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The logic of visitation: tool-use, technology and economy on Great Glennie Island, southeastern Australia

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Abstract

Archaeological excavation over 30 years ago in a small granite cave on Great Glennie Island, 7 km off the southernmost tip of mainland Australia, revealed five stratigraphically distinct midden units with intermittent occupation over the last 2000 years. Fluctuations in tool stone (quartz and flint) abundance and the nature of tool use track a shift in economic focus from one dominant taxon (seabird) during initial visits to four (seal, seabird, fish and shellfish) in the last 500 years. An analysis of flint cortex distributions indicates that during the second visit people carried core tools and retouched flint flakes, and during later visits they transported unworked flint nodules for knapping flakes as needed on the island. These data have been integrated with a functional analysis of all the stone artefacts to evaluate a model of human settlement based on island biogeography formulated by Jones (1976). I explore whether island toolkits can be linked with shifts in food procurement and argue that the island was visited infrequently because there was no compelling need to regularly harvest its rich food resources.

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ABSTRACT

Archaeological excavation over 30 years ago in a small granite cave on Great Glennie Island, 7 km off the southernmost tip of mainland Australia, revealed five stratigraphically distinct midden units with intermittent occupation over the last 2,000 years. Fluctuations in tool stone (quartz and flint) abundance and the nature of tool use track a shift in economic focus from one dominant taxon (seabird) during initial visits to four (seal, seabird, fish and shellfish) in the last 500 years. An analysis of flint cortex distributions indicates that during the second visit people carried core tools and retouched flint flakes, and during later visits they transported unworked flint nodules for knapping flakes as needed on the island. These data have been integrated with a functional analysis of all the stone artefacts to evaluate a model of human settlement based on island biogeography formulated by Jones (1976). I explore whether island toolkits can be linked with shifts in food procurement and argue that the island was visited infrequently because there was no compelling need to regularly harvest its rich food resources.

Keywords: Prehistoric coastal economy, Usewear, Residues, Island biogeography, Archeology, Lithic technology

1. Introduction

Rhys Jones (1976) sought to explain Aboriginal patterns of occupation of Tasmanian offshore islands by reference to biogeographic models. Jones concluded that, in general for humans as for other animals, island area and coastal perimeter imposed limits on the viable population size for sustained permanent settlement. Thus King Island and the Furneaux Islands were just too small to sustain human populations after sea levels rose about 8,000 years ago. At some stage, these islands shrank below the threshold to sustain permanent settlement, and eventually beyond the range of temporary visits although Tasmanian women were amazing swimmers – covering distances of three and a half miles (5.6km) (Jones, 1976, p. 238). Jones (1976) also estimated the range of available watercraft, ‘canoe-rafts’, in an open sea crossing to be about 6-14 miles (10-24km) from the Tasmanian or the Australian mainland. However, even small islands can be very important in providing essential protein resources (e.g. Keegan et al 2008), and perhaps some islands were deliberately protected from exploitation (as food reserves for hard times) by Aboriginal populations—like fire protection of monsoon rainforest patches in northern Australia (Jones 1975; Head 1996).

Bowdler (1995) outlined the general problem of Aboriginal island abandonment until the late Holocene, and an apparent loss of watercraft technology, which must have existed to make initial crossings to the Australian continent about 50,000 years ago. Watercraft of some sophisticated form likely did exist simply because of the required planning and scale of the venture. The range of possible colonization routes each involved island hopping over 90km and minimum sea crossings along any one route beyond 67km (see Allen and O'Connell 2008). Bowdler (1995) argued that:

By the end of the Pleistocene, these erstwhile mariners found themselves marooned on newly formed islands. Only within the last 4-3,000 years did they begin regularly to cross minimal water barriers, with increasing regularity in the last 1,000 years.

Sim and Wallis (2008) explored further the issues raised by Bowdler (1995), specifically the role of both cultural and environmental factors at play in the pattern of Aboriginal settlement, abandonment and renewed island visitation after about 4,200 years ago. Previously considered factors linked with island occupation, abandonment and re-visitation, have included patterns of coastal and littoral resource exploitation, mobility and watercraft in diverse environmental zones around the Australian continent (e.g. northeast: Barker, 2004; Campbell 1982; Rowland 1996, 1999; southeast: Bowdler 1995; Jones 1976; south: Dortch and Morse 1984; Draper 1987; Lampert 1981; far south; Vanderwal 1978; northwest: O'Connor 1999; Veth et al. 2007; far north Clarke 2002). Sim and Wallis (2008, p. 104) argued that the pattern of island habitation and visitation reflected a response to changing climatic regimes, particularly drought-like conditions in the mid-Holocene.

