

# Fijian Cannibalism and Mortuary Ritual: Bioarchaeological Evidence from Vunda

**DAVID DEGUSTA\***

*Laboratory for Human Evolutionary Studies, Museum of Vertebrate Zoology,  
Department of Integrative Biology, University of California, Berkeley,  
CA 94720-3140, USA*

**ABSTRACT** The human skeletal remains from the site of Vunda (AD 800–1600) in Fiji have been interpreted as evidence of cannibalism. The cannibalism hypothesis is tested by examining the modifications of the Vunda skeletal sample. The sample consists of human and non-human bones from a midden context, as well as intact human burials extracted from the midden. Most modifications are more common in the medium mammal sample than in the midden human sample—burning (9% of medium mammal remains and 5% of human remains), cutmarks (4 and 1.5%), percussion pits (1 and 0%), and peeling (2 and 0%)—though these differences are not statistically significant. There are no significant differences between the human burials and the midden human sample in the rates of cutmarks, percussion pits, peeling, or in the pattern of element representation. Therefore the cannibalism hypothesis is not supported at Vunda. Most of the ‘midden’ human remains were probably part of the formal burials. The modifications and context of the Vunda sample are compared with the remains from the nearby, partially contemporaneous site of Navatu (where an inference of cannibalism is supported) to tentatively establish the characteristics of Fijian mortuary rituals versus cannibalism. Copyright © 2000 John Wiley & Sons, Ltd.

*Key words:* burial; diet; faunal analysis; Oceania; taphonomy

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## Introduction

Anthropologists continue to debate whether cannibalism was ever practised (Osborne, 1997). Arens (1979) argued that cannibalism is essentially mythical, and that there is no good evidence for customary cannibalism in any culture. Sahlins (1979, 1983) maintained that portions of the ethnohistorical record are accurate, and that cannibalism was practised by prehistoric Aztecs and Fijians. A number of archaeological assemblages have been interpreted as evidence of cannibalism (Turner, 1989; White, 1992) but commentators have criticized these interpretations, claiming that non-cannibalistic mortuary rituals are a more palatable explanation (Bullock, 1991; Bahn, 1992a).

The majority of detailed bioarchaeological studies of cannibalism have been done on skeletal collections from the American Southwest, where recognition criteria for cannibalism have been developed (White, 1992; Turner, 1993). Some of the strongest ethnohistorical evidence for cannibalism, though, comes from Oceania, particularly Fiji (Sahlins, 1979, 1983; Rechtman, 1992; White, 1992). The question of Fijian cannibalism has centred on the reliability of written accounts, but hypotheses derived from the ethnohistorical record can be tested by archaeological excavation and analysis (Moctezuma, 1987).

The hypothesis that an archaeological assemblage represents the remains of cannibalistic activity can be tested using the methods of White (1992). In summary, the approach is to first quantify the modifications (cutmarks, burning, etc.) of the skeletal remains. Then the modifications of the human remains are compared with those of related non-human faunal

\* Correspondence to: David DeGusta, Department of Integrative Biology, 3060 VLSB, University of California, Berkeley, CA 94720-3140, USA. Fax: +1 510 6438231; e-mail: degusta@uclink.berkeley.edu

assemblages interpreted as dietary debris. If the modifications are similar in both the human and non-human samples (allowing for differences in anatomy), then an inference of cannibalism is warranted. Additionally, the taphonomic history of the assemblage must be assessed, and an evaluation made of the possibility that non-cannibalistic mortuary rituals might mimic butchery and consumption.

In Fiji, this method has been applied only to the remains from Navatu (DeGusta, in press). The human remains from the Navatu midden were interpreted as evidence of cannibalism based on several factors. The modifications of the human remains in the midden generally match those of the other taxa in the midden and a consideration of taphonomic factors indicated that humans were the primary modifiers of the assemblage. The modifications and context of the Navatu midden human sample are distinctly different from those found in formal Fijian burials and in a variety of secondary burials, including those derived from massacres (DeGusta, in press).

Samples from several other Fijian sites are stated to contain evidence of cannibalism, but very few data have been published. Gifford (1951) inferred that cannibalism had occurred at both Navatu and Vunda based on burned and broken human bones being mixed with those of other animals, but presented no data or analysis to support that inference. Best (1985) observed charring and cutmarks on some of the human bones he recovered from Lakeba, and concluded they were cannibalized, but provided no data on those or any other modifications. Spennemann (1987) cataloged the cutmarks to the human bones from a tree-fork 'cannibal' trophy on Viti Levu, but his sample was limited to 13 relatively intact human bones. Rechtman (1992) reported 1.2 kg of 'cannibalized' human bone from his excavations on Wakaya, but gives only relative frequencies of fracture angle and fracture outline for a portion of the human sample.

The claim of Gifford (1951) that the Vunda remains represent evidence of cannibalism is tested here by a detailed study of that skeletal material. The modifications seen in the midden-derived human remains are compared with those of the other midden fauna and with the alter-

tations in the contemporaneous human burials from Vunda. The analysis does not support an inference of cannibalism at Vunda. The Vunda modification data do provide information on Fijian mortuary practices that, when compared to the data on the cannibalized Navatu remains, permits the tentative establishment of the characteristics of Fijian cannibalism versus non-cannibalistic mortuary ritual.

## Materials

The sample studied was excavated by Gifford in 1947 at the site of Vunda on the island of Viti Levu (18°S, 178°E; 10388 km<sup>2</sup>) in the Fijian archipelago. The deposits are from the Middle Period, or Vunda Phase, and date from approximately AD 800–1100 to AD 1600–1800 based on pottery styles and radiocarbon dates (Gifford, 1951, 1955; Green, 1963).

All the material that Gifford excavated at this site comes from a single midden deposit (Gifford, 1951). A portion of the midden extended under the remains of a protohistoric dwelling (Figure 1). Midden materials recovered from within the perimeter of the dwelling were assigned to locus '26H', while midden materials from outside the perimeter were assigned to locus '26M'. The midden was composed of a mix of shell, potsherds, and bone fragments of many taxa, including humans. The bone

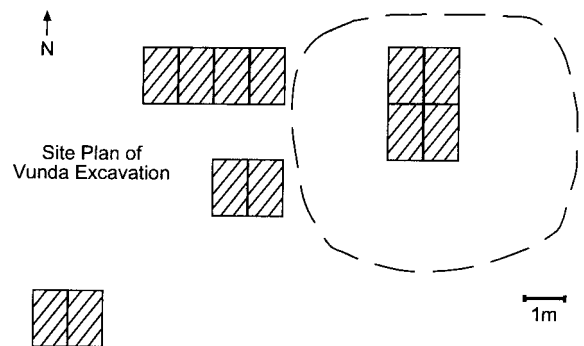


Figure 1. Excavation plan of Vunda (site 26) redrawn from Gifford (1951). The hatched rectangles indicate excavated areas. The dashed line shows the perimeter of the protohistoric dwelling. Materials excavated from within the dwelling perimeter were assigned to locus 26H, while those from outside the perimeter were assigned to locus 26M.

