations (∼100) (photos by Nina Kononenko).](image)

![Fig. 11. Left: modern reference material of *Artocarpus altilis* (breadfruit). Middle: extracted starch grains from artifact E24564 (See Fig. 6A for location). Right: modern reference material of *Cyrtosperma merkusii* (swamp taro) (photos by Huw Barton and Nina Kononenko).](image)
their own personal tools rather than producing new turtle bone cleavers to cater for the sudden high demand from the German traders.

What can the results tell us about the nature of Indigenous agency within the negotiations between Islanders and Westerners? Were people from Wuvulu and Aua so dazzled by the new western goods that they gave up useful tools to obtain them? Rather than exploitation of an Indigenous group, the evidence reveals a win–win situation within this colonial setting. Since the Wuvulu tools offered for exchange were heavily used and re-sharpened, they were probably considered to be near the end of their useful lives or in some cases completely exhausted and therefore worthless. In this regard it is interesting that so many of the hafts have been repaired by the addition of an iron nail, presumably to stabilize a loose blade and prolong the use-life of the tool (Table 1). An alternative interpretation is that the nail was added only to stabilize a loose blade and prolong the use-life of the tool (Table 1).

It is worth remembering that for barter to occur between strangers, both sides must be satisfied with the outcome, although each may be measuring their gains according to completely different scales (Humphrey and Hugh-Jones, 1992). Imagine the glee of the Wuvulu islanders at obtaining a metal axe or knife with a much longer use-life than turtle bone in return for a worn-out cleaver, as well as the traders’ delight at acquiring valuable exotic ‘ethnographic specimens’ (cf. Webster, 1901). The Wuvulu case highlights the necessary equality that existed within many colonial settings, especially in the early stages of contact.

7. Conclusions

The results of this study of turtle bone cleavers from Wuvulu emphasize the utility of integrated use-wear and residue analysis applied to ethnographic museum collections for providing new understandings of the nature of the material exchanges that formed such an integral part of past cross-cultural interaction, particularly during the period of European colonialism. The extensive ethnographic collections housed in museums around the world — including ordinary utilitarian objects generally overlooked — have great potential to contribute to a re-consideration of how Indigenous groups took active roles in negotiating their relationships with Westerners in many other parts of the world. These collections also house a myriad of tools with known uses that can greatly assist the development of use-wear and residue studies, particularly with regard to raw materials that have not yet been the subject of extensive experimentation. In the case of protected species, such as sea turtles, ethnographic artifacts may provide the only opportunity to further methods for microscopic use-wear and residue analyses.

The Wuvulu case study also highlights the potential for residue analyses of bone tools, particularly those used in association with plant rather than faunal materials, an area of research that would benefit from more extensive research (cf. Francis, 2002; Barton et al., 2009). Finally, the study shows that the flexibility and portability of digital hand-held microscopes can make a considerable contribution to the recognition of surface traces resulting from the manufacture and use of bone tools.

Acknowledgements

Research was supported by an Australian Research Council Discovery Grant and Post-Doctoral Fellowship. We are grateful to Colin Macgregor for introducing us to the digital hand-held microscopes, Maria Capa with help with software, Dominic McGearty for donating the 1960s artifact, and Peter White for the map and critical comments. We also thank Kristian Lagercrantz for sharing knowledge that improved the study and Rainer Buschmann for advice and useful criticism.

References