Patterns of island colonization, visitation and abandonment have also been considered at similar timescales and over much larger areas including the Pacific Ocean (e.g. Clark et al. 2008). At such broad scales of analysis, the available archaeological data lead to general models of environmental and social interaction but details at the individual or community are difficult to reconstruct if not irrelevant (Lilley, 2008, pp. 83-4); the timing, landing party size and precise number of visits may be never be known.

Several papers have explored motivations for island visitation but few have concentrated specifically on stone tools, although quarrying, stone material and lithic reduction have clearly been significant (see Lamb 2005; McNiven et al. 2014; Veth et al. 2007). McNiven (2000) noted the low abundance of quartz artefacts and poor resources on small islands of the Nooramunga Marine and Coastal Park to the east of Wilsons Promontory in contrast with the rich resources on Great Glennie Island to the west of Wilsons Promontory (Figure 1). He argued that Nooramunga island visitation was largely by people escaping from feuds and punishment (e.g. after breaking marriage rules) rather by people seeking rich seasonal treats (McNiven 2000). Great Glennie Island on the west side of Wilsons Promontory does have potentially rich seasonal resources and offers an opportunity to explore the role of stone artefacts in island visitation, for two reasons. First, there are two stone materials (quartz and flint) found in archaeological sites but only quartz outcrops on the island. Aboriginal visitors from the mainland most likely

transported the flint found by archaeologists on the island. Second, microwear on flint tools (in contrast with many other types of stone) has high potential for indicating function, and consequently for providing a rare source of data about resource use.

Great Glennie Island formed after the last glacial maximum by rising seas that are thought to have attained their present level along the southeast Australian coast at least by 7,700 years ago, before rising even further and then gradually dropping to the present level over the last 2,000 years (Sloss et al. 2007). Great Glennie lies about 7km from the southernmost tip of mainland Australia (Figure 1). The small rockshelter site Great Glennie 1 site (GGI/1), surveyed in 1969, assumed some significance for evaluating models of island habitation (Jones, 1976, p. 256; Jones and Allen 1979, 1985).

Jones (1976) considered a range of local conditions (e.g. strong currents and storms) that might impose limits on island visitation – and their attraction. Islands off the southeastern Australian coast potentially improve access to fish and many other marine resources, and they are often the breeding grounds for sea mammals and birds. Given these rich and predictable resources it is plausible that a major reason for visiting islands would be to exploit specific animal species. Sullivan (1982), then on the basis of three excavations on islands of the southeastern Australian coast, argued that the proportion of bone in archaeological assemblages on offshore islands was an important feature distinguishing them from mainland assemblages. People might have visited the islands for social or other reasons and then exploited particular resources because of quite expedient circumstances. The mere presence of a high proportion of vertebrate remains cannot on its own explain why islands were visited. Gaughwin and Fullagar (1995) suggested possible reasons for visiting off-shore islands in the general region: (1) hunting/gathering rare but highly valued resources, which may have high prestige value associated with their capture or collection, to justify the lengthy trips; (2) permanent or long-term occupation; (3) ceremonial meetings; (4) accidental landings; (5) escape from attackers; (6) food gathering trips at times of food shortage elsewhere; and others (see McNiven, 2000).

Nor is there any reason to suppose that island visitation should be repeated for the same reasons. Things change. Circumstances such as sea-levels, storminess, access to suitable boats etc) are never quite the same. Understanding the context of repeated Great Glennie Island visits allows us to evaluate Jones' model, which predicts that this offshore island would lack evidence of permanent settlement and any visitation would likely be constrained not so much by technology but the attraction of food resources and/or social factors.

Neither the results, which have been presented in the excavation report (Jones and Allen 1985) nor the stone artefact study (Fullagar 1986a) have been published previously in any detail. In this paper, I examine the stone artefacts from GGI/1 in the context of island visitation. The aims are to determine the function of stone tools during successive phases of occupation and to assess at what stage of reduction imported flint artefacts were likely

transported to the island. I also consider whether distinctive toolkits can be associated with documented shifts in resource-use and the nature of island visitation.

In the first part of the paper, I describe the site and summarise unpublished archaeological work undertaken and documented by others (Jones and Allen 1985), and discuss the flint sources, which are particularly significant because flint is not currently available on this Island and is unlikely to have been available in the past, although sea-levels did not stabilise until about 600 years ago (Sloss et al. 2007). I then present my methods of artifact analysis and discuss the results in the context of island stone toolkits, resource availability and possible reasons for visitation.

