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# Terrestrial Fauna from Excavations at the Kainapirina (SAC) Locality, Watom Island, Papua New Guinea

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## ABSTRACT

Identification and analysis of faunal remains, other than fish and shellfish, from excavations at the Kainapirina (SAC) locality, Watom Island, are described. Pig remains dominate the fauna, and their age structure suggests that the local Lapita economy involved animal husbandry. Taphonomic analysis of the highly fragmented material confirmed archaeological observations that the upper horizons of the deposit had been disturbed by gardening.

*Keyword:* LAPITA, WATOM, PIGS, ANIMAL HUSBANDRY, TAPHONOMY, ARCHAEOZOOLOGY.

## INTRODUCTION

Excavations at the SAC locality on Watom Island yielded substantial assemblages of faunal remains from Lapita occupation layers. The fish and shellfish components of these assemblages are described elsewhere (Green and Anson 2000). This paper deals with the remainder of the fauna, which are predominantly terrestrial species, although a small number of marine animals are also included.

The material under analysis came exclusively from rectangles III and IV, and derived from occupation layers C1 and C2, each of which was excavated in three spits. A small quantity of material was also recovered from rectangle I, but this was not available for the present analysis and is described briefly from information provided by the excavators. Material from each spit was treated as a separate assemblage during analysis. Identifications were undertaken using reference collections in the Anthropology Department, University of Auckland. Several potentially identifiable pieces were examined by specialists at the University of Otago and the Australian Museum. Analysis also involved examination of all material for evidence of cut or impact marks, burning, weathering and attrition. The maximum length of each item was measured and the total weight calculated for all material from each spit.

Pig remains, which dominated the assemblages, were examined for evidence of age at death. This was done using timetables of tooth eruption and epiphyseal fusion in modern domestic pigs (Silver 1969; Sisson 1930) and by comparison of post-cranial bones with modern specimens of known age. The extent to which prehistoric Pacific pigs differ from modern breeds in size and ages at dental and osteological maturity is not known. To reduce potential errors in ageing, five broad age classes were employed: 0–6 months, 6–12 months, 12–18 months, 18–24 months and greater than 24 months. Minimum numbers of individuals

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(MNI) were calculated from the most frequently occurring skeletal elements within each age class.

## IDENTIFICATIONS

The most striking feature of these assemblages was the fragmentary nature of the material, with 88% of the items being fragments of less than 3 cm maximum length. For this reason general description of the assemblages is best accomplished in terms of the numbers of fragments present (Table 1). In all, less than one quarter of these were able to be identified. Pig bones and teeth were most common, dominating all six assemblages. These were all similar to comparative specimens of *Sus scrofa*, but the fragmentary nature of this material precluded positive identification to species level, or assessment of subspecific affinities (cf. Groves 1981). A considerable number of bone fragments were also identified tentatively as pig (pig? in Table 1), but lacked sufficient morphological features to permit positive identification. Careful examination ensured that these were not dog, human or sea mammal remains. The only other positive identification was a single distal humerus fragment of a peramelid, probably the bandicoot *Echymipera kalubu*.

TABLE 1  
Numbers of Identified Specimens

Taxon	Zone C1			Zone C2			Total
	spit 1	spit 2	spit 3	spit 1	spit 2	spit 3	
pig	32	72	98	18	29	2	251
pig?	13	20	19	6	4	3	65
bird	-	3	3	2	1	-	9
crab	-	1	-	2	5	-	8
turtle	-	-	1	-	3	-	4
reptile	-	-	1	-	-	-	1
bandicoot?	-	-	-	1	-	-	1
Unidentified	159	391	401	57	54	5	1067
<b>TOTAL</b>	<b>204</b>	<b>486</b>	<b>523</b>	<b>84</b>	<b>96</b>	<b>10</b>	<b>1406</b>
<b>% identified</b>	<b>22.1</b>	<b>19.5</b>	<b>23.3</b>	<b>32.1</b>	<b>44</b>	<b>50</b>	<b>24.1</b>

Other animals represented in the assemblages could only be identified to a very general level. Fragments of bird bone were present in four of the spits. These included one vertebra and eight limb bone shaft fragments. All appeared to be from relatively small individuals. Eight small fragments of crab exoskeleton were present, predominantly in layer C2. Turtle remains were recovered from both layers; a mandible fragment in the upper layer, and three fragments of carapace in the lower. Finally, a single fragment from the base of layer C1 appeared to be from the humerus of a small reptile, perhaps a lizard.