Table 1. Number of specimens by taxa at the Vunda site (see text for explanation of categories)<sup>a</sup>

Taxa	26H	26M	Total
Human	74 (39)	60 (13)	134 (20)
Medium mammal	58 (31)	179 (38)	237 (36)
Small mammal	1 (0.5)	6 (1)	7 (1)
Mammal CBH	37 (20)	31 (7)	68 (10)
Aves	4 (2)	19 (4)	23 (4)
Reptilia	7 (4)	114 (24)	121 (18)
Pisces	6 (3)	44 (9)	50 (8)
Indeterminate	2 (1)	19 (4)	21 (3)
Midden total	189	472	661
Human burials			583

<sup>a</sup> Values in parentheses are percentages.

fragments of all taxa, including humans, were commingled. Several human skeletons were extracted from the midden at locus 26H and were considered by Gifford to be burials distinct from the midden material. The burials are of Fijians based on the associated artifacts (Gifford, 1951) and non-metric traits of the skeletons (e.g. rocker jaws, general cranial configuration, etc.).

Gifford excavated the midden in a series of three foot by six foot rectangles, digging down in arbitrary six inch increments. Eight of these rectangles were excavated at 26M and four at 26H. A description of the features found at these loci is given in Gifford (1951). Gifford did not state the exact recovery method used in the excavations, but he noted that all bone was saved (Gifford, 1951). Very small bone fragments (longest dimension < 1 cm) were recovered, so there was probably no significant size bias introduced by the excavation methods.

The human remains from this site, though they were all recovered from within the midden, were divided into two analytical categories: the burial sample (the human remains judged by Gifford to be intact human burials at midden locus 26H), and the midden human sample (the fragmentary human remains that Gifford judged to belong with the midden deposit as opposed to the formal burials). Based on excavation records and the bones themselves, it appears that Gifford made the distinction between 'burial' and 'midden' human material at 26H based on the completeness of the bones—they are spatially commingled,

with some 'burial' human remains found in the same excavation square and level as 'midden' human remains. The midden human remains are further divided into two subcategories: those from midden locus 26H, and those from midden locus 26M. All non-human fauna is part of the midden sample, and is similarly divided into two loci (26H and 26M).

The majority of bones are of fish. Due to time constraints, a randomly selected portion of the fish remains was analysed rather than the entire fish sample. All remains labelled by Gifford and co-workers as 'fish' were inspected to confirm that taxonomic identification. Every recovered non-fish bone was analysed.

The faunal composition of the midden is given in Table 1. The non-human mammalian fauna consists primarily of pig (*Sus scrofa*), with a few bat (*Pteropus* sp.), rat (*Rattus exulans*), goat (*Capra hircus*), and dog (*Canis familiaris*) remains. For analytical purposes, the rat and bat remains are grouped as 'small mammal', while the other non-human mammals are grouped as 'medium mammal'. The reptilian fauna is entirely turtle (*Chelonia* cf. *mydas*), while the avifauna contains representatives of Phasianidae and Charadriiformes/Procellariiformes (Tom Stidham, personal communication). The fish taxa are given in Fowler (1955). There are a number of small fragments of limb shaft (longest dimension < 2 cm) which are not identified beyond class Mammalia. They are termed 'mammal—CBH (could be human)' and are not counted toward either the human or non-human totals. The 'indeterminate' category contains specimens that are not human, but were not identified beyond that. The burials contain 585 human specimens.

The minimum number of individuals (MNI) in the midden human sample is given in Table 2, along with the maximum number of individuals and the number of identified specimens of each element. The MNI values take into account antimeric correspondence, age category (immature or adult), and, for dental elements, the general degree of occlusal wear. It is possible that a single individual spanned both loci, so the total MNI values for an element reflect an MNI analysis of the pooled 26H/26M sample. The MNI values for the midden human sample are influenced by the high degree of

fragmentation, and so are not comparable with more intact assemblages.

The overall MNI in the midden human sample is three (two adult, one immature) and the overall MNI in the burials is four (three adult, one immature). Given that the midden and burial human remains were commingled in the deposit, portions of the same individual could be represented in both categories. The MNI values were tabulated separately, however, so they are not a true minimum. Conjoining was also not undertaken for the burial sample, but the effect on the MNI should be minimal given the relatively intact nature of the burials.

Table 2. Number of identified specimens (NISP), maximum number of individuals (MAXNI), and minimum number of individuals (MNI) for the Vunda midden human sample<sup>a</sup>

Element	Locus 26H	Locus 26M	Total
Frontal	3/3/2	3/3/1	6/6/2
Parietal	2/2/2	1/1/1	3/3/2
Temporal	2/1/1	1/1/1	3/2/2
Occipital	1/1/1	1/1/1	2/2/2
Mandible	1/1/1	—	1/1/1
Teeth	1/1/1	4/4/2	5/5/2
Rib	3/3/2	8/8/1	11/11/2
Cervical vertebrae	1/1/1	—	1/1/1
Thoracic vertebrae	1/1/1	2/2/1	3/3/2
Indeterminate vertebrae	7/7/2	4/4/2	11/11/2
Humerus	1/1/1	—	1/1/1
Radius	1/1/1	—	1/1/1
Ulna	1/1/1	1/1/1	2/2/1
Carpals	1/1/1	—	1/1/1
Metacarpals	2/2/1	2/2/1	4/4/1
Prox. hand phx.	2/2/2	1/1/1	3/3/2
Int. hand phx.	—	2/2/1	2/2/1
Os coxae	—	1/1/1	1/1/1
Femur	3/3/1	—	3/3/1
Patella	2/2/1	—	2/2/1
Tibia	4/4/2	—	4/4/2
Fibula	2/2/1	—	2/2/1
Tarsals	1/1/1	1/1/1	2/2/1
Metatarsals	1/1/1	1/1/1	2/2/1
Prox. foot phx.	1/1/1	—	1/1/1
ICR1	2/x/x	5/x/x	7/x/x
ICR2	12/x/x	7/x/x	19/x/x
IP1	6/x/x	7/x/x	13/x/x
IP2	2/x/x	5/x/x	7/x/x
IP3	1/x/x	1/x/x	2/x/x
IP4	5/x/x	1/x/x	5/x/x

<sup>a</sup> Numbers in table are NISP/MAXNI/MNI. ICR1, frontal or parietal; ICR2, cranial vault; IP1, radius, ulna, or fibula; IP2, humerus, femur, or tibia; IP3, femur or tibia; IP4, indet. postcranial; Prox, proximal; Int, intermediate; phx, phalange.

## Methods

The unit of analysis was the piece of bone, or specimen. A small portion of the sample (< 1%) had been previously been the subject of reconstruction attempts. All glued joins in the midden sample were dissolved prior to analysis. Those joins across obviously modern breaks (using the criteria of White, 1992) were then reglued. For the burials, joins were only 'conceptually' dissolved due to curatorial concerns. That is, the various pieces making up the reconstructed element were scored as separate specimens despite being physically connected.