2. GGI/1 and previous work

2.1 Excavation results

Great Glennie Island lies about 7 km west of Wilsons Promontory along the Victorian coast, near the southernmost tip of mainland Australia (Figure 1). An archaeological excavation (1 m x 1 m x 1.1 m deep, an estimated 7% of the deposit) undertaken by Jim Allen and Rhys Jones in a small granite cave (field code GGI/1) revealed five stratigraphically distinct prehistoric occupation units in a sandy deposit about 1 m deep on granite bedrock. The shelter is just large enough to provide cover for a handful of people. The occupation units are 5–12 cm thick, all contain shell and bone, and I refer to them here as midden units (Figure 2). The oldest occupation horizon, Midden Unit 5 (MU5), dates to about 1500 years ago (see conventional radiocarbon ages reported by Head et al., 1983, p. 106). Above MU5 is MU 4, containing the oldest stone artefacts, dates to about 1000 years ago. The three upper midden units (MU1, MU2 and MU3) were deposited in rapid succession and date to the last 500 years. The aims of this excavation were to establish dates for occupation, the nature of the occupation, seasonality, the reasons for visitation and population numbers (Jones and Allen 1985).

Shellfish are present in each unit, and are dominated by the limpet *Cellana solida* (Head et al., 1983, p. 103). Seabird, seal and fish dominate the 2.5 kg of bone, and together with shellfish indicate a marine diet, albeit with distinct variation in the midden units. A preliminary study (Jones and Allen 1985) has shown that sea bird bones are common (MNI>222). Diving Petrels, Fairy Prions, Mutton Birds and Fairy Penguins are present in varying abundance in MU1–MU5. Bird MNIs are highest in MU 1 with Diving Petrels and Fairy Prions most common with Mutton Birds also present and Fairy penguins absent.

Spring/summer/autumn seasonal visits by Aboriginal people are indicated by the absence of Cape Barren Geese, which breed from February, or as late as May in dry season, to September (Frith 1977, pp. 130-4) and the presence of Mutton Birds, which breed from October to April.

In the lowest unit, MU5, about 85 cm below surface, bone is in least abundance and dominated by bird. In MU4, bone increases markedly and bird bone and seal bone are approximately of equal weight; and there are small amounts by weight of rodent, fish and unidentified mammal. In MU3 there is slightly more bird bone by weight than seal bone, and there is less fish, rodent and unidentified mammal bone. In MU2, the proportion of bird bone increases dramatically compared with the previous units and seal bone is less common; and fish bone and rodent bone are still relatively uncommon. In the uppermost unit, MU1, about 40cm below the surface, bird bone weight remains about the same, but fish and seal bone weights increase markedly, so that bird, fish and seal each contribute more than 20% of the total bone weight.

The number of stone artefacts decreases from the MU4 up to MU1 (Table 1). Jones and Allen (1985, p. 6) observed no typological difference in the stone tools from different units and no backed microliths. Indeed, retouched flakes were all but absent and they observed no distinctive types of regularly recurring tool shapes. Based on macroscopic observations, no utilised or retouched quartz tools were observed, and no stone at all in MU5. The assemblage appeared to be similar to the Yanakie B assemblages, identified by Coutts (1970). Distinctive features of the flint Yanakie B flint industry are the simple, large form of the artefacts and the use of local stone resources (Coutts, 1970, p. 125). A single shell tool made of mussel shell was found.

Head et al. (1983, p. 103) concluded that visitation to Great Glennie Island by Aboriginal groups in the past was rare, short-term and accomplished by small groups:

In the case of occupation units 2 to 5, the number of individual limpet shells in the parts excavated range from between 12 and 200. Only unit 1 was a true 'shell midden' in that it contained 1000 shells in its excavated volume of 0.05 m³. We estimate that our excavation accounted for some 7% of the total deposit. Trying to relate these 'excavation units' to real ethnographic events, we see them all as having been ephemeral events - in the case of units 2 to 4, perhaps single visits for a few days by a small number of people. Only the top unit 1 contains enough food debris of shell and animal bone to necessitate the occurrence of a longer term occupation to be measured in terms of several weeks or a few months. We interpret the entire prehistoric sequence therefore as a series of rare and short-term visits separated by substantial periods of time over a total time span of about 1500 years.

Two other sites were located on the island including an open scatter of shell (undated) and another cave, GGI/2. A shell sample from a disturbed section in the cave on the island yielded a date of 1350 ± 80 (ANU-2431) corresponding to Unit 4 in GGI/1 (Head et al., 1983, p. 111). In their review of coastal versus marine economies and offshore island occupation in Victoria, Gaughwin and Fullagar (1995, p. 48) concluded that 'the offshore islands of the Victorian coast were intermittently visited but did not form an important part of the overall subsistence strategy and land use activities of the Aborigines of the recent past'. The excavated faunal data from GGI/1 are consistent with this argument. However, the flint and quartz artefacts provide

a new source of evidence about island visitation both because of the stone source distributions and because of the diagnostic potential of usewear on flint.