A large proportion of the items in each assemblage could not be identified. These were almost exclusively very small fragments. Most appeared to be mammal bone, and thus probably derived from pigs.

## PIGS

Details of the pig remains are summarised in Tables 2 and 3. In terms of the minimum numbers of elements (MNE) present, pigs would appear to have been considerably more abundant in layer C1 with 84% of total MNE deriving from that layer. This disparity is not so great when MNI are considered. Calculated on a spit by spit basis, at least seven individuals are represented in the upper layer, and five in the lower. However, given that the division of each layer into three spits was an arbitrary procedure, it seems more reasonable to combine the material from each layer for the calculation of MNI. This does not alter the total for layer C1, but reduces to three the MNI calculated for layer C2.

**TABLE 2**  
Pigs: MNE, MNI and Age Determinations

layer	spit	MNE*	MNI*	MNI**	age determinations**	
C1	1	22	1		2	6-12 months
	2	59	2	7	1	12-18 months
	3	82	4		3	18-24 months
					1	> 24 months
C2	1	14	2		1	6-12 months
	2	16	2	3	1	12-18 months
	3	2	1		1	18-24 months
<b>Total</b>		<b>195</b>	<b>12</b>	<b>10</b>	<b>3</b>	<b>6-12 months</b>
					<b>2</b>	<b>12-18 months</b>
					<b>4</b>	<b>18-24 months</b>
					<b>1</b>	<b>&gt; 24 months</b>

Note: MNE - minimum number of elements  
MNI - minimum number of individuals  
\* - calculated per spit  
\*\* - calculated per layer

Most of the pigs appear to have been killed during their second year of life. No teeth or bones from very small individuals were found, although clearly these might not have been recognisable given the fragmentary nature of the collections. Nevertheless, the three individuals aged less than 12 months all appeared to be near the end of their first year of life, and all but one of the remainder were aged between 12 and 24 months. The only older animal was at least 3½ years.

In all but the smallest assemblage a wide range of skeletal parts are represented (Table 3). However, there is considerable variation in the proportional representation of body parts. When all the assemblages are taken together the head, and in particular the teeth and crania, stand out as being much better represented than all other body parts. Only the most robust limb bones, the humerus and femur, could be considered relatively common, with all other elements representing one third or less of total MNI. In view of the fragmentary nature of the collections it would be unwise to interpret this pattern as a direct reflection of pig butchering and disposal practices. Indeed, half of the fragments identified tentatively as pig?

were limb bone shaft fragments, suggesting that a much more even pattern of body parts representation would have been observed if the bones had been more or less complete. Despite these uncertainties, it seems reasonable to suggest that the presence of elements from most body parts in almost all the assemblages indicates that pigs were butchered and eaten at the site.

Some confirmation of this was found through analysis of cut marks on the bones. Thirteen examples were recorded, from all spits of layer C1 and the uppermost spit of layer C2. Nine of the cut marks were on bones identified as pig or pig?, the remainder on fragments not able to be identified. They appeared most frequently (four examples) as short transverse cuts around the distal end of the humerus. These are likely to have been made during disarticulation of the foreleg from the shoulder. Other examples were observed on fragments of femur, metatarsal, pelvis, rib and mandible. All of these would seem to reflect flensing of flesh from bone.

A further 47 fragments showed signs of burning, which could be seen as evidence of cooking, or the discard of food waste back into ovens or fire places after a meal. Once again these items were widely distributed, being present in all assemblages except that from the base of layer C2. Unfortunately none of these fragments were identifiable, although it has been suggested above that most of this class of bones probably derived from pigs.