A few unreconstructed specimens had breaks that were obviously modern and had probably occurred in curation or transport of the collection. Midden specimens with modern breaks were compared with every other specimen from the same excavation square and level for a match across the modern break. Such joins were reglued prior to analysis. A similar procedure was followed for the burials, but the joins were 'conceptual'. That is, the joined pieces were scored as a single specimen despite being physically separated.

Every specimen was then scored for a variety of characteristics: element and taxonomic identification, bitemarks, burning, crushing, cutmarks, fragmentation, incipient fracture cracks, peeling, percussion pits, random striae, and weathering. The attributes and their definitions were taken from White (1992). Any modification judged potentially due to excavation or preparation damage was excluded. Data were collected on the specimens by excavation rectangle and level to help prevent any observer bias which might be introduced by analysing the human remains separately. To ensure consistent identification of two important modifications, all specimens that might possibly have cutmarks or percussion pits were identified in the initial round of analysis. Then, in one session, all bones (human and non-human) with possible cutmarks or percussion pits were scored for those modifications with frequent cross-checking between specimens to ensure consistent application of the recognition criteria. After all modification data were collected, maximal

conjoining (in the sense of White, 1992) was done for the midden human specimens that had been identified to a specific element. Not a single join was located.

Modification frequencies are presented here as the percentage of scorable specimens on which the particular modification is found. The statistical significance of differences in modification frequencies between taxa was assessed using Fisher's exact chi-squared test with Yate's correction ( $\alpha = 0.05$ ). All  $p$  values reported are two-sided and refer to this test. The analytical categories commonly used are 'midden human sample' (human remains from within the midden, not including the burials), 'burials' (the human remains from the formal human burials at locus 26H), and 'medium mammal sample' (medium-sized mammal remains from within the midden).

## Results

### Human element representation

The postcranial element representation in the Vunda human samples is shown in Figure 2. The bars in the chart indicate what percentage of each postcranial sample is composed of specimens from the listed elements; that is, what percentage of the number of identified specimens (%NISP) are from each element. Specimens not identified to element (i.e. small fragments of long bone shafts) were not included in the calculation. The 'normal' bars represent what the percentages would be for a single complete skeleton. Figure 3 compares the human postcranial element representation in the

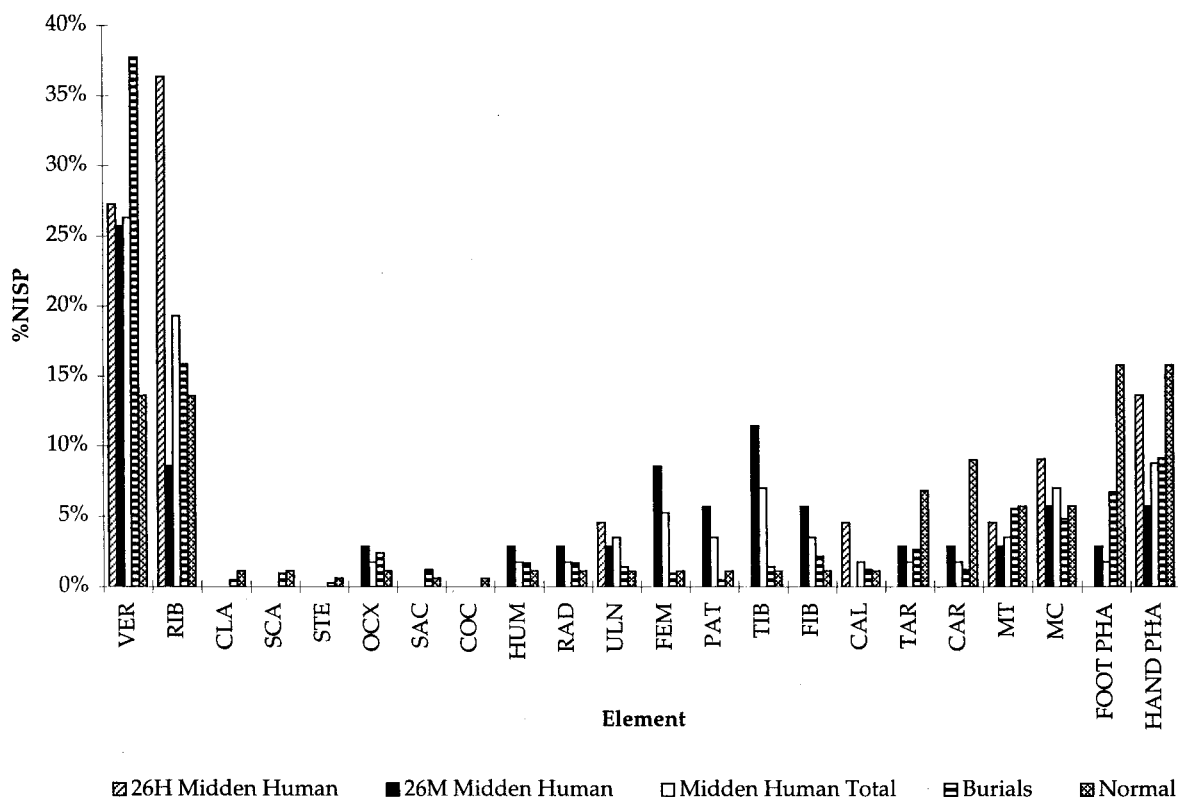


Figure 2. Postcranial element representation in the Vunda human samples. The bars indicate the percentage of identified postcranial specimens that are from each element. The 'normal' bars show what the element representation would be in a single complete skeleton. The abbreviations for skeletal elements along the x-axis are as follows: ver, vertebra; rib, rib; cla, clavicle; sca, scapula; ste, sternum; ocx, os coxae; sac, sacrum; coc, coccyx; hum, humerus; rad, radius; uln, ulna; fem, femur; pat, patella; tib, tibia; fib, fibula; cal, calcaneus; tar, other tarsal bones; car, carpals; mt, metatarsals; mc, metacarpals; foot pha, foot phalanges; hand pha, hand phalanges.

Vunda midden and burials with that of the Navatu midden human remains (DeGusta, in press) and a sample of canid-modified human burials from prehistoric Illinois (30 individuals; Milner & Smith, 1989).

The postcranial element representation varies considerably between the two midden loci, but the relatively small sample size for each may exaggerate the differences. The human remains from locus 26M and the aggregate midden human sample have element representations generally similar to that of the burials, which in turn resemble the 'normal' distribution. The Vunda midden human sample has far more specimens from the axial skeleton, but fewer from the appendicular skeleton, than the Navatu midden human sample. The Vunda burials are broadly similar to the canid-modified burials from prehistoric Illinois.

In the Vunda midden, 30% of all human specimens are cranial or mandibular (40 out of

134), while the proportion in the burials is 15% (89 out of 585). Part of the difference between the two samples is likely due to the greater fragmentation of the midden sample. In the Navatu midden, however, a significantly greater percentage of the human remains (about 50%) are cranial and mandibular (DeGusta, in press). Qualitatively, the Vunda midden cranial remains appear to contain relatively more vault fragments compared to the Vunda burial cranial remains.