2.1 Flint and quartz

Tool stones at GGI/1 include quartz and flint. The quartz is found locally in the granite landforms on Wilsons Promontory (see Coutts, 1970, p. 117) and, in contrast with flint, is also found on Great Glennie Island itself. Both quartz pebbles and vein quartz were commonly used as hammerstones and as cores to produce flakes. Numerous experiments have been undertaken specifically on quartz, a mineral found worldwide, and known to sustain distinctive usewear, although the use-polishes on quartz are generally less distinctive than for flint (e.g. Broadbent and Knutsson 1975; Fullagar 1986b).

The flint is a microcrystalline marine chert (grey to black in colour) that is very similar to European flint. Importantly for this study, flint has not been found on the island. Flint tool use experiments had been widely reported at the time of the study, and had shown that flint could sustain distinctive usewear, including use-polishes that sometimes can be diagnostic of material worked (e.g. Kamminga 1982; Keeley 1980). The southern Australian flint formed in late Oligocene to mid-Miocene limestone, and nodules are exposed along parts of the southern Australian coast, mostly west of Victoria (Fullagar 2011). Although it may have been available as a land source by quarrying prior to 7,500 years ago, flint only became available on the present beaches after the rising sea level of Bass Strait (about 12,000 to 7,000 years ago) had eroded the nodules and deposited them in close offshore reservoirs, from where they were 'buoyed' to shore attached to giant kelp. Headlands have formed prominent on-shore catchments for accumulating flint washed in from the reservoirs.

Scott-Virtue (1982) argued that utilisation of the GGI/1 flint was affected by the supply and accessibility of the catchments. She suggested that some assemblages (e.g. GGI/1) were comprised of small flakes because of voids and inclusions in nodules, and that the scarcity and smallness of nodules necessitated maximum utilisation of available flint. It is possible that the flint came from the predictable flint catchment zones, identified by Scott-Virtue (1982) at Cape Liptrap 40 km away, although Coutts (1970:117) reported that flint nodules had been washed up on the beaches at Wilsons Promontory and Scott-Virtue (1982, Table 2) collected one medium-sized nodule from Darby Bay, Wilsons Promontory (weight: 64 g; dimensions: 22 cm x 8 cm x 4 cm). She collected several smaller nodules from Cape Liptrap, ranging from 25 g to 440 g (mean weight: 153.6 g; mean dimensions: 7.8 cm x 5 cm x 3.3 cm). The results suggest that flint in this area of southern Victoria was available at a limited number of mainland catchments, but was never in abundant supply.

3. Methods

The 458 quartz and flint artefacts were classified as flakes, cores, flaked fragments and whole cobbles. Flint flakes that were complete with intact

platforms were further classified into 5 groups that indicate reduction stages, based on distribution of cortex, following replicative experiments and the research by Toth (1982, pp. 56-87). Reduction stages of imported flint potentially provide an indication of the form in which the flint was likely to have been imported—as unworked cobbles, prepared cores and/or flakes.

Stage 1 flakes have cortex all over the dorsal surface and on the platform, unless the latter is crushed and thus not visible. Stage 1 flakes are obviously the first series to be removed from a nodule.

Stage 2 flakes are the second series of flakes to be removed and may either have cortex on the platform (substage 2.1) or not (substage 2.2). If they do have cortex in the platform, the dorsal surface will either have no cortex on the dorsal surface (substage 2.1a) or have cortex to one side of a single dorsal ridge (substage 2.1b). It may be possible to remove several series of substages 2.1a and 2.1b flakes from one platform. If there is no cortex on the platform then a stage 2 flake will have cortex all over the dorsal surface. The most likely option will depend on the shape of the nodule.

Stage 3 flakes are grouped into those struck from unidirectional cores and those struck from alternating directions along the core platform (i.e. bifacially struck platform edges). The latter are indicated by faceted platforms or impact scars of previously removed flakes on the dorsal edge of the platform, and were found to be rare at GGI/1 (only one case). Unidirectional flaking, on the other hand was common. If flakes are removed without cortex on the platform, following substage 2.2, cortex will likely be present to one side of a dorsal ridge.

Stage 4 flakes only have cortex on the distal end of a flake with multiple dorsal scarring.

Stage 5 flakes have no cortex. Although small non-cortical flakes may be removed during early stages of reduction, Stage 5 flakes are likely to be more common during later stages, as either re-sharpening flakes or flake tools.

The grouping of flint flakes into five stages of reduction provides a basis for evaluating the form of imported flint in MU1–4.

All stones were examined macroscopically and microscopically for wear and residues. The functional analysis was based on published experimental data of usewear and residues available at the time (e.g. Hayden 1979; Loy 1983), and a comparative reference library of 321 stone tool-use experiments undertaken by Fullagar (1986a), whose study included re-analysis of experimental flint tools made and used by Kamminga (1982). Wear and residues were examined under a stereomicroscope (Olympus SM 5 with x6 to x100 magnification) with an external fibre optic, incident light source, and a metallographic microscope (Olympus BH2 with x50, x100, x200, x500 and x1000) with vertical incident light. The latter microscope was also employed to

study extracted residues under transmitted light.