TABLE 3

Pigs - MNI per Skeletal Element

Element	C1/S1	C1/S2	C1/S3	C2/S1	C2/S2	C2/S3	Total
crania	1	1	2	1	1	1	7
teeth	1	2	4	2	2	1	12
mandibles	1	2	-	-	1	-	4
vertebrae	-	1	1	-	-	-	2
ribs	1	-	1	1	1	-	4
scapulae	-	-	1	-	-	-	1
humeri	-	2	2	2	-	-	6
radii	-	-	-	-	-	-	-
ulnae	-	-	-	-	-	-	-
carpals	-	1	1	-	-	-	2
metacarpals	-	1	1	-	-	-	2
phalanges	-	1	2	-	1	-	4
pelvis	-	1	-	-	-	-	1
femora	1	1	2	-	1	-	5
tibiae	-	1	1	-	2	-	4
fibulae	-	-	-	-	-	-	-
tarsals	-	-	-	-	-	-	-
metatarsals	1	1	1	1	-	-	4
phalanges	-	1	1	-	-	-	2

Some of the pig remains in layer C2/spit 2 were recovered from features relating to the earliest occupation of the area (Green and Anson 2000: Fig. 8). Part of a cranium and several teeth came from an oven (A), and two left tibiae were found in a posthole (I) at the

base of this oven pit. Another tibia came from pit e, and a rib fragment identified tentatively as pig? was found in pit g. These associations provide secure evidence for the presence of pigs in this earliest occupation.

Further evidence derives from Green and Anson's excavation of the basal levels of rectangle I, where a bone and canine tooth were recorded in posthole k, and another bone in pit (c). Specht (1968: 125–26), who excavated the upper part of Zone C in this area, and in locality SAD, also noted that pigs were the most commonly occurring animal.

## TAPHONOMY

Several features of the rectangle III and IV assemblages provide evidence of the post-depositional history of the site. Comments have already been made about the fragmentary nature of the material and the limitations which this imposed upon the process of identification. This impact appears to have been greatest in the upper layer, where smaller proportions of total NISP were identifiable (Table 1). It could be argued that this disparity was simply a reflection of unequal sample sizes, with the relatively rare (i.e., identifiable) components being exaggerated in importance in the smaller samples from layer C2. However, if all the assemblages from this layer are combined, increasing the sample size to 190, the proportion of items identified (38.9%) is still much greater than was observed in the comparably sized sample from layer C1/spit 1. This suggests that there was indeed a qualitative difference in the nature of the assemblages from the upper and lower layers.

Two measures were employed to evaluate this proposition. The size of each item was assessed by recording its maximum dimension within 1 cm size classes (Fig. 1). This showed that small fragments were relatively more common in layer C1, and larger fragments more common in layer C2. The average weights of fragments in each assemblage were also calculated (Table 4), demonstrating that those in the lower layer were considerably heavier than those above. Thus fewer items were able to be identified in the upper layer because the bones were broken into smaller pieces.

These observations are consistent with the archaeological observation (Green and Anson 2000) that layer C1 had been thoroughly turned over by gardening. However, alternative explanations should also be considered. Clearly, waste bones could have been fragmented during marrow extraction or artefact making, damaged by animal attrition or eroded by natural weathering processes. Deliberate breaking by human agency does not seem to be in evidence. There is no sign of the impact marks or spiral fractures that would be expected (Kooyman 1984) if fresh bone had been deliberately broken open. Likewise, there were no bone tabs or blanks, or any sawn, ground or polished fragments to suggest regular bone working at the site.

