

Mortuary Patterns in Burial Caves on Mangaia, Cook Islands

S. C. ANTÓN^{a,b*} AND D. W. STEADMAN^b

^a Department of Anthropology Rutgers University

^b Florida Museum of Natural History, University of Florida, Gainesville, Florida, USA

ABSTRACT The behavioural, cultural, and political implications of archaeological human remains in non-mortuary, possibly culinary, contexts requires that we understand the range of mortuary practices in a particular region. Although several rockshelter sites on Mangaia, Cook Islands have yielded burned, fragmentary human bones in earth ovens that seem to support archaeological models and ethnohistoric accounts of ritual sacrifice and cannibalism, the absence of data on the range of Mangaian mortuary patterns obscures these interpretations. We describe burial patterns based on 40 above-ground interments representing at least 92 individuals in caves of Mangaia, Cook Islands, in order to begin to develop an island-wide perspective on mortuary patterns. Sampling both pre- and post-European contact sites we found that multiple interments dominate probable pre-contact burials (73%, 19 of 26) and single interments dominate post-contact contexts (80%, eight of ten burials), probably reflecting the influence of Christianity on mortuary ritual. Subadults were more frequent in all post-contact contexts suggesting alternative burial places, probably church cemeteries, for adults. Burial cave remains are broadly consistent with ethnohistoric accounts of interment in caves, however, they also illustrate additional burial practices and differences between time periods, such as primary body position and the role of multiple-individual interments, which are not discussed ethnohistorically. The mortuary practices in Mangaian burial caves differ from burials associated with *marae* and seem completely unrelated to the presence of highly fragmentary and burnt human remains in pre-contact rockshelter middens elsewhere on the island. Copyright © 2003 John Wiley & Sons, Ltd.

Key words: Oceania; burial styles

Introduction

Environmental changes related to human population growth and agricultural intensification led to significant changes in consumption of terrestrial vertebrates during the late prehistory of Mangaia, Cook Islands (Steadman & Kirch, 1990; Ellison, 1994a; Kirch, 1996). Likely related to this archaeologically-documented decline in remains of native birds, domestic pigs, and dogs, are the 19th century ethnohistoric accounts of intense fighting over limited land and other resources that include well-planned interpersonal/intertribal aggression, ritual sacrifice, and either nutritive or

ritual cannibalism (Gill, 1894; Hiroa, 1934). Several Mangaian archaeological sites have yielded burned, fragmentary human bones in midden context that some have interpreted as evidence of such cannibalism (Anderson & Antón, in press; Antón & Steadman, 1998; Steadman *et al.*, 2000). However, limited knowledge of the range of Mangaian mortuary patterns obscures the island-wide, socio-political implications of these midden remains. We address this inadequacy by describing human remains in caves around the island and comparing our results with ethnohistoric accounts of burial practices on Mangaia.

The earliest definitive habitation site on Mangaia (MAN-44) dates to no earlier than AD 1000, although pollen and charcoal analyses of sediment cores from Lake Tiriara immediately

* Correspondence to: Department of Anthropology, Rutgers University, 131 George Street, New Brunswick, NJ 08901, USA.
e-mail: scanton@rci.rutgers.edu

adjacent to this site, suggest that human-induced deforestation of the island began as early as ca. 2500 years BP (Figure 1; Ellison, 1994a; Kirch & Ellison, 1994). Mangaia is located at 21.5°S latitude and 157.9°W longitude in the southern group of the Cook Islands, some 177 km south of the next nearest island, Rarotonga, and some 2300 km northeast of New Zealand. Although large for the Cook Islands, Mangaia is less than 7.4 km across at its widest point. Mangaia (Figure 1) has two concentric geological areas, an inner core of weathered basalts reaching 168 m at its summit, surrounded by a continuous ring of limestone, the *makatea*, reaching some 70 m in height and bounded by cliffs on both the inland and seaward sides (Stoddart *et al.*, 1985). Rockshelter sites such as MAN-44 are located on the inland side of the *makatea*. From its summit to the coast Mangaia is divided radially by major

drainage systems into six traditional geographic and cultural districts. In each district, only a small strip of prime agricultural land exists between the volcanic slopes and limestone cliffs. Thus at European contact, the 2000 to 3000 Polynesian inhabitants of Mangaia represented a population density of as much as 70–100 persons per km² of arable land (Kirch, 1996). Because the limited resources inherent in a small island ecosystem preclude the opening of new resource niches in response to increasing population, as might happen on the mainland, this combination of little arable land and high population seems to have led to resource scarcity and possibly intertribal aggression in late pre-contact Mangaia.

To understand the significance of human remains in midden contexts at rockshelter sites, burial practices must be explored. The brief ethnohistoric mention of Mangaian burial practices

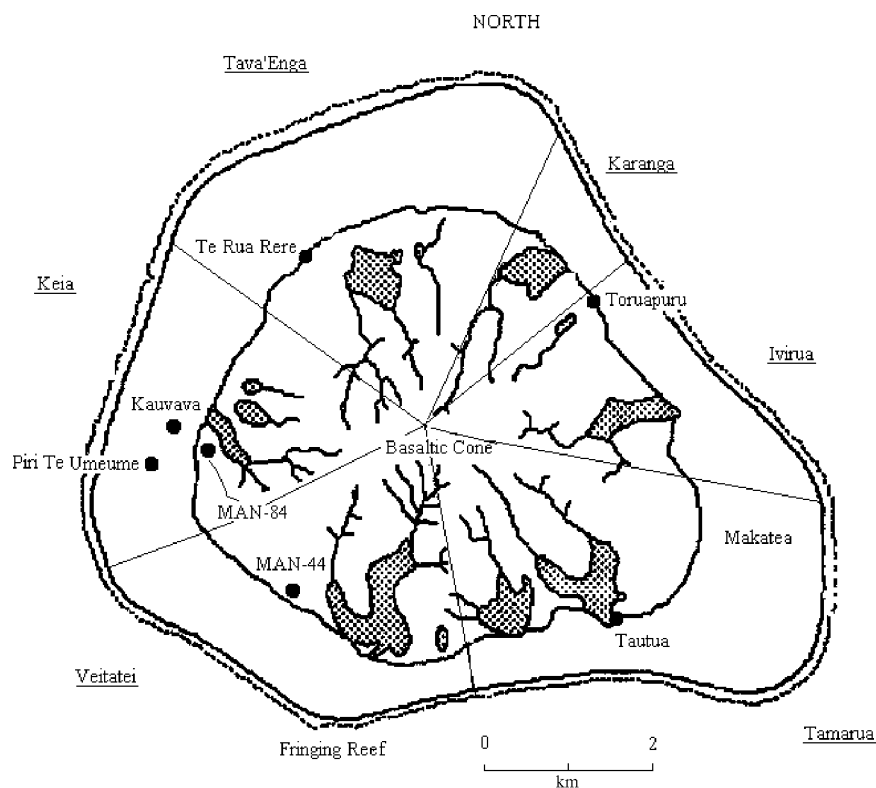


Figure 1. Mangaia, Cook Islands showing burial caves explored and rockshelters mentioned in text (black dots). Mangaia is the southernmost of the Southern Cook Islands group, located at 21.5°S, 157.9°W and some 2300 km northeast of New Zealand. Note the underlined names of the six traditional districts and their boundaries. Dotted areas are lakes and taro swamps fed by streams from the volcanic uplands.