The identifications of worked material as determined on the basis of usewear were assigned confidence levels: (1) no visible traces of use; (2) possible traces of use but overlapping with wear from some other agency (e.g. weathering); (3) probable traces of use, but with no clear indication of worked material; (4) definite traces use, with a clear indication of the class (e.g. wood or bone) of worked material. Residues were identified on the basis of distinct visual structures (e.g. starch grains, collagen bundles, cellulose etc.). In the Tables presented here worked material is interpreted on the basis of definite use as indicated by a combination of usewear and residue data. Tools, for which the material worked could not be determined, had clear traces of use in combination with residues that could not be further identified.

Subsequent functional studies of stone tools have refined our capacity to determine specific utilized resources via residue morphology, biochemical analysis and spectroscopy (e.g. Coster and Field 2015; Fullagar 2014; Prinsloo et al. 2014), whereas here I refer with confidence to only broad classes of worked material indicated by microwear (e.g. Fullagar 1991).

4. Results

The distributions of quartz (found locally on the island and also on the mainland) and flint (only found on the mainland) potentially provide us with information about local and imported stone. The total number of stone artefacts decreases through time from 246 in MU4 up to 42 in MU1 (Tables 1-2). The percentage of used quartz flakes and fragments also steadily decreases from 11% in MU 4 to 0% in MU1. However the percentage of used flint flakes and fragments falls initially (from 24% in MU4 to 15% in MU3) and then rises to 52% in MU1.

Midden Unit 4 had 17 quartz individual artefacts or 'tools' with a total of 26 utilised edges; and 20 flint tools with 24 utilised edges (Table 3). Of all the 37 tools from MU4, there were 50 utilised edges: four for skin working, one for bone working, 8 for butchering, 15 for plant working, two for working bone and plant and two for working skin and plant. There were 18 utilised edges that could not be assigned a specific function. Of the quartz pieces, 17 out of 159 (11%) had utilized edges, and of the flint implements, 20 of 87 (23%) had utilized edges. Overall, 16% of all stone pieces had been utilized (Table 2). Of the 50 utilised edges in MU4, 18 (36%) could not be assigned a specific function (Table 3).

Midden Unit 3 had five quartz tools and a total of six worked edges; and five flint tools with 7 utilised edges (Table 4). Of all 10 tools, there were 13 utilised edges—a similar proportion to MU4 but used differently: one for plant processing and two for woodworking. Ten utilized edges could not be assigned a specific function. Of the 13 utilised edges, only three (21%) could be assigned a specific function.

In MU2, two quartz tools each had a single utilised edge with wear indicating woodworking. Three flint edges had traces of use, including butchering (n=1), plant processing (n=2). At least eight (61%) utilised edges could not be assigned a specific function.

In MU1, the most recent unit and also with the most abundant shell, none of the nine quartz artefacts had traces of use. Of the 31 flint flakes and two cores, there were 31 utilised edges on 18 tools. At least four edges were used for working skin and three for butchering. At least 8 edges were used for woodworking. Function could not be determined for at least 18 edges (~58%). The increasing proportion of tool edges with function not determined (from MU4 to MU1) suggests more edges were used less intensively, as the total number of artefacts decreased.

On the other hand, the intensity of tool-use (estimated by documenting the number of used edges on each tool) appears to be slightly higher in the upper two middens, although in each midden unit one utilised edge per tool is most common (Tables 3-6). The most intensively utilised tool, probably for scraping reeds (*Phragmites australis*) was from MU4 (Figure 3). However, because early stages of flake reduction are completely absent in MU4 (Table 7) a flint core with bifacial flaking on the single platform tools was probably transported to the island in this form. Initial stages of reduction are present in higher units, but there are shifts in other stages. For (MU4) early stages of reduction are absent in contrast with MU3 when later stages of reduction are absent. Midden Unit 2 and MU2 are mostly dominated by middle stages of reduction.

Table 8 summarises the results for each midden unit, presenting the available data for fauna, stone artifact counts, functional analysis and the flint flake reductions stages. These results are discussed below.

5. Discussion

The 7 km crossing to Great Glennie Island is about half the distance that separates the Great Keppel Islands from the tropical Queensland coast and very short compared with the 85 km crossing to the more distant Percy Isles—the most distant island group off the Australian east coast (see Border 1999; Rowland 1984) or the 90 km crossing of initial Sahul colonization. Yet the archaeology indicates that this 7km was crossed barely five times in the last 2000 years – with a minimum of three visits in the last 500 years. It is not possible with available data to discern exactly how long a visit may have lasted or if each midden unit related to several visits over decades or longer time intervals. However, there are several reasons to suppose that the phases of occupation represent a low number of visits by few people over short period of time. Neither the faunal remains nor the stone tool evidence support intensive occupation.