Some evidence was found for animal attrition (Table 5). Rat gnawing was observed on one fragment from layer C2/spit 2, and another from layer C1/spit 2 had a puncture mark from the canine tooth of a larger animal. The remaining 33 examples exhibited the crenulated edges typical of bones that have been chewed (cf. Binford 1981: 44). The two latter kinds of attrition are known to be produced by dogs (Taylor 1984). However, as Greenfield (1988) has shown, pigs can modify bones in similar ways. Irrespective of which animals inflicted the damage, two points are clear: only small numbers of bones show evidence of animal attrition, and they are relatively less common in the upper layer than the lower layer. Thus animal attrition does not appear to be responsible for the greater breakage of bones in the upper layer.

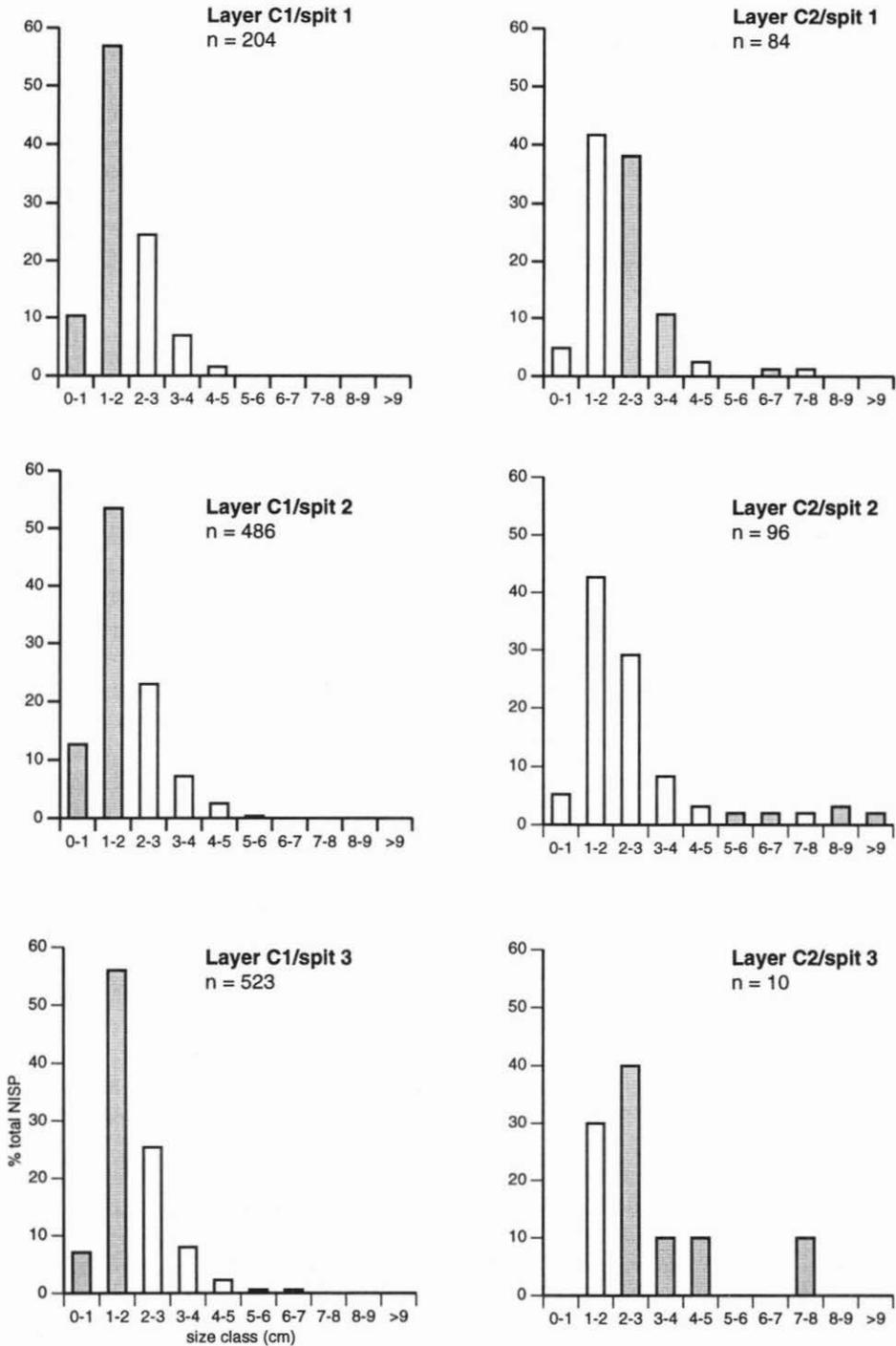


Figure 1: Size frequency distribution of bone and tooth fragments from SAC. The shaded bars are values greater than the mean for that size class.