suggests that family members would wrap the corpse in layers of cloth and then place it in a shallow pit, occasionally within a temple (*marae*), but most often in a cave (*ana*), or in a chasm (deep vertical crevice) in the *makatea*, usually within a day of death (Gill, 1876:71; Hiroa, 1934:190). According to Gill (1876:72,75), those buried in the ground were placed face down in a flexed position with limbs secured by a sennit cord and the head towards the rising sun. Stones were placed on top of these graves reportedly to keep the spirit in. Most bodies, however, were said either to have been hidden in secret caves or thrown into chasms to avoid interference with the body by their living enemies (Hiroa, 1934:191). Hiroa specifically suggested that the body of a warrior obtained by his enemies would be burned. Some secondary burial practices are described in the case of cave burials. This treatment entailed exposing the remains to the sun, rubbing them with oil, and then rewrapping them in cloth (Hiroa, 1934:191). It is not clear whether bones or desiccated corpses were treated in this way. No dismemberment, bone breaking, cleaning, or burning are reported for remains interred in caves, however, it is also not clear the extent to which these descriptions represent first hand observations rather than reports from informants. However, since particularly powerful individuals were thought to be capable of returning from the dead, their corpses were purportedly dismembered and distributed around the island (Reilly, 1991:160).

In this study we describe burial patterns found in four caves in three of Mangaia's six districts with particular focus on Te Rua Rere, an 800 m long cave with the largest known sample of human burials on the island (Figure 1). By comparing these burials with those from different time periods and in different parts of the island we infer standard modes of burial within cave contexts and how these may have varied through time. Through additional comparisons with ethnographic accounts and human remains from archaeological middens, we begin to develop an island-wide perspective on Mangaian mortuary patterns. We recognize that each of these lines of evidence has inherent biases; ethnographic accounts may not reflect primary observation and are likely to be intentionally and

unintentionally coloured by the writer's beliefs and aims, archaeological remains from excavated sites and burial caves are subject to taphonomic processes. Because the burial cave remains are above ground interments, taphonomic processes including water, rodent and crab activity can obscure primary burial patterns as may later human intervention. With this in mind we set out to document burial pattern and, to the extent possible, disentangle human from non-human and primary from secondary activities. We note the limitations and difficulties below. By pooling these various lines of evidence we provide a fuller, if still incomplete, picture of mortuary ritual on Mangaia.

Materials

The Mangaian *makatea* has extensive cave systems that were used as living, storage, and burial places. We collected data from 40 above-ground interments or bone scatters representing more than 92 individuals in four cave systems on Mangaia. We selected four caves with relatively dry, horizontal passages at three different levels in the *makatea* (10–20 m, 20–30 m, and 40–60 m above current sea level) that correlate with previous sea level stands. Although lacking radiometric (U-series) age determinations, the age of the caves in this uplifted limestone probably increases with elevation. All of the caves had formed by the end of the Pleistocene (Ellison, 1994b), well before human colonization of Polynesia (Irwin, 1992). Access to each burial cave is currently controlled by a specific Mangaian family and we were accompanied by one or more members of these families during each of our visits. At one of the caves, Te Rua Rere, we were allowed to sample the human bone for preliminary ^{14}C and DNA analysis.

The caves examined are solution cavities in the *makatea* probably formed by fossil streamways (Ellison, 1994b; Figures 2–5). As a result, cave floors are mostly flat or only slightly pitched. Ceilings are high enough to walk upright in at least parts of each cave. Each cave (Piri Te Umeume, Tautua, Te Rua Rere, and Kauvava) has at least one very large, amphitheatre-like room. Access to Tautua and Te Rua Rere requires either

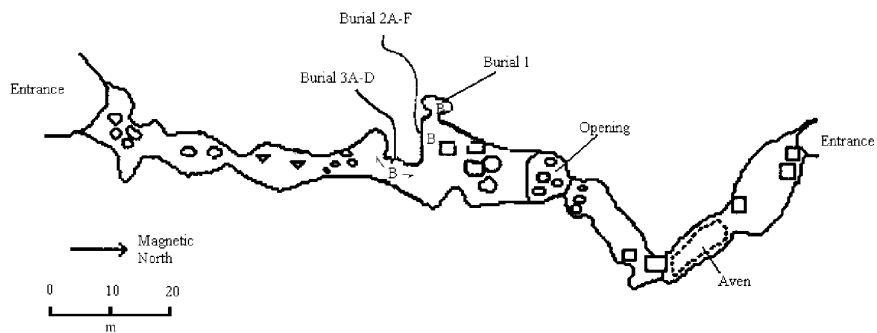


Figure 2. Plan view of Piri Te Umeume, Keia District, Mangaia. B indicates locations of human remains.

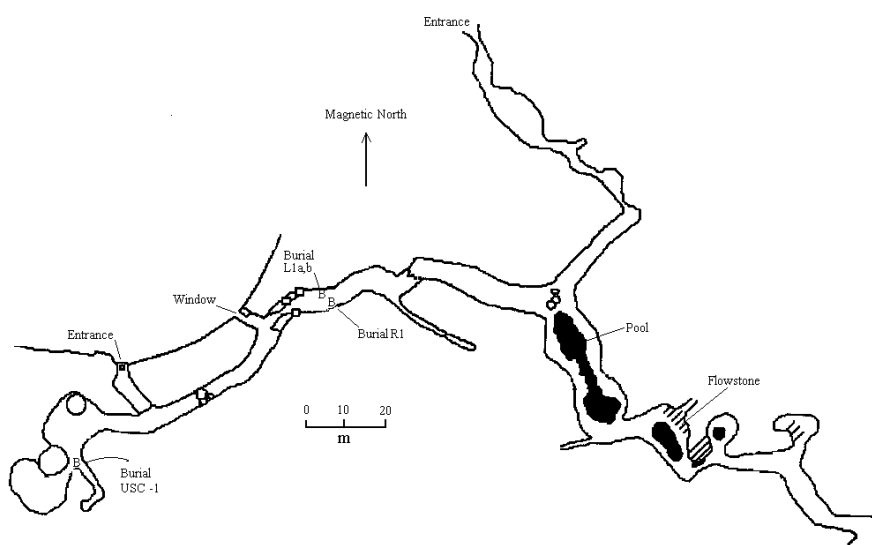


Figure 3. Plan view of Tautua, Tamarua District, Mangaia. B indicates locations of human remains.