The midden is dominated by the bones of bird, seal and fish with shellfish only common in the most recent visit (Table 8). Following the interpretation of the excavators (Head et al. 1983), the five phases of occupation (MU1-5) likely represent single visits. The logic of their argument is based not only on

discrete stratigraphic units but also their calculations indicating that the food and stone in all midden units could easily have accumulated as a consequence of small groups visiting for short time periods. Even a hundred or so birds (in MU4) could not feed many people for very long. The most recent phase of occupation (MU1), which has the most abundant food debris, could easily result from a relatively short visitation over a few weeks or months (Head et al., 1983, p. 103). Even if what is interpreted as a series of rare visits by small groups actually represented phases of occupation comprising multiple visits, evidence for any kind of permanent occupation is lacking. For the purposes of discussion, I focus on Table 8 and treat the occupation units as discrete visits.

The initial visit has the lowest bird counts and bone weights of all the units, and did not result in discard of stone artefacts at the site (Table 8). Stone is first introduced in MU4 and comprises 246 artefacts. The number of flint artefacts discarded then declines steadily in subsequent units. The second visit, 500 years later is characterized by later stages of flint reduction with no flakes from early stages (Tables 7 and 8). The tools from this unit have the most developed wear and the edges show traces indicating animal processing (n=15 edges) and plant (n=18 edges) processing. Midden Unit 4 is the only unit to have tools with multiple worked edges used for processing plant and animal tissue; and the only unit not to have woodworking tools (Tables 3–6).

The third visit (MU3) is characterized by initial stages of reduction with no later stages (Tables 7 and 8). The number of birds drops markedly in MU3. No animal traces were identified on tool edges in MU2 and 3. Subsequent visits (MU2 and MU1) in rapid succession after MU3, with increasing numbers of birds, peaks in the last visit with 108 MNI and over one kilogram of bone. Midden Unit 2 is characterized by all stages of reduction, but more from middle stages, and MU1 is characterized by all stages of reduction, mostly middle stages. The tools from MU1 have edges showing traces of processing animal (n=5 edges) and plant (n=8 edges) tissue.

With respect to stone technology, the three most recent visits reveal a trend away from the transportation of tools that were probably knapped and perhaps used on the mainland, towards transportation of nodules that were flaked onsite. The low proportion of utilized edges that could be assigned a specific function and the high proportion of tools with one used edge suggest that most tools were used expediently for a short period of time, with few intensively used. The variation in stone technology and patterns of use suggest that exploitation of birds, fish and seal did not demand a specialised set of tools or a complex level of technological organisation. Fluctuations in the frequency of tool edges with plant and animal traces do not seem to be related to the frequency of particular fauna frequencies. At any rate, the frequency of animal tissue processing tools bears no clear relationship to the number of animals represented through the site. There is a subtle increase in the frequency of wood processing tools suggesting that craft materials made of woody tissue increased in importance. The possible increase in the importance of organic tools may be further supported by the low frequency of stone in the most phase of occupation, which has the most abundant midden

debris.

I have suggested that the first stone toolkit brought to the island included tools whose patterns of use relate to tasks many of which were likely to have been undertaken on the mainland, but it would be difficult to determine whether a particular tool was used on site or not. It may be difficult to evaluate a methodology determining on-site versus off-site stone tool use (but see Hayes et al. 2014). Nevertheless, unlike the first two visits, so distantly apart in time, the radiocarbon dates for the last three visits overlap and it is possible that the last two visits reflect knowledge passed on by previous visitors, who may have been aware that existing supplies of flint previously transported were sufficient for the tasks required on the island.

It is difficult to securely base a history of island visits on evidence from a single location on the island. Presumably the visitors did not dump tools just at one spot, and given the likely speed of canoe-rafts (0.5 knots, i.e. barely 1 kmh⁻¹, see Jones 1976, p. 246) at least one overnight stay was a necessity, unless they travelled at night. Nevertheless, the evidence at hand hardly indicates regular or frequent visitation.

6. Conclusion

Analysing why people travelled to Great Glennie must take into account their knowledge of birds, seals, fish and watercraft. Mike Rowland (e.g. (1996, p. 197-9) was keenly aware of the complexity of island visitation. People made the journey as a result of purpose, 'the result of deliberate action' (Gamble 1995, p. 245), and I think there is little doubt that they knew what to expect. It is possible that although visits to Great Glennie Island were not accidental, they may have been a response to environmental constraints and/or social pressure (Gaughwin and Fullagar 1995, p. 48). The reason why people may have made the journey so infrequently is certainly more difficult to answer, but the evidence from stone artefact technology and tool-use supports the hypothesis that island visitation was not an integral systematic component of mainland Aboriginal coastal economies. This line of argument suggests that people did not travel frequently to the island simply because there was little compelling need to go, not because they lacked a maritime technology.