*Fragmentation*

The midden sample is quite fragmentary—the longest dimension of many pieces is less than 4 cm—while the bones in the burials are more intact. Each specimen was evaluated for fracture surfaces of ancient, modern, and indeterminate origin. The antiquity of breaks was judged

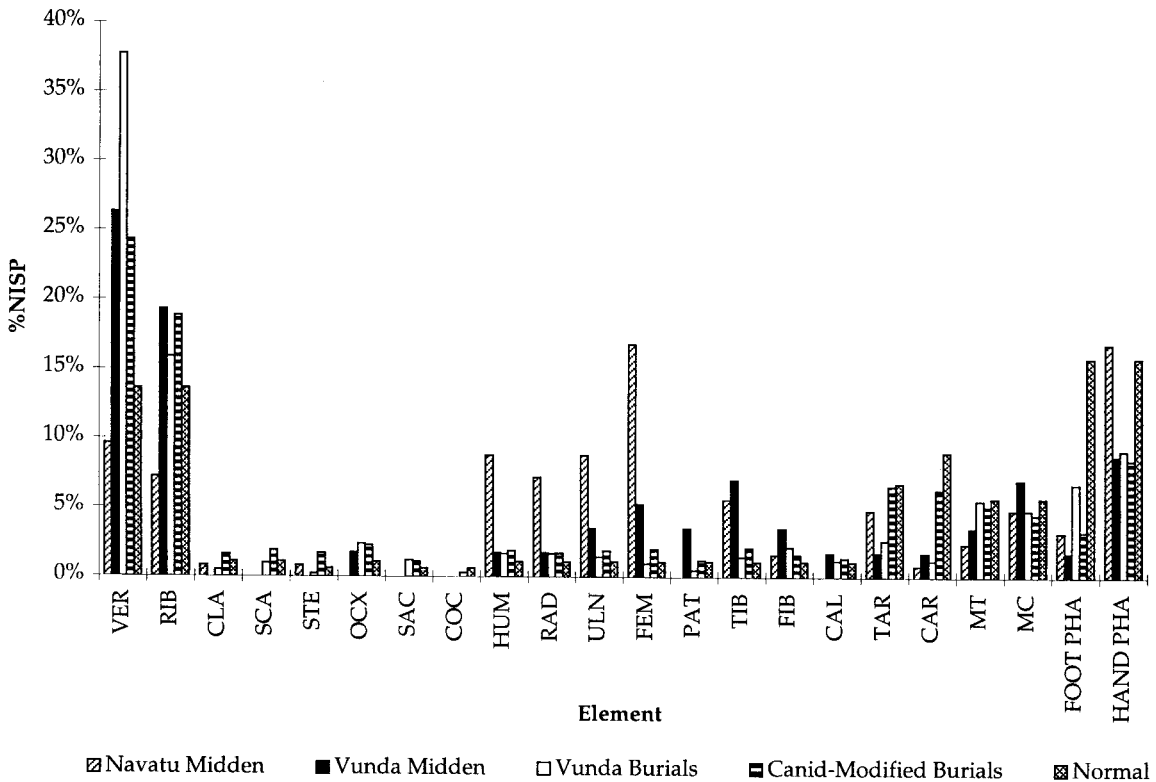


Figure 3. Postcranial element representation in the Vunda human samples compared to the Navatu midden human sample (DeGusta, in press) and canid-modified burials from Illinois (Milner & Smith, 1989). The bars and abbreviations are as in Figure 2.

Table 3. Ancient breaks in the Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Human	69/74 (93)	53/60 (88)	122/134 (91)
Medium mammal	14/17 (82)	167/179 (93)	181/196 (92)
Aves	4/4 (100)	19/19 (100)	23/23 (100)
Reptilia	7/7 (100)	114/114 (100)	121/121 (100)
Pisces	6/6 (100)	44/44 (100)	50/50 (100)
Midden total	179/189 (95)	453/472 (96)	632/661 (96)
Human burials	—	—	468/585 (80)

<sup>a</sup> Values in parentheses are percentages.

Table 4. Number of 'fragmentary' remains in the Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Human	49/59 (83)	34/45 (76)	83/104 (80)
Medium mammal	18/20 (90)	86/107 (80)	104/127 (82)
Midden total	99/111 (89)	154/189 (82)	253/300 (84)
Human burials	—	—	173/348 (50)

<sup>a</sup> Values in parentheses are percentages.

based on the correspondence in colour, patina, matrix adhesion, and texture between the broken surface and the rest of the specimen (Lyman & O'Brien, 1987; White, 1992). If the break surface matched the rest of the specimen, the fracture was judged ancient. If not, the fracture was judged modern. Ambiguous cases were scored as fractures of indeterminate antiquity. The number of specimens with ancient breaks is given in Table 3. The rate of ancient fractures does not

differ significantly between the midden human remains and the medium mammal remains ( $p = 0.687$ ). There are significant differences between both of those and the human burials ( $p < 0.002$ ).

The degree of fragmentation was roughly quantified by scoring each specimen as 'whole' if it represented more than half of the element, or 'fragmentary' if it represented less than half (White, 1992). Non-human specimens not identified to element were scored as indeterminate for this category. Human specimens not identified to element were only scored as 'fragmentary' if they would represent less than half of any element they might possibly be. The number of fragmentary specimens is given in Table 4. The midden human remains are not significantly more fragmentary than the medium mammal remains ( $p = 0.738$ ). Both of these samples are significantly more fragmentary than the human burials ( $p < 0.001$ ).

The portion of the bone preserved was recorded for all tubular elements as either complete (portions of both articular ends plus shaft), shaft only, proximal end only, distal end only, proximal end plus shaft, or distal end plus shaft (White, 1992). The portions preserved for the midden and burial samples are quantified in Table 5. There are no significant differences between the portions preserved for the midden human remains and the medium mammal remains. Both are significantly different from the burial sample—the burials have far more 'complete' tubular elements and relatively few 'shaft only' specimens.

Table 5. Element portion preserved in Vunda tubular bone sample<sup>a</sup>

Locus	Complete			Proximal/distal end plus shaft		
	Burials	Midden human	Medium mammal	Burials	Midden human	Medium mammal
26H	—	3 (10)	1 (5)	—	1 (3)	1 (5)
26M	—	3 (13)	7 (9)	—	2 (8)	9 (12)
Total	96 (51)	6 (11)	8 (8)	27 (14)	3 (6)	10 (105)
	Proximal/distal end only			Shaft only		
26H	—	5 (16)	1 (5)	—	22 (71)	18 (86)
26M	—	0 (0)	3 (4)	—	19 (79)	59 (75)
Total	18 (10)	5 (9)	4 (4)	48 (25)	41 (75)	77 (78)

<sup>a</sup> Values in parentheses are percentages.

Table 6. Shaft circumference preserved in Vunda tubular bone sample<sup>a</sup>

Locus	<50% preserved			>50% but <100% preserved			100% preserved		
	Burials	Midden human	Medium mammal	Burials	Midden human	Medium mammal	Burials	Midden human	Medium mammal
26H	—	15 (58)	14 (63)	—	0 (0)	1 (5)	—	11 (42)	7 (32)
26M	—	16 (67)	45 (60)	—	2 (8)	4 (5)	—	6 (25)	26 (35)
Total	33 (19)	31 (62)	59 (61)	0 (0)	2 (4)	5 (5)	138 (81)	17 (34)	33 (34)

<sup>a</sup> Values in parentheses are percentages.