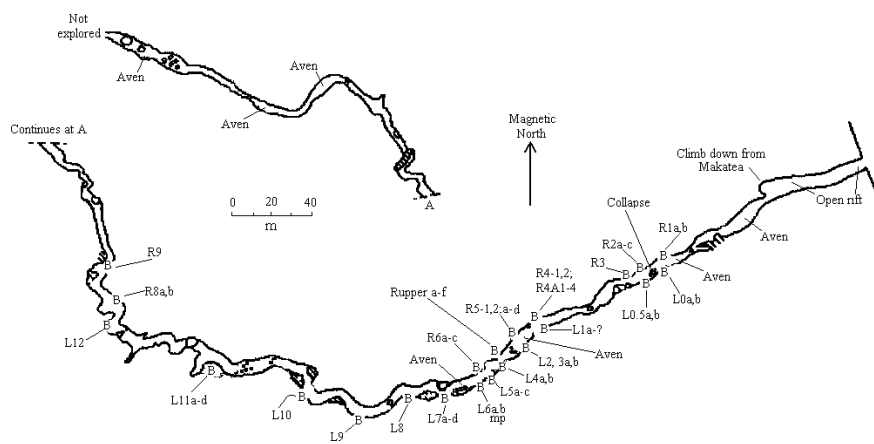


Figure 4. Plan view of Te Rua Rere, Tava'Enga District, Mangaia. B indicates locations of human remains.

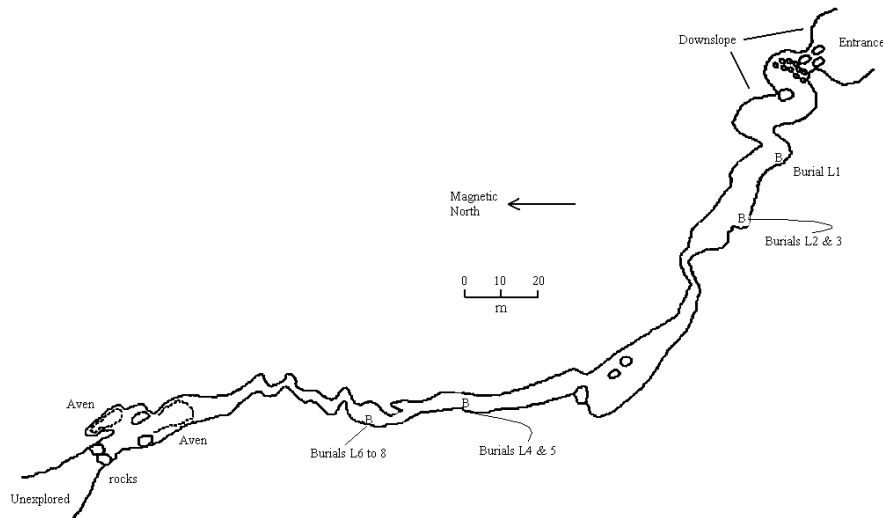


Figure 5. Plan view of Kauvava, Keia District, Mangaia. B indicates locations of human remains.

sheer ascents or descents into cave entrances. Alternatively, Kauvava and Piri Te Umeume are accessed by diagonal descents through bouldery roof collapses from the top of the *makatea*. The upper entrance to Kauvava, which is in the Auraka region of Keia district, serves as a drainage sump, receiving heavy water and sediment flows during rains, draining eventually to the sea. Although Gill (1876:71–79) noted a cave in Keia named Auraka, with one of its two entrances named Kauvava, his description of the physical features of this cave does not match that of the cave currently known as Kauvava. In addition, Gill's observations that 'Hundreds of well-preserved mummies lie in this natural home of the dead, some in rows on ledges of stalactite, others on wooden platforms. Most of them were over fifty years old, though some were more recent.' (1876:72) do not match the distribution of remains in the current Kauvava, as described below.

Three of the caves (Kauvava, Piri Te Umeume, Te Rua Rere) appear to have been used primarily or exclusively as burial sites, whereas Tautua has few human remains/burials and is known ethnohistorically primarily as a living site of the defeated Tonga tribe (Gill, 1894:290–292). None of these caves has been excavated. Of the primary burial caves, Te Rua Rere has the largest number of burials located throughout most of its accessible length. The burials in Kauvava

are concentrated near the entrance (Figures 2–5), whereas the burials at Piri Te Umeume, a cave with two entrances, are concentrated in an alcove near the centre of the cave (Figure 2).

Most of the cave names include references to hidden locations and some, such as Te Rua Rere, refer to graves (Savage, 1980). *Te* means the, *Rua* refers to a hole, excavation, grave or abyss, and *Rere* means to jump, to bound, to let oneself go, or to jump from a height. Thus, Te Rua Rere could mean the hole or chasm reached by a large leap, perhaps referring to the steep descent required to reach the cave entrance. Alternatively, the name could refer to the Mangaian practice of dumping bodies into a cave through skylights (*avens*). *Piri* as an adjective refers to confined, reserved, hidden, or secret, and *Ume* is to gird, to bind round, to surround, or to clothe. The name Piri Te Umeume thus may refer to a secret/hidden area where cloth-bound bodies were placed, although no remnants of cloth were preserved in this cave. *Tau* means to come to rest or to alight. *Tua* as an adjective means secret, from sight, or hidden. Thus Tautua refers to a secret hiding place, an appropriate name for the dwelling place of a defeated tribe. *Kau* means to swim, float, or paddle, or to indicate a number for something. *Vava* is the general name for a cricket (insect) or means to talk or converse in a friendly way. The reference to water in the case of Kauvava may refer to its frequent flooding or to

its presumed, but inaccessible connection to the sea. Alternatively, the name could refer to a place with many crickets. The full name of each of the last four caves should be preceded by the words *Te Ana* meaning 'the cave' (i.e., *Te Ana Kauvava*). For brevity we exclude these prefixes.

Methods

In each cave we numbered burials sequentially beginning at the entrance. Because most burials lie near a cave wall rather than in the middle of the passage, we gave each side of the cave, as one faces inward, its own numeric sequence prefixed either with L (near left wall) or R (near right wall). We assigned numerals with decimal points to burials discovered or delineated after the original sequence was in place (e.g., R5.5a-c). Burials in elevated, secondary passages were annotated with 'UPR' (e.g., RUPRa-f). Multiple interments are noted by alphabetic suffixes to burial numbers (e.g., R5a). We photographed each burial and mapped its location onto plan views of each cave prepared previously by Ellison (1994b). We noted the burial's compass orientation and relative placement, whether on the cave floor or on a natural ledge, in which case we recorded the height above the floor (Figures 2–5). We also noted each burial's relationship to cave features such as overhangs and avens (treacherous daylight windows in the ceiling that are accessible only from the ground surface above). We recorded the extent to which each burial was demarcated by rocks, or broken stalactites and whether the remains had been placed on or in any sort of wood, canoe, or box. We also recorded any associated artifacts (which often indicate the time period of burial) and faunal remains.