**TABLE 4**  
Average Weight of Fragments

layer	Total weight (g)	Total fragments	weight/fragment
C1/S1	184.36	204	0.90
C1/S2	354.96	486	0.73
C1/S3	489.13	523	0.94
C2/S1	136.67	84	1.63
C2/S2	195.91	96	2.04
C2/S3	19.71	10	1.97

**TABLE 5**  
Animal Attrition and Weathering

Layer	Total Bone Fragments*	Animal Attrition		Weathering	
		N	%	N	%
C1/S1	193	1	0.5	51	26.4
C1/S2	449	5	1.1	59	13.1
C1/S3	474	19	4.4	50	10.5
<b>C1 Total</b>	<b>1116</b>	<b>25</b>	<b>2.2</b>	<b>160</b>	<b>14.3</b>
C2/S1	76	7	9.2	30	39.5
C2/S2	91	3	3.3	19	20.9
C2/S3	9	0	0	3	33.3
<b>C2 Total</b>	<b>176</b>	<b>10</b>	<b>5.7</b>	<b>52</b>	<b>29.5</b>

Note: \* NISP minus teeth

Evidence of weathering was more common, occurring on about 16% of all bone fragments (Table 5). These showed fine hair line cracks which are characteristic of bones in the early stages of weathering (Behrensmeyer 1978). There were no examples of splitting or exfoliation to indicate that the bones had been subjected to more advanced weathering. This suggests that weathering was not a major cause of bone fragmentation. Furthermore, as with animal attrition, this kind of damage occurred on a smaller proportion of bones in the more fragmentary assemblages from the upper layer.

While weathering seems not to have influenced the observed pattern of bone breakage, it may reflect another aspect of the post-depositional history of the site. Leaving aside the very small assemblage from the base of layer C2, the greatest proportions of bones showing weathering occurred in the uppermost spits of each layer. This indicates that bones were exposed for some time on the surface of each layer, suggesting abandonment of the site or at least cessation of activity in the SAC area.

## DISCUSSION AND CONCLUSIONS

The material described above provides evidence of the depositional history of the site, the composition of its fauna, and details of some aspects of economic activity there. The pattern

of weathering on the bones indicates that the surface of each layer represents a period during which the SAC locality was abandoned, or at least not a major focus of activity. The taphonomic data also provide strong evidence in support of the archaeological observation that the upper layer had been disturbed by gardening. Bones and teeth from this horizon were broken into smaller, lighter fragments than was the case in the lower layer. Deliberate breakage of bones, attrition by animals and natural weathering have all been rejected as potential explanations for this pattern. This leaves mechanical breakdown, such as would occur with repeated digging of the deposit, as the only viable explanation.

Despite the fragmentary nature of the material it is clear that pigs dominated the fauna. This was the case not only in the large assemblages from rectangles III and IV, but also amongst the identifications reported from rectangle I. This predominance was consistent throughout the Lapita occupation sequence. Pig bones and teeth were securely provenanced to features from the earliest occupation, and outnumbered all other identified remains in the disturbed deposits above.

Minor components of the terrestrial fauna include single elements of a bandicoot and an unidentified reptile. Bird remains were slightly more numerous, but as none of these were identifiable it is not clear whether they reflect exploitation of terrestrial or marine avifauna. However, it can be noted that Horwood's (1988: 124) trace element analysis of two of these bones suggests that one may have been from a terrestrial herbivore, and the other from a marine carnivore. Minor components of the marine fauna identified here include crab and turtle. As with the pig remains, these minor components show no evidence for change in economic focus throughout the occupation sequence.