The shaft circumference preserved was recorded for all tubular elements retaining any portion of the shaft. The maximum enclosure of the marrow cavity was scored as either less than 50% of the shaft circumference preserved, greater than 50% but less than 100% preserved, or 100% preserved (White, 1992). The circumference preserved in the midden and burial specimens is given in Table 6. The midden human and medium mammal samples are very similar in the proportions of the circumference preservation scores. Both are significantly different from the human burial sample, in which virtually all tubular specimens have completely enclosed marrow cavities.

#### *Incipient fracture cracks*

Incipient fracture cracks are fissures in the bones that partly or completely cross the bone surface, but are not minor hairline cracks (White, 1992). The number of specimens in the sample with incipient fracture cracks is given in Table 7. Within the midden, there are no significant differences in the rate of incipient fracture cracks between the taxa. Almost all specimens in the midden with this modification have only a single crack (11 out of 12); the lone exception has four separate cracks. There does not appear to be any significant element patterning of incipient fracture cracks.

#### *Conjoining*

After all modification data were collected, the midden human specimens identified to element were subjected to maximal conjoining (*sensu*

White, 1992). No joins were located within the midden human sample. The burials were not subjected to conjoining.

#### *Weathering*

The six stage weathering scale of Behrensmeyer (1978) was employed to assess the degree of weathering. These weathering scores do not carry any implications about the duration of surface exposure of the bones (White, 1992), but do provide an indication of both general preservation and relative rates of weathering between the various loci of this sample. The weathering scores for the sample are given in Table 8. The sample is relatively unweathered, with almost all specimens scoring zero or one. The weathering does not vary appreciably by taxa, and the two loci have roughly the same degree of weathering—26H is somewhat more weathered, the burials somewhat less.

#### *Random striae*

Random striae are marks that, while superficially similar to cutmarks, are shallow and random in their orientation on the bone. They also tend to be most intense on projecting areas of the bone (White, 1992 and the references therein). They are usually interpreted as the results of rockfalls, animal trampling, or mechanical abrasion by sand (Fiorillo, 1989). Only a single specimen in the midden (out of 658 scorable specimens) has random striae: a human vault fragment from locus 26H. None of the 585 scorable burial specimens have random striae.

Table 7. Incipient fracture cracks in Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Midden human	1/74 (1)	1/60 (2)	2/134 (2)
Medium mammal	2/58 (4)	3/179 (2)	5/237 (2)
Midden total	5/189 (3)	7/471 (2)	12/660 (2)
Burials	—	—	0/585 (0)

<sup>a</sup> Values in parentheses are percentages.

Table 8. Weathering in the Vunda sample<sup>a</sup>

Score	26H	26M	Midden total	Burials
Zero	110	376	486	543
One	71	93	164	40
Two	6	1	7	1
Mean	0.44	0.20	0.27	0.07

<sup>a</sup> Weathering scale from Behrensmeier (1978).

### Bitemarks

Each specimen was evaluated for the presence of carnivore bitemarks, rodent gnawing, and bitemarks of uncertain origin. No single specimen has more than one kind of bitemark. Carnivore bitemarks were diagnosed based on the presence of circular perforations of the bone and associated striae (Binford, 1981; White, 1991). The term 'carnivore' is used here to refer to dietary behaviour rather than to the order Carnivora. The taxa known from Viti Levu that might produce carnivore bitemarks are dogs, pigs, goats, and humans. The carnivore bitemarks observed are of a size consistent with a canid, though the possibility that some of them are human bitemarks cannot be ruled out (White, 1992). The frequency of carnivore bitemarks in the midden sample is given in Table 9. The difference in the frequency of carnivore bitemarks between the midden human

Table 9. Carnivore bitemarks in the Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Midden human	0/74 (0)	0/60 (0)	0/134 (0)
Medium mammal	0/58 (0)	8/179 (5)	8/236 (3)
Midden total	0/188 (0)	9/472 (2)	9/660 (1)
Burials	—	—	0/585 (0)

<sup>a</sup> Values in parentheses are percentages.

and medium mammal remains is not quite significant ( $p = 0.055$ ).

Rodent gnawing was diagnosed based on the presence of parallel indentations (White, 1991; Haglund, 1992). The gnawing observed is of a size consistent with the rat species known from the site (*Rattus exulans*). The frequency of rodent gnawing in the midden sample is given in Table 10. The difference in frequency of rodent gnawing between the midden human and medium mammal remains is not significant ( $p = 0.180$ ).

Some modifications were observed that, while clearly the result of a tooth impact, could not be unambiguously assigned to either rodent gnawing or carnivore action. These were tabulated as bitemarks of uncertain origin, and their frequency in the sample is given in Table 11.

### Burning

Specimens were scored as burned if they exhibited either severe discolouration (i.e. blackened or calcined) or a combination of moderate discolouration and exfoliation of the bone surface (White, 1992). An example of thermal alteration observed in the midden sample is illustrated in Figure 4. The frequency of burning in the sample is given in Table 12. No burning was observed in the human burials. Due to the small size of most specimens, it was generally not possible to assess the patterning of the burning relative to soft tissue cover. The burned human sample has one specimen that exhibits patterned burning relative to soft tissue cover, one which does not, and five which are unclear in this regard. There is no significant difference in the frequency of burning between the midden human and medium

Table 10. Rodent gnawing in the Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Midden human	3/74 (4)	2/60 (3)	5/134 (4)
Medium mammal	1/58 (2)	17/179 (10)	18/236 (8)
Midden total	4/188 (2)	28/472 (6)	32/660 (5)
Burials	—	—	2/585 (0.3)

<sup>a</sup> Values in parentheses are percentages.

Table 11. Bitemarks of indeterminate origin in the Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Midden human	0/74 (0)	0/60 (0)	0/134 (0)
Medium mammal	2/58 (4)	4/179 (2)	6/236 (3)
Midden total	1/188 (1)	5/472 (1)	7/660 (1)
Burials	—	—	0/585 (0)

<sup>a</sup> Values in parentheses are percentages.



Figure 4. Two burned human specimens from the Vunda midden (26M). The white bar is 5 mm long.

mammal remains ( $p = 0.226$ ). There is a significant difference between both of those samples and the burials ( $p < 0.001$ ). Locus 26M has a significantly higher rate of burning than locus 26H ( $p = 0.005$ ).

*Cutmarks*

Cutmarks were identified in the sample using the recognition criteria outlined by White (1992). The frequency of cutmarks is given in Table 13, and a representative cutmark is illustrated in Figure 5. There is no significant difference in the frequency of cutmarks between the midden human sample and the burials ( $p = 0.160$ ) or the medium mammals ( $p = 0.224$ ). The cutmarked midden human specimens are a femur shaft and an indeterminate long bone shaft. The cutmarked burial specimens are a fibula shaft and a mostly complete frontal.