Because cave interments are above ground, various taphonomic processes may influence preservation and position of skeletal elements. For example, to varying extents each of the caves exhibits signs of current or past water activity, including wet floor/walls, current or fossil ponds, stalactite and stalagmite formation, and calcite deposits on and within skeletal elements. So water action, either in decaying of bone or wood or moving of skeletal elements was assessed on a burial by burial basis. Likewise, our experience

clearly indicated the presence of land crabs, insects, and rats in at least the outer portions of each cave so modifications to the bone such as gnawing and possible movements of small elements were also considered on a case by case basis. All of the caves exhibit some evidence of recent human disturbance to the burials such as placement of selected bones to increase their visibility. We also found evidence of some mixing of bones between burials. In addition, previous researchers have measured some of the specimens from *Te Rua Rere*, reportedly moving some of these for measurement (Katayama, 1986, 1988; Katayama *et al.*, 1988; Tagaya & Katayama, 1988). Such recent disturbances mostly affected our ability to discern original body position, especially in the case of primary versus secondary multiple interments. Because a number of burials were classified as disturbed rather than primary or secondary, we do not present frequency statistics for primary versus secondary interments. However, the discovery on our last day at *Te Rua Rere* of a pristine multiple-individual secondary interment (RUPR) confirmed our suspicion that such burials occurred prehistorically in the cave.

Bearing these possible secondary disturbances in mind and while disturbing the remains as little as possible, Antón and students conducted skeletal inventories of each burial, determined whether burials/bone scatters were of single or multiple individuals, and to what extent these remained in anatomical position. To the extent possible, we determined the age and sex of each individual using standard techniques. Subadult age was determined by dental eruption patterns (Ubelaker, 1984), epiphyseal fusion patterns (McKern & Stewart, 1957; Krogman & Isçan, 1986), and long bone, pelvic, or scapular dimensions depending upon preservation (e.g., Fazekas & Kósa, 1978; Buikstra & Ubelaker, 1994; Krogman & Isçan, 1986). We also recorded obvious pathological conditions, although because of dim light in the caves and the degraded condition of many of the bones, it is likely that generalized inflammation, as indicated by periosteal reaction, and other subtle conditions are underreported. Based on the anatomical positioning and other clues we inferred whether these represented primary versus secondary interments, and to what extent the remains had been disturbed sometime in the

recent past by either human or non-human agents. All remains were left in place in the caves.

For selected burials we obtained accelerator-mass spectrometer (AMS) radiocarbon (^{14}C) dates on purified collagen from a single skeletal element. AMS ^{14}C dates can be done on individual identified bones because the method requires much less bone (as little as 15 mg, if well preserved chemically) than the 100–1000 g needed for conventional beta-decay ^{14}C dating (Stafford *et al.*, 1991). Thus AMS ^{14}C dating eliminates the uncertainty of whether human remains in a burial context are truly coeval with associated cultural materials, which may or may not be datable. AMS ^{14}C dating also does not suffer from time-averaging as long as each ^{14}C date is based on a single bone rather than multiple bones. Each of the AMS ^{14}C dates reported herein is based on a portion of a single human bone identified and collected by Antón. Lying at 21.5°S latitude, Mangaia does not have the problem of atomic bomb-contaminated organic carbon (associated with surface testing of nuclear weapons) that can occur farther north in the tropical Pacific (see Steadman *et al.*, 1991).

Results

Bone condition and modification

Unlike human remains excavated from rockshelter sites (e.g., Steadman *et al.*, 2000) burial cave remains exhibit many more complete elements and no evidence of intentional burning or exposure to heat. We found no evidence of intentional bone breakage at the time of interment with most burials represented by either complete, unbroken elements or by those altered primarily by non-human processes. It is always possible that some of the natural breakage of remains obscured human induced breakage, nonetheless, intentional breakage would still be quite rare in burial cave contexts. We also found no evidence of burning at the time of interment, although a single element (from Te Rua Rere L7a) shows blackening, probably from a later fire in the cave.

Not surprisingly given their extended exposure, burial cave remains, despite their relative completeness, exhibit surface bone conditions that

vary greatly among the burials. This preservation depends largely upon exposure to flowing water and standing pools. The most fragmentary remains are attributable to water degradation and shattering due to calcite formation in medullary cavities or on bone surfaces, factors that are easily distinguishable from human activity. Rodent gnawing and breakage due to rock falls was noted, but less common than water damage in most contexts and again easily distinguishable from intentional human activity. Recent trampling by humans was also a factor in the breakage of bone on the cave floors but was generally confined to single elements that had been moved into passage ways either by rats, crabs or water. Bone movement by non-human agents was limited in extent and scope and usually involved single, small elements. This incidental movement was usually easily attributable to its natural process on the basis of rodent signatures on bone or the presence of water. When such movement influences interpretations it is so noted below.

Relative age of burials in caves

We recorded 40 burials representing at least 92 individuals in the four caves (Table 1). Te Rua Rere is the longest cave and the only one to contain both definitive pre- and post-contact burials (Figures 4 and 5). The distribution of the caves around Mangaia indicates that using caves as burial sites was an island-wide practice during both pre- and post-contact times (Figure 1).

Among the 40 burials, 26 were classified as pre-contact, ten as post-contact, and four as questionable (Table 2). Associated artifacts were few in number but more plentiful in post-contact burials. Artifacts clearly indicating the post-European contact period include European glass trade beads (Te Rua Rere L11), box construction of milled, sometimes painted wood, metal hinges and hasps, nails and dovetailed or boxtailed joints and other colonial artifacts (e.g., Kauvava and Piri Te Umeume), and deteriorated plain, usually blue, cloth (e.g., Kauvava L1). Because many of the post-European contact burials were found in wooden boxes with multiple indications of their age and with at least one other post-contact item such as a bottle, a post-European contact

Table 1. Caves surveyed on Mangaia, Cook Islands. Pre-contact and post-contact are before and after AD 1823. Assignment to time period is based on radiocarbon dating and the presence/absence of associated colonial or traditional materials

Cave	Figure	District	Minimum number of burials ¹	Minimum number of individuals ²	Time period of burials	Passage height above sea level	Passage length ³
Piri Te Umeume	2	Keia	3	11	Post-contact	55 m	136 m
Tautua	3	Tamarua	3	≥4	Pre-contact	10–20 m	335 m
Te Rua Rere	4	Tava'enga	~26	≥68	Pre-post-contact	20–30 m	791 m
Kauvava	5	Keia	8	9	Post-contact	40 m	358 m
Total	—	—	~40	≥92	—	—	—

¹ The number of burials in Te Rua Rere is a conservative estimate. The imprecision derives from evaluating long (>3 m) scatters of bones representing multiple individuals.

² Minimum numbers of individuals (MNI) for each cave is calculated by summing the MNIs for each burial within the cave.