The evidence suggests no technological constraints, because we know that suitable water craft were available at various times. Jones' (1976) model is supported by the Great Glennie Island evidence. As predicted, there is no secure evidence of permanent settlement in the archaeological record at Great Glennie Island. Jones speculated that social proscription might have played a role, by restricting access to places, perhaps as a consequence of occasional disasters at sea. However, infrequent visitation cannot be attributed to inadequate maritime technology, and the most likely explanation for these infrequent visits lies in the realm of deliberate choice and the lack of any compelling need to gather whatever rich resources were clearly available.

However, despite the apparent infrequency of visitation to this island, shifts in technological strategy can be discerned. At various times the strategy

changed from transportation of previously manufactured tools to the transportation of complete nodules, indicating fluctuations in provisioning of people and of place. The final phase of occupation with the most abundant shell midden debris and all stages of flint reduction suggests a relatively more intensive exploitation of island resources just prior to beginning of European colonisation.

Similarly, changes in the nature of tool-use fluctuate, suggesting more intensive processing of animal and plant resources in the second (MU4) and final phases (MU1) of occupation. Although there is no apparent linear trajectory evident in the tool-use data, there is a clear decline in the abundance of stone from both local and imported sources.

In conclusion, the reasons for island visitation and the strategies of resource exploitation do not appear to be constant through time. While the harvesting of bird, fish and seal resources must have been a key attraction, the infrequency of visitation, fluctuating tool-use patterns and the shifting technological strategies suggest that the economics of subsistence alone cannot provide an adequate explanation for island visitation at various times in the past. The processes even on one small island, Great Glennie, are complex and elusive—as Mike Rowland (1996) appreciated for the 643 islands of the Great Barrier Reef Province; a case of treats *and* retreats (cf. McNiven 2000).

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Figure Captions

Figure 1: Location of the GGI/1 rockshelter off the west coast of Wilsons Promontory in southeastern Australia.

Figure 2: Stratigraphic sections (west and north) of GGI/1 excavation and calibrated (INTCAL13) radiocarbon ages with 95% probability.

Figure 3: Flint flake (artefact X85618) from MU4 and image below of the use-polished surface, sustained by scraping highly siliceous plant tissue—probably reeds. The scale bar is 0.25mm.

Figure 1

Figure 2

Figure 3

Table 1: Stone artefacts recovered from GGI/1 (n=458)

Occupation/Midden Unit	1	2	3	4	5	Total
Approximate depth below surface (m) of the spit with carbon and shell dates	0.4	0.45	0.53	0.70	0.82	
Flint						
Flakes/Fragments	31	25	34	85	0	175
Cores	2	0	0	1	0	3
Quartz						
Flakes/Fragments	8	42	63	154	0	267
Cores	1	3	2	5	0	11
Whole cobbles	0	0	1	1	0	2
Total	42	70	100	246	0	458

Table 2: Counts of used and unused artefacts from GGI/1. Percentages of used and unused for the artefact class 'Flakes & fragments' are in brackets.

Unit	U1		U2		U3		U4		Total	
Depth bs m	.4		.45		.53		.70			
Count	2		0		00		46		58	
Use	sed	nused	sed	nused	sed	nused	sed	nused	sed	nused
Flint:										
Flakes & fragments	2) 16	8) 15	6) 4	4) 21	5) 5	5) 29	4) 19	6) 66	25) 44	5%) 132
Cores										
Quartz:										
Flakes & fragments	0	00) 8	1	8) 41	5	2) 58	1) 17	9) 137	33) 23	1%) 244
Cores										0
Whole Cobbles										
TOTAL	3	4	4	4	0	0	7	09	6%) 71	4%) 387

Table 3: Counts of utilised edges (n=50) and tools (n=37), MU 4, GGI/1

Worked Material	Quartz: No. Used edges per tool				Flint: No. Used edges per tool				Quartz + Flint: No. Used edges per tool			
	1	2	3	>3	1	2	3	>3	1	2	3	>3
Skin	1	1	0	0	1	1	0	0	2	2	0	0
Bone	0	1	0	0	0	0	0	0	0	1	0	0
Carcass	4	0	1	0	2	1	0	0	6	1	1	0
Plant	1	3	1	0	6	4	0	0	7	7	1	0
Wood	0	0	0	0	0	0	0	0	0	0	0	0
Bone + Plant	1	0	0	0	1	0	0	0	2	0	0	0
Skin + Plant	1	0	0	0	1	0	0	0	2	0	0	0
Not determined	2	5	4	0	5	2	0	0	7	7	4	0
Total Edges	10	10	6	0	16	8	0	0	26	18	6	0
Total Tools	10	5	2	0	16	4	0	0	26	9	2	0