Table 12. Burning in the Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Midden human	2/74 (3)	5/60 (8)	7/134 (5)
Medium mammal	4/58 (7)	17/179 (10)	21/237 (9)
Aves	1/4 (25)	3/19 (16)	4/23 (17)
Reptilia	1/7 (14)	22/114 (19)	23/121 (19)
Pisces	1/6 (17)	4/44 (9)	5/50 (10)
Midden total	10/189 (5)	60/472 (13)	70/661 (11)
Burials	—	—	0/585 (0)

<sup>a</sup> Values in parentheses are percentages.

Table 13. Cutmarks in the Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Midden human	2/74 (3)	0/60 (0)	2/134 (2)
Medium mammal	2/57 (4)	8/179 (5)	10/236 (4)
Aves	0/4 (0)	1/19 (5)	1/23 (4)
Reptilia	0/7 (0)	3/114 (3)	3/121 (3)
Pisces	0/6 (0)	0/44 (0)	0/50 (0)
Midden total	4/187 (2)	14/471 (3)	18/658 (3)
Burials	—	—	2/585 (0.3)

<sup>a</sup> Values in parentheses are percentages.

*Percussion pits*

Percussion pits are caused by the impact of a percussor that scars solid cortical bone without causing inward crushing of the bone cortex (White, 1992). They are roughly circular in outline, and are more irregular in internal topography and outline than carnivore tooth

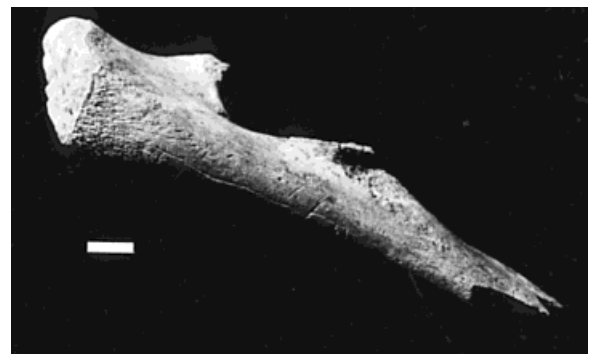


Figure 5. A pig ulna with cutmarks from the Vunda midden (26M). The white bar is 5 mm long.

pits. Only four specimens in the sample have percussion pits (Table 14): two medium mammal specimens, one indeterminate shaft fragment, and one complete human femur from the burials. The small number of specimens with percussion pits precludes meaningful comparisons of frequencies between taxa.

### Peeling

Peeling is the characteristic pattern of exfoliation produced when a fresh bone is snapped in two (White, 1992). The resulting 'peeling apart' of the two pieces produces a roughened, exfoliated surface with parallel grooves. All tubular elements (long bones, non-terminal phalanges, metacarpals, and metatarsals) were scored for this characteristic, along with ribs and vertebral spines. Only two specimens in the sample exhibit peeling; both are medium mammal specimens from locus 26M (out of 130 scorable midden medium mammal specimens). None of the 68 scorable midden human specimens or the 343 scorable burial specimens have peeling. The small number of specimens with peeling precludes meaningful comparisons of frequencies between taxa.

### Crushing

Crushing is the inward displacement of cortical bone into the inner spongy bone space. Crushing covers a larger area and produces a more gradually sloped margin than do carnivore bitemarks and percussion pits, which typically consist of a sharp depression surrounded by uncrushed bone (White, 1992). Seven specimens in the sample have crushing (Table 15). There are no significant differences in the rates

Table 14. Percussion pits in the Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Midden human	0/74 (0)	0/60 (0)	0/134 (0)
Medium mammal	0/57 (0)	2/179 (1)	2/236 (1)
Midden total	1/187 (1)	2/471 (0.4)	3/658 (1)
Burials	—	—	1/585 (0.2)

<sup>a</sup> Values in parentheses are percentages.

Table 15. Crushing in the Vunda sample<sup>a</sup>

Taxa	26H	26M	Total
Midden human	1/74 (1)	1/60 (2)	2/134 (2)
Medium mammal	1/57 (2)	1/179 (1)	2/236 (1)
Midden total	2/186 (1)	5/471 (1)	7/657 (1)
Burials	—	—	0/585 (0)

<sup>a</sup> Values in parentheses are percentages.

of crushing between the midden human and medium mammal samples ( $p = 0.623$ ). The difference between the midden human and burial specimens is significant ( $p = 0.035$ ), but only two midden human specimens have crushing.

### Summary of modifications

Breakage and fragmentation are relatively common in the midden remains and somewhat less so in the burials. Cutmarks and burning are less common in the midden and virtually absent in the burials. Peeling, percussion pits, and crushing are extremely rare in both the midden and the burials. While there are no statistically significant differences between the midden human and medium mammal remains, the medium mammals have noticeably higher frequencies of burning, cutmarks, percussion pits, and peeling (Figure 6).

## Discussion

### Agents of modification

Many agencies have the potential to modify skeletal remains. These include sediment pressure, weathering, trampling by animals, and the actions of carnivores, rodents, and humans. The potential non-human causes of bone modification in the Vunda assemblage must be evaluated before inferences about human behaviour can be drawn from the modification data.

If sediment pressure were a major cause of bone fragmentation then a substantial portion of the midden human sample might be expected to conjoin, which it does not. Additionally, if sediment pressure were an important factor it would be expected that the burials and the locus 26H

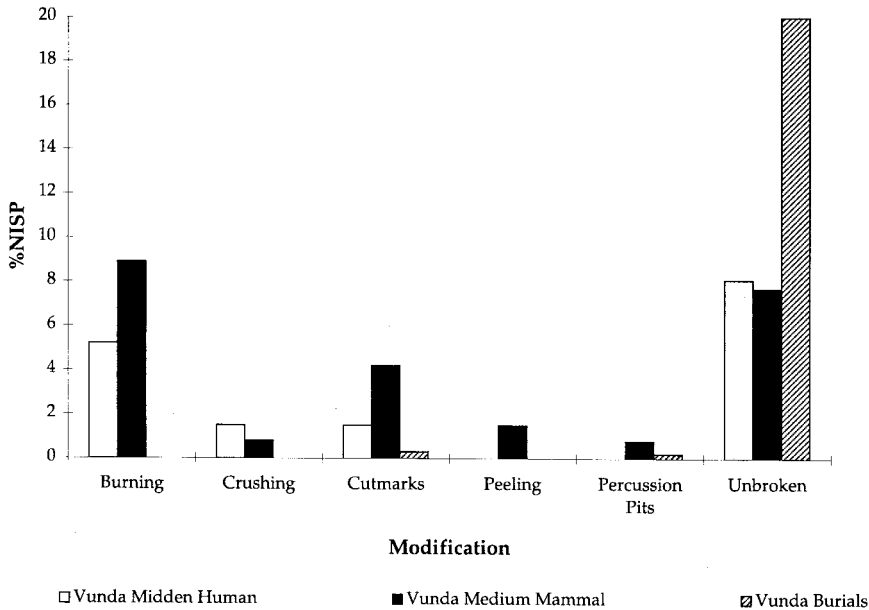


Figure 6. Summary of modification frequencies in the Vunda midden and burial samples. Bars represent the percentage of scorable specimens with a given modification.

midden remains would be similarly fragmented since they come from the same place, but the former are far more intact than the latter. These are admittedly quite indirect evaluations of sediment pressure-induced breakage, but the sample sizes from the various levels are insufficient to reveal possible changes in fragmentation rates through the stratigraphy. Thus, while it seems unlikely that the majority of the fragmentation was caused by sediment pressure, it is not currently possible to more finely characterize its potential contribution to bone breakage.