³ Passage lengths were calculated for routes explored by Ellison (1994b) and do not represent the entire length in caves where natural obstacles (deep pits, flooded passages) prevented further advance.

Table 2. Number of single and multiple burials/bone scatters by cave and time period, Mangaia, Cook Islands

	Single	Multiple	Total
Piri Te Umeume			
Post-contact	1	—	1
Questionable	—	2	2
All	1	2	3
Tautua			
Pre-contact	2	1	3
Te Rua Rere			
Pre-contact	5	18	23
Post-contact	—	1	1
Questionable	1	1	2
All	6	20	26
Kauvava			
Post-contact	7	1	8
All caves	16	24	40
All pre-contact	7	19	26
All post-contact	8	2	10
All questionable	1	3	4

designation was easier to make with confidence than was a pre-European contact designation. Presence of a dugout canoe, unmilled wood, or a stone ring, and/or the absence of any contact period or later materials, was taken as evidence of a pre-European contact age. Other than placement in dugout canoes or on hand-hewn lumber, no items of pre-European material culture (e.g., stone, bone, or shell artifacts) were found with the burials. The occasional introduction of very modern artifacts, such as cigarette lighters, without any other indication of recency of burial, was not taken to be an indication of post-contact burial. In a few cases assignment to pre-contact versus post-contact age

was questionable because of poor associations between artifacts and burials. We excluded these cases ($n = 4$) from comparisons between time periods. At Te Rua Rere we were able to test our age designations based on material remains against radiocarbon (^{14}C) dates for five burials (see below).

The exclusively pre-contact artifacts in Tautua suggest pre-contact ages for these remains. A decaying box made from milled lumber clearly dates the single interment from Piri Te Umeume as post-contact. The two multiple interments from Piri Te Umeume have a few small remnants of post-contact artifacts with them including milled wood pieces and a square nail. However, because these burials are positioned downslope from the first and all the artifacts are small enough to have either tumbled to their present position or have been moved there by rodents or crabs, we cannot clearly differentiate the age of these two multiple burials using artifacts alone.

The Kauvava burials ($n = 8$) appear to represent a single, brief period of post-contact use. The individuals are interred in boxes made of milled lumber and are of similar design (including dove-tailed joints) and colour. Most burials contain associated colonial artifacts and all are of young children (mean age 1.8 years).

Based on physical evidence and ^{14}C dating, Te Rua Rere appears to represent the longest period of use including both definitive pre-contact burials (R1, R8, RUPRa, based on ^{14}C dating) and early contact period burials (L11, based on European glass trade beads and supported by

a ^{14}C date; Table 3). Te Rua Rere lacks any evidence of milled wood boxes or decaying boxes such as those at Kauvava or Piri Te Umeume, however, decaying wood from what were probably dugout canoes is present in the most remote burials in the cave. Bone from one of these burials (R8b) confirms their pre-contact age and provides the oldest ^{14}C date yet determined for a burial cave (AD 1275–1410; Beta number 114103), suggesting that use of the cave for burial purposes began at least as early as the transition period from early (before ca. AD 1300) to late prehistory (after AD 1300). European contact on Mangaia occurred in 1823. Furthermore, calcite deposition suggests relative antiquity for some of the multiple-individual burials (e.g., RUPR, L3). One of the individuals encrusted with calcite (RUPRa) yielded the second oldest ^{14}C date (AD 1430–1650; Beta number 111944), placing this individual in the middle part of late Mangaian prehistory, well within the period of island-wide resource depletion as indicated by faunal remains at archaeological rockshelter sites such as Ana Manuku (MAN-84; Steadman *et al.*, 2000) and Tangatatau (MAN-44; Steadman & Kirch, 1990; Kirch *et al.*, 1995; Kirch, 1996). The more extensive calcite deposits on other individuals in the RUPR burial suggest they were interred before RUPRa and thus are of even greater antiquity (see below). A second individual with calcite-encrusted bones yielded an age estimate that encompasses late prehistory and post-contact times (L3a). The absence of any contact period materials with this burial suggests that it is a late pre-contact interment and is so treated here.

Burial styles

Single and multiple interments are found in all caves and during both time periods, although multiple interments predominate in probable pre-contact contexts (73%, 19 of 26 burials) and single interments predominate in post-contact contexts (80%, eight of ten burials; Figure 6; Table 2). Overall, multiple interments are more numerous than single interments (24 versus 16). Pre-contact burials and bone scatters were demarcated by rocks, or placement on canoes or unmilled wood, or not demarcated at all. All post-contact burials

were associated with some kind of milled wooden box or the remains thereof.

Single interments

Where it was possible to discern body placement, single interments in Mangaian burial caves usually consist of an individual in an extended, supine position. A few instances of single flexed burials may be present (e.g., Piri Te Umeume 1, Figure 2), although recent disturbance made these cases difficult to distinguish from disturbed extended burials. No definitive examples of single secondary burials were found, although one individual of the Te Rua Rere RUPR burial is likely to be a single secondary interment placed with a true multiple interment (see below). Other possible secondary single interments include some of the Te Rua Rere burials near avens (skylights) and certain burials at Piri Te Umeume. However, it is difficult to distinguish these from bodies that were dropped through avens and later scattered by water and rodents.

All post-contact single burials are of juveniles (Figure 7). Each is associated with some type of wood or box. Most are interred in decaying boxes of milled wood with metal hinges, nails, and dovetailed joints. Piri Te Umeume and Kauvava produced the entire sample of post-contact single burials.

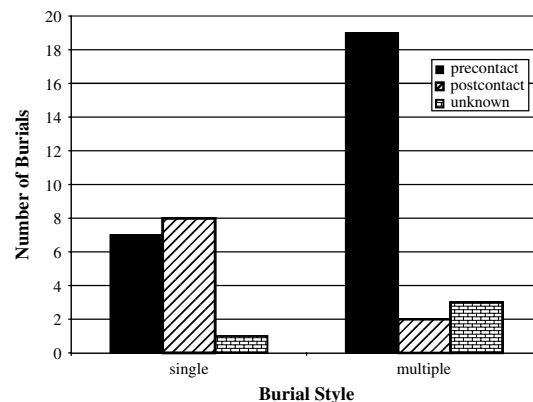


Figure 6. The numbers of burials of each burial type by time period. Note that multiple interments outnumber single interments overall, but that there are many more multiple burials during pre-contact times than during post-contact times and approximately equal numbers of single interments at any given time.

