

**BIRD BONES FROM THE TO'AGA SITE:
PREHISTORIC LOSS OF SEABIRDS AND MEGAPODES**

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INTRODUCTION

AS PART OF A LONG-TERM program to reconstruct the natural distribution and diversity of bird-life in the South Pacific (figure 14.1), I have sought bird bones from archaeological sites in many different archipelagos. Until recently, the islands of Samoa have not been represented in this data base. In 1987, T. L. Hunt and P. V. Kirch conducted excavations at the To'aga site (AS-13-1), Ofu Island, American Samoa yielding a small sample of bird bones representing at least six taxa (Steadman 1990). This first glimpse of the prehistoric avifauna of Samoa showed that at least two species (a shearwater and petrel) had been lost on Ofu since the first arrival of humans more than 3000 years ago. Hunt and Kirch expanded the excavations at To'aga in 1989. This paper reports the entire bird bone assemblage from both the 1987 and 1989 field seasons. The sample of bird bones from To'aga now consists of at least fifteen taxa (table 14.1) and provides a more thorough, although still far from complete, portrayal of the birdlife of ancient Samoa.

The bird bones from To'aga have been catalogued in the University of Washington Burke Museum (UWBM) Fossil Bird Collection. Comparative skeletal or oological specimens are from UWBM, the British Museum (Natural History) (BMNH), the New York State Museum (NYSM),

and the United States National Museum of Natural History, Smithsonian Institution (USNM). In the species accounts that follow, "Unit" refers to meter square excavations (designated with Arabic numerals). Roman numerals refer to stratigraphic layers. For details of the stratigraphy, chronology, material culture, and non-bird faunal assemblages of the To'aga site, see Hunt and Kirch (1988), Kirch et al. (1989, 1990), and various chapters in this volume.

Unless stated otherwise, the modern distributions of species within American Samoa are taken from the excellent surveys conducted in 1975-1976 by Amerson et al. (1982a,b) and in 1986 by Engbring and Ramsey (1989). Modern distributions for elsewhere in Polynesia are taken from Pratt et al. (1987). The prehistoric records are from Steadman (1989a) and from unpublished data from my recent research; islands preceded by an asterisk (*) represent extirpated populations.

SPECIES ACCOUNTS

Order Procellariiformes
Family Procellariidae

Puffinus pacificus (Wedge-tailed Shearwater)

MATERIAL. Humerus (UWBM 1680), T9/500E, Unit 21, IIB. Five ulnae (UWBM 1244, 1251,

Table 14.1
Bird Bones from the To'aga Site

Taxa	Number of Identified Bones
Seabirds	
* <i>Puffinus pacificus</i>	11
* <i>Puffinus lherminieri</i>	2
* <i>Puffinus griseus</i>	15
* <i>Pterodroma rostrata</i>	6
* <i>Pterodroma</i> sp., size of <i>P. heraldica</i>	2
(*)Procellariidae sp.	9
* <i>Sula sula</i>	1
<i>Fregata</i> sp.	2
<i>Anous stolidus</i>	1
<i>Gygis alba</i>	1
Sternae sp.	1
Landbirds	
<i>Egretta sacra</i>	1
<i>Numenius tahitiensis</i> (M)	1
<i>Gallus gallus</i> (I)	16
* <i>Megapodius</i> sp.	2
<i>Gallicolumba stairii</i>	3
TOTAL	15/74
Total Seabirds (species/bones)	10/51
Total Landbirds (species/bones)	5/23
Total Native Landbirds, without I,M (species/bones)	4/7
% of Bones from Extirpated Species (without I,M)	85%

I=Introduced species

M=Migrant Species

* Extirpated on Ofu

(*) represents extirpated species, but not necessarily different from those already listed.

1256, 1678, 1679), Unit 9, IIB; Unit 5, IIC; Unit 14, IIIa-4; T9/500E, Unit 21, IIB (2 bones). Radius (UWBM 1664), T9/500E, Unit 20, IIIB. Carpometacarpus (UWBM 1630), T3/200W, Unit 27, IIIA. Tibiotarsus (UWBM 1642), T5/100E, Unit 28, IIB. Two pedal phalanges (UWBM 1246, 1248), Unit 4, IIB; Unit 1, IIB.

REMARKS. This tropical shearwater is rarely noted at sea today in American Samoa. It may nest on Pola Islet (off Tutuila) and on Ta'u, but this has not been confirmed. There are no previous records from Ofu. It is widespread in Polynesia today, although nesting islands are few. Other Polynesian archaeological records of *Puffinus pacificus* are from *Ua Huka and *Tahuata (Marquesas), *Huahine (Society Islands), *Lifuka and *Eua

(Tonga), and Tikopia and Anuta (Solomon Islands).

Puffinus lherminieri (Audubon's Shearwater)

MATERIAL. 2 ulnae (UWBM 1651, 1671), T9/500E, Unit 23, IIB; T9/500E, Unit 21, IIB.