Notable *in situ* decay of skeletal remains has been observed in coastal environments (Hanson & Butler, 1997), so it is possible that natural decay contributed to the fragmentation in the Vunda sample. However, relatively few bones in the sample have incipient fracture cracks and most have weathered very little, suggesting that natural decay was not a major cause of breakage.

The skeletal remains from Vunda are relatively unweathered, suggesting that few modifications were deleted by weathering. Trampling and fluvatile sediment abrasion are predicted to result in random striae on bones (Fiorillo, 1989). Only a single specimen in the Vunda sample

has random striae, so animal trampling and mechanical abrasion by sand probably did not affect this assemblage. The low incidence of bitemarks and the pattern of element representation indicate that carnivores and rodents were not major modifiers of this assemblage.

It appears, then, that humans were the primary, though not exclusive, modifiers of the Vunda skeletal remains. The observed cutmarks, peeling, percussion pits, crushing, and burning can be attributed to the actions of prehistoric Fijians, and it seems reasonable to assume that they were probably responsible for a substantial portion of the fragmentation as well.

#### Comparison of Vunda with Navatu

Skeletal assemblages from four other sites in the Fijian archipelago have been interpreted as evidence of cannibalism: Lakeba (Rowland & Best, 1980; Best, 1985), Namosi (Spennemann, 1987), Navatu (Gifford, 1951; DeGusta, in press) and Wakaya (Rechtman, 1992). Of these, the only sample with sufficient quantitative data on bone modifications to allow comparison with the Vunda sample is the Navatu assemblage (DeGusta, in press).

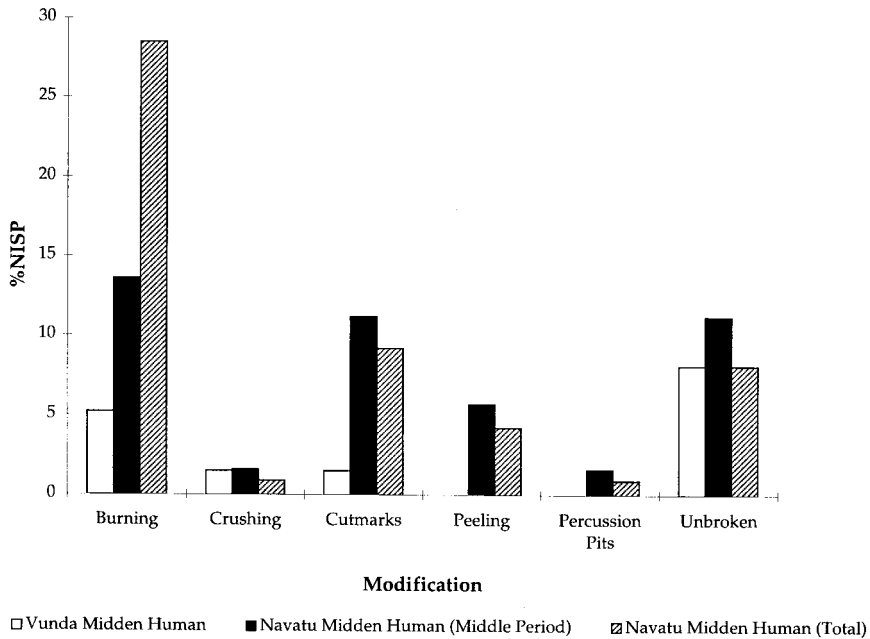


Figure 7. Comparison of modification frequencies in the Vunda midden human sample with the Navatu midden human sample. Bars represent the percentage of scorable specimens with a given modification.

The site of Navatu is located on the north coast of Viti Levu, about 7.5 km from Vunda, and was also excavated by Gifford (1951). The skeletal remains recovered derive from both a waste midden and a set of formal human burials (Gifford, 1951). The Navatu midden sample spans the period from 50 BC to AD 1900 based on pottery styles and radiocarbon dates (Gifford, 1951, 1955; Green, 1963) and includes 552 specimens of various taxa from the Middle Period (contemporaneous with the Vunda skeletal sample). The human burials, which are spatially and contextually distinct from the midden, date to the Late Period. The same methodology was used to study both the Vunda and Navatu samples.

Figure 7 compares the frequencies of the modifications in the Vunda midden human sample to those of the Navatu midden human sample (DeGusta, in press). The Navatu midden human sample, both overall and in the Middle Period, has notably higher rates of burning, cutmarks, and peeling than does the Vunda midden human sample. The differences are statistically significant for burning (overall  $p <$

0.001, Middle Period  $p = 0.030$ ) and cutmarks (overall  $p = 0.002$ , Middle Period  $p = 0.001$ ). The patterns of postcranial element representation differ sharply between the two samples as well (Figure 3).

## Conclusions

### *Cannibalism at Vunda*

For an inference of cannibalism to be supported, the modifications of the human remains in question should correspond to modifications of non-human remains accepted as having been consumed (allowing for differences due to anatomy). The taphonomic history of the assemblage must be also assessed to identify non-human agents of modification, and an evaluation made of the possibility of non-cannibalistic mortuary practices that might mimic cannibalism.

The assessment of the taphonomic history of the Vunda assemblage indicates that humans were the primary cause of the observed modifications, though an unknown portion of the

fragmentation may be due to other agencies. The modifications to the human remains in the Vunda midden correspond to those of the medium-sized mammals in type, but not in frequency. The midden medium mammals have higher rates of ancient breaks, fragmentation, burning, cutmarks, percussion pits, and peeling than do the midden human remains. The differences are not statistically significant, but this may be due to the small sample size.

The human burials at Vunda provide direct evidence regarding mortuary practices at that time and place. The Vunda burials share the same context as the midden remains, as the burials were extracted from the midden by Gifford. The Vunda burials have less fragmentation, crushing, and burning than do the Vunda midden human remains. In most other modifications, though, the burials have roughly similar modifications. There are no significant differences between the burial and human midden samples in the rates of cutmarks, percussion pits, and peeling. The pattern of human element representation is very similar between the burials and the midden.

In summary, then, the modifications of the midden human remains are generally less frequent than those of the other taxa. The modifications and context of the midden human sample are similar to that of the formal human burials. Therefore the hypothesis of Gifford (1951) that the human bones in the Vunda midden are the remains of cannibalized individuals is not supported by this analysis.