Table 3. AMS Radiocarbon dates on individual human bones from Te Rua Rere, Mangaia, Cook Islands. All determinations by Beta Analytic, Inc., Miami, Florida, except OxCal calibration (version 3.3, Ramsey, 1999)

Beta #	Burial	Element/Age	Location; associated features	Measured ¹⁴ C age	¹³ C/ ¹² C ratio (0/00)	Conventional ¹⁴ C age	CALIB cal AD (2σ)	OxCal cal AD (2σ)
114103	R8b	Rib; subadult	Ledge; underlain by hard and coconut wood	550 ± 50	-18.5	650 ± 50	1275-1410	1280-1410 (0.95)
111944	RUPR-A	Rib; adult	Ledge; underlain by decayed wood, partial rock circle, calcite	260 ± 60	-18.5	370 ± 60	1430-1655	1430-1650 (0.95)
114100	R1a	Fibula; subadult	Floor; rock circle, pig, bird bone	150 ± 40	-19.0	250 ± 40	1525-1560 1630-1680 1755-1805	1510-1600 (0.24) 1610-1690 (0.43) 1730-1810 (0.24)
114102	L11b	Rib; subadult	Ledge; missionary trade beads of glass	50 ± 40	-24.6	50 ± 40	1695-1725	1930-1950 (0.04) 1680-1740 (0.22)
114101	L3a	Metacarpal; adult	Floor beneath overhang; underlain by decayed wood, rock circle, calcite	99.8 ± 0.4%	-19.7	50 ± 30	1815-1920 1825-1835	1800-1930 (0.65) 1940... .. (0.08) 1690-1730 (0.19)
				modern			1880-1915	1810-1920 (0.65) 1940... .. (0.12)

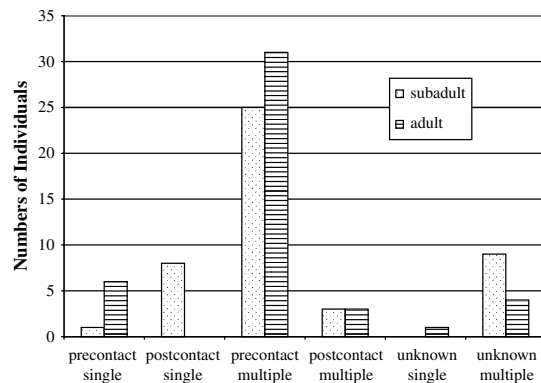


Figure 7. The numbers of individuals by age class and burial style. Note that pre-contact single interments are nearly all adults while post-contact single interments are all subadults. Adults also outnumber subadults in pre-contact multiple interments, but the age classes are equal (and small) in post-contact multiple interments.

In contrast to post-contact single interments, juveniles make up only 14.3% (one of seven) of all probable pre-contact single burials. Both juveniles and adults have been found demarcated by wood, stones, or both, although some are not demarcated at all. Pre-contact single interments may be found in dugout canoes but more frequently are associated with unmilled, decaying wood, that perhaps represents the remains of a hand-hewn wooden plank or canoe (Te Rua Rere R9, L2, L12; Figure 4). In addition, some single interments are bordered by rings or rectangles of small rocks or stalactites at Te Rua Rere (e.g., R9, L2, L10), with or without associated wood underlayment. Some Manganian informants suggest that these 'rings' are more recent additions to the pre-contact burials and others suggest that they are original features of the burials. The discovery of a partial demarcation of rocks around the undisturbed Te Rua Rere RUPRa individual discovered in 1997, suggests that at least some of these rings may indeed be ancient (see below). At Tautua a few bones of a single adult were found inside a clearly ancient rectangle made of very large stones, although it was impossible to discern whether these bones were in primary context. Finally, some pre-contact single interments are not demarcated by either wood or rocks (Te Rua Rere L8, L9). All pre-contact single interments are from Te Rua Rere and Tautua.

Multiple interments

Multiple interments are found in all caves but are rare in definitively post-contact contexts (only two of 21 cases). The two post-contact multiple interments are from Kauvava and Te Rua Rere, one with two and the other with four individuals. Three of the six individuals are subadults (Figure 7). One of the post-contact multiple interments is of two very young individuals sharing a single box (Kauvava L6a,b; Figure 5), whereas the other (Te Rua Rere L11a-d) contains two adult females, a young infant (ca. six months) and a few bones of an unsexed adult. All of these burials are associated with boxes or very decayed wood; they appear to be true multiple-individual primary burials in which the bodies were placed in the cave simultaneously.

In contrast, pre-contact multiple interments, found at Tautua and Te Rua Rere only, represent 90% of all multiple interments that could be assigned to time period (19 of 21 cases) and include minimally 75 individuals. These interments average four individuals per burial (range two to six), or one individual more than in the two post-contact multiple interments. Equal or nearly equal numbers of subadults and adults are present in 17 of the 22 mixed-age burials (Figure 7). Both primary and secondary burials are present.

Like their single-interment counterparts, pre-contact multiple interments are sometimes associated with decaying wood (Te Rua Rere R8a,b), marked by stones that may or may not be synchronous with the burial (Te Rua Rere R1a,b, R3a-?, R5.5a-c; L3a,b, L5a-c), and in other cases are unmarked, sometimes diffuse, bone scatters (Te Rua Rere R4a-d, L7a-d). Some of the demarcated multiple burials result from primary single interments being placed on top of one another over time (Te Rua Rere L3a,b, R3a-?), whereas others are true multiple-individual interments in which several individuals were interred simultaneously either in a primary or secondary context (Te Rua Rere R8a,b and RUPRb-f, respectively). Definitive multiple-individual secondary burial is best documented in the Te Rua Rere RUPR burial which was discovered by Tuara Tuara George in pristine condition during our 1997 survey. Based on differential calcite encrustation on the remains, this burial probably was made in at least two stages and may represent the initial simultaneous

placement of the disarticulated remains of five individuals (RUPRb-f) and the later placement of the disarticulated remains of a single individual (RUPRa, which yielded a pre-contact ^{14}C date (Table 3). The latter individual is underlain by decaying wood and partially encircled by small rocks. The other individuals are not circumscribed by rocks or visibly underlain by wood.

Finally, at Te Rua Rere eight of the multiple interments on the cave floor are located directly below or within 10 m of avens. Five of these are not delimited by rocks that might indicate deliberate placement of the body (L0a,b, L1a-?, R4a-d, R4.5a,b, R5a-d). It is possible that these remains represent either single or multiple interments dropped through the avens as has been mentioned ethnohistorically (Hiroa, 1934:190). Because of their complete commingling, these burials are treated here as disturbed multiple interments representing a minimum of 12 individuals (if individuals are not combined between burials). Treated collectively, these burials could represent as few as six individuals. If some of these were indeed single 'burials' through avens, pre-contact burial types would be more evenly distributed between single and multiple interments (i.e., up to five burials that are currently classified as multiple would be classified as single interments).

Burial location

The compass orientation of most burials is dictated largely by cave morphology, with the long axis of the body roughly parallel to the long axis of the cave passage. Other choices in burial positioning are afforded by natural ledges and clefts in the cave walls. Burials and bone scatters were found either on the floor, usually against cave walls ($n = 24$; 60%), or on natural ledges or holes ($n = 16$; 40%). With the exception of interments below avens, no burials were found in the centre of passages. Two of the floor burials were found under overhangs. These burials and many of those on ledges would be unobserved by the casual visitor. While these numbers suggest a relatively even division of burials between floor and ledge locations, such pooling across sites obscures large differences between caves. For example, 88% of post-contact burials at Kauvava (which floods

periodically) are found on high ledges, whereas 73% of those at Te Rua Rere (a dryer cave) are found on the ground. Only pre-contact burials are found beneath overhangs.