Two notable absences from the SAC fauna should be commented upon. Although no rat bones were recovered, clear evidence of rat gnawing was observed on one bone fragment. This was recovered from a pit (Green and Anson 2000: Fig. 8, pit [g]) associated with the earliest occupation. As no rat burrows were encountered during excavation this can be taken as secure, if indirect, evidence for the presence of rats. It is possible that rat bones were present in the site but were not recovered by the sieving methods used. In contrast, there is no indisputable evidence of dogs. No bones or teeth of this species were recovered, and it was argued above that the evidence of chewing on bones possibly attributable to dogs could equally have been produced by pigs.

The terrestrial fauna described here parallels that reported from Lapita contexts elsewhere. Pigs are reported from all other Bismarck Archipelago sites for which faunal data are available (Gosden *et al.* 1989: Table 4; Spriggs 1997: 111–26). In these same sites chickens and other birds, dogs and other small mammals, lizards and other reptiles occur sporadically but with considerable regularity. A similar situation obtains in sites farther east (Green 1979; Nagaoka 1988: Table 8.3; Spriggs 1997: 126–46), with pigs present in most sites, chickens also widely represented, but dogs either uncertainly identified or insecurely provenanced. Few other terrestrial species are present, presumably reflecting a general depauperisation of the indigenous fauna further to the east.

Despite their widespread occurrence, pig remains have generally not been abundant in Lapita sites, making it difficult to determine the manner in which they were exploited. As non-indigenous fauna, their presence in Oceania implies human introduction, whether as imported game or husbanded stock. It has also been suggested that during the Early Western Lapita phase in the Bismarcks pigs might have been obtained by exchange from New Guinea rather than locally (Kirch 1997: 211–12), although recent reviews of the evidence cast doubt upon claims for pre-Lapita presence of pigs in that area (Golson 1997: 44, 47; Harris 1995: 852–53; Spriggs 1996: 335).

With a mid to late first millennium BC age (Green and Anson 2000), the Kainapirina remains cannot elucidate the earliest stages of pig usage in the region. However, they are the largest assemblage of pig remains yet recovered from a Lapita context, and the only one for which evidence of age at death is available. This permits closer examination of the nature of Lapita pig exploitation than has previously been possible. There are two general forms that this exploitation could have taken: pig husbandry, or the hunting of feral animals. In archaeological terms the distinction between the two rests upon the assumption that the former would involve selective culling of most pigs at a relatively young age while maintaining a small number of older animals for breeding. In contrast, hunting would be expected to yield a more diverse age structure in the kill population. On this basis it can be argued that the predominance in the excavated assemblages of pigs aged between 12 and 24 months indicates that the Lapita economy at Watom involved pig husbandry.

There are no reliable data on growth rates in prehistoric pigs in the Pacific, so it is not possible to tell whether this emphasis on 1 to 2 year old pigs reflects a strategy designed to optimise meat production from these animals. What can be said is that the pattern observed at Watom is broadly similar to those reported from three other Pacific sites for which demographic data are available. Pig remains from Pakea Islet (Horton and Ward 1981), TO-6 on Tongatapu (Poulsen 1987), and two sites on Taumako (Smith n.d.) are nearly all from animals aged 24 months or less. Only one out of 16 pigs from Pakea and four out of 23 on Taumako are older. There is, however, some variability within the age structures of these populations. As at Watom, 1 to 2 year old pigs predominate on Pakea Islet, while younger animals are most abundant at TO-6 and on Taumako. More detailed analysis of the extent and causes of this variation is not possible because of differences in the ways in which the various sets of demographic data are presented.

In conclusion, the data presented here provide clear evidence for an important terrestrial component in the Lapita economy at Watom. Although few wild animals were hunted, pigs were present throughout the sequence and show that animal husbandry was practised. These animals can also be seen as indirect evidence for horticulture, as it seems unlikely that pig rearing could be sustained on a small island such as Watom unless food crops were also grown.

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