Instead, it seems likely that most, if not all, the midden human remains were part of the formal burials. Most specimens in the midden human sample could easily be mistaken for non-human remains in the field, which would have led Gifford to place them in the 'midden' category rather than the burial category. Even with the benefit of a laboratory setting, 40 of the 134 midden human specimens (30%) were incorrectly identified as non-human by Gifford and co-workers in the post-excavation analysis. The context and condition of the material thus suggests that all human remains in the deposit were the result of formal burials. What few modifications they do bear seem best attributable to

mortuary practice, as there is no support for an inference of cannibalism.

### *Cannibalism in Fiji*

In the present analysis, the condition of the Vunda remains is inferred to be the result of mortuary and excavation practices rather than cannibalism. In a similar analysis presented elsewhere (DeGusta, in press), the midden human remains from the nearby, partially contemporaneous site of Navatu are inferred to have been cannibalized. A comparison of the modifications and context of these two sites allows for the tentative establishment of the *characteristics* of Fijian cannibalism versus non-cannibalistic mortuary ritual. The fundamental *criterion* for recognizing cannibalism, however, remains a correspondence between modifications of human and non-human remains.

The Vunda and Navatu midden human samples have similar rates of crushing and percussion pits. A few specimens with crushing and percussion pits are also present in burials from these sites. Thus, the presence of these modifications at low frequencies, or their absence, is not unique to either cannibalism or a non-cannibalistic mortuary ritual. The Vunda and Navatu midden human samples are both intensively fragmented, suggesting that a high rate of breakage alone provides no indication of the various processes (cannibalism, mortuary ritual, decay, etc.) that resulted in the fragmentation. A low rate of fragmentation and breakage, though, would seem to indicate a non-cannibalistic explanation. Human remains from both Vunda and Navatu derive from midden contexts, suggesting that the mere presence of human bones in a waste midden is not indicative of cannibalism. If, however, the possibility of intrusive formal burials into a midden (the apparent circumstance at Vunda) can be ruled out, as it can at Navatu, then the identity of context between human remains and non-human food remains can be taken as support for an inference of cannibalism.

The Vunda and Navatu midden human remains differ in their pattern of element representation, with the distribution of the Vunda sample

more closely resembling that of an intact skeleton. This suggests that a fairly normal element distribution can be taken as evidence against an inference of cannibalism—when one animal consumes another, the element distribution of the prey organism is typically altered substantially (Lyman, 1994). The Vunda midden human sample lacks any specimens with peeling, while the Navatu sample has six. The medium mammal assemblages from both sites also contain specimens with peeling, while neither set of burials do. This suggests that the presence of human specimens with peeling may be characteristic of Fijian cannibalism. The rates of cut-marking and burning in the Vunda midden human sample are significantly lower than those in the Navatu sample. Notable rates of burning (perhaps greater than ~10%) and cut marks (perhaps greater than ~5%) in a Fijian assemblage might then be an indication of cannibalism.

The bioarchaeological attributes of Fijian cannibalism can be summarized as follows. Characteristics which are necessary, but not sufficient, for an inference of cannibalism are human remains in a midden context with intensive fragmentation, an element distribution that departs significantly from that expected for complete skeletons, and lack of evidence of major non-human modifiers. Characteristics which are inferred to be indicative of cannibalism are notable rates of burning (>10%) and cutmarks (>5%), and the presence of peeling. These characteristics must be regarded as very tentative, as they are based on only two sites, and future results from analyses of other sites will quite likely require the alteration of this list.

It is important to note that, to date, the hard evidence for Fijian cannibalism is limited to one site. Therefore it is clearly inappropriate to characterize all, or even most, prehistoric Fijians as 'cannibals'.

#### *Fijian versus American Southwest cannibalism*

The osteological patterning of Fijian cannibalism, though based on a single site, appears to differ from that of cannibalism in the American

Southwest. The principal characteristics of cannibalized assemblages in the American Southwest include a context indicative of a single, short-term episode of deposition; relative lack of vertebrae; bone breakage by percussion hammering; butchering and skinning marks on 1–5% of all specimens; and, in general, evidence of intense exploitation of marrow (White, 1992; Turner, 1993). The Fijian pattern generally lacks evidence for intense marrow exploitation in the form of high rates of percussion pits and crushing, the context is more likely one of multiple episodes over a long period of time, and cut-marks are somewhat more frequent. The possible causes of these differences cannot currently be evaluated due to the small sample of well-studied Fijian sites and the intersite variation in the American Southwest.

The apparent differences between the Fijian pattern and that of the American Southwest do serve to illustrate that the fundamental criterion for recognition of cannibalism is a correspondence between the modifications of human and dietary non-human remains, rather than a single set of globally applicable modification frequencies. There is tremendous variation in food choice, procurement, and processing behaviours between different human cultures (Brothwell & Brothwell, 1969; Rozin, 1982). If different cultures practised cannibalism in the past, similar variation can be expected in the motivations and methods involved in human consumption. The osteological modifications produced by cannibalism will likely vary by region and time period (contra Bullock, 1991). So while the methods that were developed for investigating prehistoric cannibalism in the American Southwest are applicable to studies of cannibalism in Oceania, the osteological patterning of cannibalism is likely to differ between and within the two regions.

#### *Critiques of osteological inferences of cannibalism*

Several commentators have offered various criticisms of osteologically based inferences of cannibalism (Osborne, 1997). The analysis of the material from Vunda reported here, as well as

that from Navatu (DeGusta, in press), provides an opportunity to evaluate these criticisms.

Some commentators have claimed that processes other than cannibalism are responsible for the condition of the bones in question—either violence and mutilation (Bullock, 1991, 1994) or mortuary rituals, especially those involving secondary burial with defleshing (Bahn, 1992a,b). In the case of Navatu, however, the modifications of the human material do not resemble, quantitatively or qualitatively, the modifications of secondary burial and violence-derived assemblages (DeGusta, in press). Until a quantitative or qualitative correspondence is shown between the Navatu sample and an actual (as opposed to hypothetical) violence-derived or secondary burial assemblage, this line of criticism should be discounted.

Bullock (1991, 1997) has claimed that inferences of cannibalism are due to a failure to recognize cultural variability in behaviour. However, this study of cannibalism does not just recognize culture variability in behaviour, it documents it (as discussed above in the comparison of Fijian and American Southwest cannibalism). In any case, the recognition of cannibalism would seem to only increase, rather than decrease, the documented variation in behaviour between and within cultures.

Arens (quoted in Osborne, 1997) has stated that researchers studying cannibalism in the archaeological record have been 'seduced by the idea of cannibalism', and thus inevitably come to a conclusion of cannibalism. The present study of the Vunda remains, which leads to a conclusion of no cannibalism, contradicts Aren's claim, as does the previous debunking of several claims of prehistoric cannibalism (White & Toth, 1989, 1991).

Arens (quoted in Osborne, 1997), Bahn (1992a) and Bullock (1997) have all stated that it is impossible to absolutely prove cannibalism. This is correct, in-so-much as it is impossible to absolutely prove anything about past human dietary behaviour (Lyman, 1982). In some cases, such as Navatu, every line of evidence that leads to an inference of human consumption of other mammals also leads to an inference of human consumption of humans (DeGusta, in press). In these cases, the choice is between accepting an

inference of cannibalism or concluding that nothing can be known about prehistoric diet.

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