Demographics

Nearly equal numbers of adults ($n = 45$) and subadults ($n = 47$) were found in the burial caves. Ages were equally represented in multiple interments, but subadults were slightly more frequent (56%) in single interments when time periods are combined. When time periods are considered separately, adults and subadults were still relatively equally represented in multiple interments of both time periods, whereas 100% of pre-contact single interments but only 11% of post-contact single interments were of adults. Subadult remains occur in all caves. Adults occur in all caves except the exclusively post-contact Kauvava.

Only 39% ($n = 18$) of all adults were sufficiently preserved to determine sex. Of these, half are female. Sexable adults in single interments were predominantly male (three of four) with three additional cases unsexable. Sexable adults in multiple interments were slightly more likely to be female (eight of 14), although many additional individuals ($n = 25$) were unsexable. Because of the fragmentary nature of most remains, as well as limited visibility within the caves, no attempt was made to age the adult skeletal remains.

Age estimates were possible for 36 of the 47 subadults, ranging from newborn to 16 years. Although younger ages are present in both time periods, pre-contact burials of all types contained larger numbers of older subadults (mean age 6.9 years) than did post-contact burials (mean age 1.6 years). Individuals in multiple pre-contact interments are slightly older (mean age 7.0 years) than the only pre-contact single interment of a juvenile (3 years). No age difference is noted in the post-contact juvenile interments, regardless of burial style.

Faunal associations

Seven burials from two caves had associated faunal remains (Kauvava L3, L5; Te Rua Rere,

R1, R5.5, L4, L6, L8). These included usually isolated elements from either pig, dog, rat or bird and in one case marine shell (Te Rua Rere L4b). In addition, hundreds of bones of rats and birds are scattered here and there along the entire length of Te Rua Rere, with no apparent association with any human burial (Steadman, 1985). Except for burial L3 at Kauvava, the association between human and non-human remains was restricted to burials on cave floors, often those beneath or just downslope from avens or entrances. Thus we believe that these non-human bones at burials are not grave offerings. An exception may be a dog atlas and rib inside the wooden box housing Kauvava L3 that may have been introduced by humans at or after burial.

Discussion

The burial cave remains generally support and augment the brief ethnohistoric descriptions of Mangaian burial practices in caves. As suggested by Hiroa (1934), there are both primary and secondary burials as well as circumstantial evidence of aven 'burial'. Furthermore, the post-contact remains are associated with cloth in which they may have been wrapped; prehistorically, such burial cloth would have been the bark cloth (*tapa*) from the paper mulberry tree, a material more unlikely to survive for centuries in the caves. Multiple interments are frequently found in pre-contact cave burials yet are not mentioned in the ethnohistoric literature. Single interments in caves are most frequently in extended rather than in the flexed position reportedly used for non-cave burials (Gill, 1876:72,75).

The increase of juvenile single interments and the relative decrease of adult remains in post-contact times very likely represent a shift in ideology reflecting the religious influence of Christian missionaries. The greater relative frequency of subadult burials in post-contact times seems unlikely to reflect demographic changes, such as fewer adult deaths, since contact periods typically exact high death tolls due to introduced disease as well as conflict (Larsen *et al.*, 1992). It may suggest that alternative burial places, such as church cemeteries, were used for some adults beginning in the late 19th

century. Such a practice might reflect both an increasing missionary/religious influence and a decreased need to hide bodies. The shift from dugout canoes (hewn with stone adzes) to sawn wooden boxes is a modification of traditional burial enclosures with the arrival of iron tools and other European technology.

The decrease in average subadult age in post-contact times may be related to high infant mortality rates from foreign infectious disease (Gill, 1894; see also Larsen, 1990; Larsen *et al.*, 1992 for disease influence in other contact situations). However, to the extent that it was possible to assess, we found no bony evidence in these infants of conditions indicative of generalized stress such as cribra orbitalia or porotic hyperostosis, systemic periostitis, or significant enamel hypoplasia. It is thus possible that the larger number of young subadults in post-contact time periods reflects greater fertility rates rather than increased infant mortality (*sensu* Larsen, 1999:339). Alternatively, these infants may have succumbed too quickly to disease for a bony response to be recorded. Further elucidation of this issue is not possible, however, given the time averaging inherent in the sample.

The other archaeologically-derived human remains from Mangaia can be divided into two categories: isolated or fragmentary bones from rockshelters or inland terraces (e.g., Steadman *et al.*, 2000; Endicott, 2000; Anderson & Antón, in press) and partially articulated remains possibly in association with a *marae* (MAN-100; Endicott, 2000). The former remains are found in midden contexts from habitation sites and are generally few in number. An exception to this is Ana Manuku (MAN-84), a rockshelter in Keia district radiocarbon dated to ca. AD 1400–1450, which yielded a number of individual specimens of 1864 human bones and a minimum of 40 individuals, most based on quite fragmentary, burnt remains (Steadman *et al.*, 2000). In all cases, the specimens are isolated and lack evidence of articulated remains or 'burials' in the traditional sense of the word. Alternatively, although the data concerning the human remains from the site have not been fully published, the undated bones from MAN-100 may represent the remnants of more articulated burials. The preliminary report suggests that MAN-100 yielded far fewer

($n = 4$) but more complete individuals than did Ana Manuku and also suggests that some elements were articulated. Endicott (2000) postulates that these specimens may be the remains of individuals buried in association with the *marae*, a practice recorded ethnohistorically.

The burial cave remains described here differ from those found in rockshelters and *marae*, and most especially from the former. Unlike human bones from rockshelters, the burial cave remains show no signs of intentional breakage, cleaning, or burning. The relatively complete nature of the burial cave remains, even after centuries of exposure to water and rodent activity, suggests that the mortuary rituals they represent are completely unrelated to the presence of highly fragmentary and burned human remains described from rockshelter middens (Steadman *et al.*, 2000). A full comparison cannot be made between the burial cave remains and those from MAN-100, although available data suggest that the burial cave remains are substantially more complete than those from near the *marae*. This difference, however, may reflect only the more protected nature of the burial cave remains.

Despite at least partial contemporaneity with rockshelter sites that yield fragmentary human remains, the mortuary practices illustrated by the burial cave remains described here bear no resemblance to those from rockshelter sites. Preliminary evidence suggests a greater similarity to the human remains associated with *marae*. Either Mangaian mortuary rituals were quite varied or, as we have suggested (Steadman *et al.*, 2000), the human remains from rockshelter sites are not in a mortuary context.