Table 4: Counts of utilised edges (n=13) and tools (n=10), MU 3, GGI/1

Material Worked	Quartz: No. Used edges per tool				Flint: No. Used edges per tool				Quartz + Flint: No. Used edges per tool			
	1	2	3	>3	1	2	3	>3	1	2	3	>3
Skin	0	0	0	0	0	0	0	0	0	0	0	0
Bone	0	0	0	0	0	0	0	0	0	0	0	0
Carcass	0	0	0	0	0	0	0	0	0	0	0	0
Plant	1	0	0	0	0	0	0	0	1	0	0	0
Wood	1	1	0	0	0	0	0	0	1	1	0	0
Not determined	2	1	0	0	3	4	0	0	5	5	0	0
Total Edges	4	2	0	0	3	4	0	0	7	6	0	0
Total tools	4	1	0	0	3	2	0	0	7	3	0	0

Table 5: Counts of utilised edges (n=14) and tools (n=6), MU 2, GGI/1

Material Worked	Quartz: No. Used edges per tool				Flint: No. Used edges per tool				Quartz + Flint: No. Used edges per tool			
	1	2	3	>3	1	2	3	>3	1	2	3	>3
Skin	0	0	0	0	0	0	0	0	0	0	0	0
Bone	0	0	0	0	0	0	0	0	0	0	0	0
Carcass	0	0	0	0	0	0	1	0	0	0	1	0
Plant	0	0	0	0	0	1	1	1	0	1	1	1
Wood	2	0	0	0	0	0	0	0	2	0	0	0
Not determined	0	0	0	0	0	3	2	3	0	3	2	3
Total Edges	2	0	0	0	0	4	4	4	2	4	4	4
Total tools	2	0	0	0	0	2	1	1	2	2	1	1

Table 6: Counts of utilised edges (n=31) and tools (n=18), MU 1, GGI/1

Material Worked	Quartz: No. Used edges per tool				Flint: No. Used edges per tool				Quartz + Flint: No. Used edges per tool			
	1	2	3	>3	1	2	3	>3	1	2	3	>3
Skin	0	0	0	0	0	0	1	1	0	0	1	1
Bone	0	0	0	0	0	0	0	0	0	0	0	0
Carcass	0	0	0	0	2	0	1	0	2	0	1	0
Plant	0	0	0	0	0	0	0	0	0	0	0	0
Wood	0	0	0	0	3	2	2	1	3	2	2	1
Not determined	0	0	0	0	6	6	2	4	6	6	2	4
Total Edges	0	0	0	0	11	8	6	6	11	8	6	6
Total tools	0	0	0	0	11	4	2	1	11	4	2	1

Table 7: Reductions stages

Midden Unit	Complete Flint flakes	Reduction stages				
		present				
		Early	Middle		Late	
		1	2	3	4	5
1	Unused	1	2	0	0	0
	Used	0	3	5	3	1
	Total	1	5	5	3	1
2	Unused	2	1	0	0	0
	Used	0	0	3	0	1
	Total	2	1	3	0	1
3	Unused	1	0	1	0	1
	Used	0	2	3	0	0
	Total	1	2	4	0	1
4	Unused	0	0	6	3	11
	Used	0	0	2	3	6
	Total	0	0	8	6	17

Table 8: Summary data.

Midden Unit	1	2	3	4	5	Base
Lab code	ANU 2422	ANU 2424	ANU 2425	ANU 2427	ANU 2429	ANU 3832
Conventional Radiocarbon Age	390 ± 75	*270 ± 85	320 ± 170	1070 ± 90	1480 ± 120	1850 ± 120
IntCal 13 Age 95% probability calBP	301–536	0–505	0–630	789–1229	1177–1693	1526–2109
Birds MNI	108	49	15	40	10	0
Two most abundant bird taxa	Fairy Prion Diving Petrel	Fairy Prion Diving Petrel	Fairy Prion Fairy Penguin	Fairy Prion Mutton Bird	Fairy Prion Fairy Penguin	None
Bone weight (g)	1026	526	185	749	114	0
Dominant bone taxa by weight. Bold indicates >100g of bone	Bird Fish Seal Rodent	Bird Seal Fish Rodent	Bird Seal Fish Rodent	Bird Seal Fish Rodent	Bird Seal	None
All stone no.	42	70	100	246	0	0
Quartz no.	9	45	65	160	0	0
Flint no.	33	25	34	86	0	0
Reduction stages (flint)	All, mostly middle	All, mostly middle	All, mostly Initial	Later	None	None
No. Edges with animal traces	5	0	0	15	0	0
No. Edges with **plant traces	8	5	3	18	0	0
Retouched flakes	1	0	0	5	0	0

- indicates multiple intercepts on the calibration curve

** plant traces include wood