Acknowledgements

We thank the many Mangaian who helped us, in particular T. Arokapiti, T. George, M. Harry, T. Mautairi, P. Ngatakorua, S. Ngatakorua, D. Ngu, M. Ngu, A. Tangatakino, A. Tuara, G. Tuara, and T. Tuara. Research permits were graciously issued by T. Okotai (Office of the Prime Minister). Funding for field work was provided by the University of Florida Division of Sponsored Research (grant U001) and the National Geographic Society. Laboratory analyses and manuscript preparation were

funded in part by National Science Foundation grant EAR-9714819. Tuara Tuara George, Alan 'Mickey' Tuara, Rhonda Quinn, and Karen Weinstein assisted in burial cave reconnaissance and data collection. We dedicate this paper to the memory of our dear friend, George Tuara.

References

- Anderson PKB, Antón SC. Patterns of bone modification at archaeological sites on Mangaia, Cook Islands. In *Archaeological and Paleocological Research at Tangatatau Rockshelter, Mangaia, Cook Islands*. Contributions of the Archaeological Research Facility, UCB, monograph series. In Press.
- Antón SC, Steadman DW. 1998. Cannibals in the Cooks? Island biogeography and hominid behavior. *American Journal Physical Anthropology Supplement* 26: 64–65.
- Buikstra JE, Ubelaker DH. 1994. Standards for data collection from human skeletal remains. *Arkansas Archeological Survey Research Series* No. 44.
- Ellison JC. 1994a. Palaeo-lake and swamp stratigraphic records of Holocene vegetation and sea-level changes, Mangaia, Cook Islands. *Pacific Science* 6: 85–115.
- Ellison JC. 1994b. Caves and speleogenesis of Mangaia, Cook Islands. *Atoll Research Bulletin* No. 417.
- Endicott JM. 2000. *Archaeological and ethnohistoric evidence for protohistoric social relations on Mangaia Island, Cook Islands*. PhD. dissertation. University of California, Berkeley.
- Fazekas IG, Kósa F. 1978. *Forensic Fetal Osteology*. Akadémiai Kiadó: Budapest.
- Gill WW. 1876. *Life in the Southern Isles*. Religious Tract Society: London.
- Gill WW. 1894. *From Darkness to Light in Polynesia*. Religious Tract Society: London.
- Hiroa TR. 1934. Mangaian Society. *Bernice P. Bishop Museum Bulletin* 122.
- Irwin G. 1992. *The Prehistoric Exploration and Colonization of the Pacific*. Cambridge University Press: Cambridge, UK.
- Katayama K. 1986. Human skeletal remains of late Pre-European Period from Mangaia, Cook Islands. *Man and Culture in Oceania* 2: 57–80.
- Katayama K. 1988. Biological positioning of Mangaia Cook Islanders among Polynesians, as viewed from non-metric cranial variants. In *People of the Cook Islands Past and Present*. Cook Islands Library and Museum Society, Rarotonga, Cook Islands, Bulletin No. 5., 37–66.

- Katayama K, Tagaya A, Houghton P. 1988. Osteometric and somatometric analyses of Mंगाians. In *People of the Cook Islands Past and Present*. Cook Islands Library and Museum Society, Bulletin No. 5; 91–114.
- Kirch PV. 1996. Late Holocene human-induced modifications to a central Polynesian island ecosystem. *Proceeding National Academy of Sciences, USA* **93**: 5296–5300.
- Kirch PV, Ellison JC. 1994. Paleoenvironmental evidence for human colonization of remote oceanic islands. *Antiquity* **68**: 310–321.
- Kirch PV, Steadman DW, Butler V, Hather J, Weisler M. 1995. Prehistory and human ecology in Eastern Polynesia: excavations at Tangataua Rockshelter, Mangaia, Cook Islands. *Archaeology in Oceania* **30**(3): 47–65.
- Krogman WM, İşcan MY. 1986. *The Human Skeleton in Forensic Medicine*. Second edition. C.C. Thomas: Springfield, IL.
- Larsen CS (ed.). 1990. The archaeology of Mission Santa Catalina de Guale: 2. Biocultural interpretations of a population in transition. *Anthropological Papers American Museum Natural History* No. 68.
- Larsen CS. 1999. *Bioarchaeology: Interpreting behavior from the human skeleton*. Cambridge Studies in Biological Anthropology no. 21. Cambridge University Press: Cambridge, UK.
- Larsen CS, Ruff CB, Schoninger MJ, Huchinson DL. 1992. Population decline and extinction in La Florida. In *Disease and Demography in the Americas*, Verano J, Ubelaker DH (eds). Smithsonian Institution Press: Washington, DC; 25–39.
- McKern T, Stewart TD. 1957. *Skeletal age changes in young American males, analyzed from the standpoint of identification*. Technical Report EP-45. Headquarters Quartermaster Research and Development Command: Natick, MA.
- Ramsey CB. 1999. *OxCal version 3.3*. Oxford Radiocarbon Accelerator Unit Research Laboratory for Archaeology: Oxford, UK.
- Reilly MPJ. 1991. *Reading into the Past: A historiography of Mangaia in the Cook Islands*. PhD. dissertation, Australia National University (quoted in Endicott).
- Savage S. 1980. *A Dictionary of the Maori Language of Rarotonga*. Institute of Pacific Studies, University of the South Pacific: Suva, Fiji.
- Stafford TW Jr, Hare PE, Currie L, Jull AJT, Donahue DJ. 1991. Accelerator radiocarbon dating at the molecular level. *Journal Archaeological Science* **18**: 35–72.
- Steadman DW. 1985. Fossil birds from Mangaia, southern Cook Islands. *Bulletin British Ornithologists' Club* **105**: 58–66.
- Steadman DW, Kirch PV. 1990. Prehistoric extinction of birds on Mangaia, Cook Islands, Polynesia. *Proceedings National Academy Sciences, USA* **87**: 9605–9609.
- Steadman DW, Stafford TW Jr, Donahue DJ, Jull AJT. 1991. Chronology of Holocene vertebrate extinction in the Galapagos Islands. *Quaternary Research* **36**: 126–133.
- Steadman DW, Antón SC, Kirch PV. 2000. Ana Manuku: A prehistoric ritualistic site on Mangaia, Cook Islands. *Antiquity* **74**: 873–883.
- Stoddart DR, Spencer T, Scoffin TP. 1985. Reef growth and karst erosion on Mangaia, Cook Islands: A reinterpretation. *Zeitschrift Geomorphologie, N.F.* **57**: 121–140.
- Tagaya A, Katayama K. 1988. Biological affinity of Mंगाians in the Cook Islands, Polynesia as viewed from measurements of male crania. In *People of the Cook Islands Past and Present*. Cook Islands Library and Museum Society Bulletin, No. 5. 115–142.
- Ubelaker DH. 1984. *Human Skeletal Remains, Excavation, Analysis, Interpretation*. Taraxacum: Washington, DC.