REMARKS. Within American Samoa, *Puffinus lherminieri* nests only on Ta'u, where at least 200 birds breed in the cloud forest, and on Tutuila (colony size unknown). It is uncommon at sea and has not been recorded previously on Ofu. Like *P. pacificus*, *P. lherminieri* nests today on relatively few islands scattered across Polynesia. Other Polynesian archaeological records of *P. lherminieri* are from *Nuku Hiva, Ua Pou, *Ua Huka, *Hiva Oa, and *Tahuata (Marquesas), *Huahine (Society

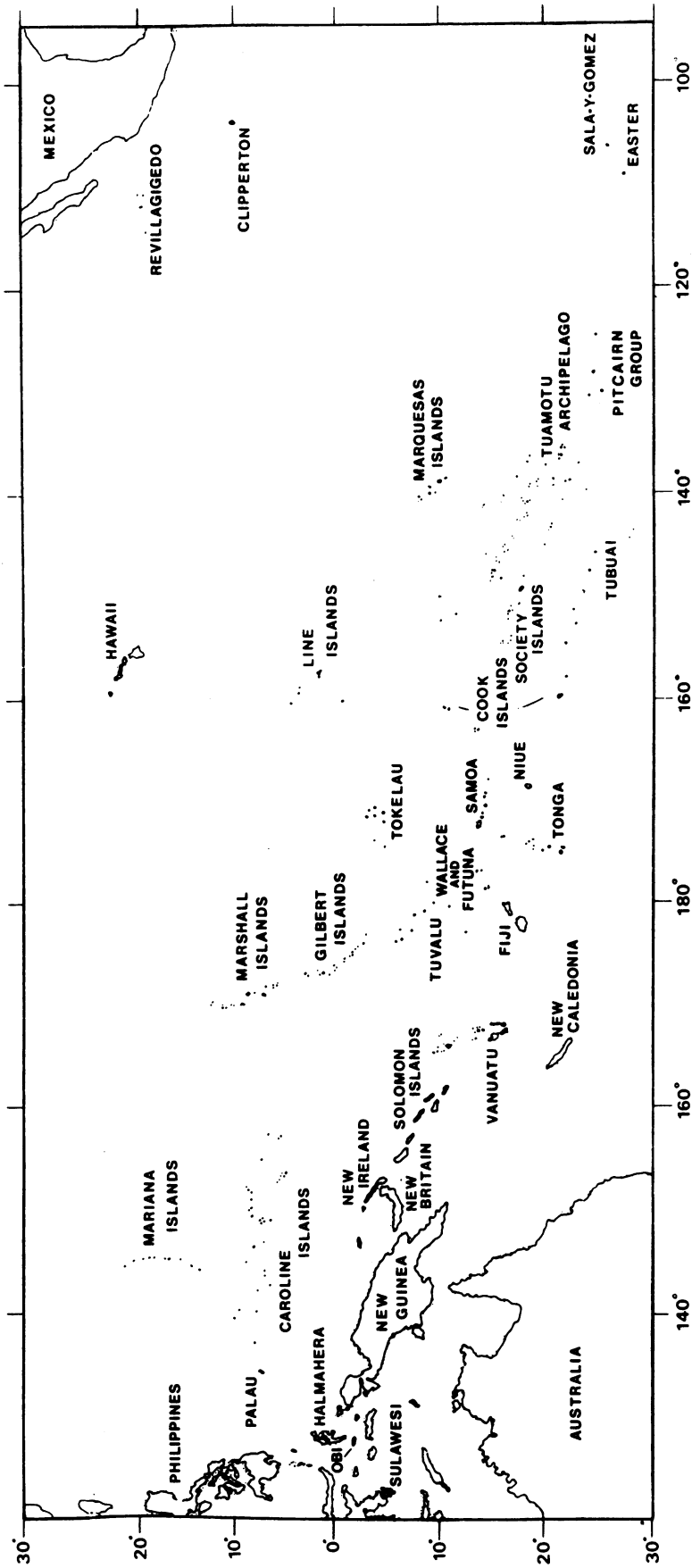


Figure 14.1 Map of the Pacific Islands, showing localities mentioned in the text.

Islands), *Mangaia (Cook Islands), 'Eua (Tonga), and Tikopia and *Anuta (Solomon Islands).

Puffinus griseus (Sooty Shearwater)

MATERIAL. Sternum (UWBM 1681), T9/500E, Unit 21, IIB. Coracoid (UWBM 1645), T5/100E, Unit 29, IIB. Scapula (UWBM 1245), Unit 9, IIB. Three humeri (UWBM 1641, 1643, 1659), T5/100E, Unit 29, II; T5/100E, Unit 28, IIB; Unit 20, IIB. Three ulnae (UWBM 1240, 1241, 1647), Unit 11, II-8 (2 bones); T5/100E, Unit 30, II. Carpometacarpus (UWBM 1259), Unit 7, IIA. Manus digit (UWBM 1260), Unit 7, IIA. Pelvis (UWBM 1674), T9/500E, Unit 21, IIB. Three tibiotarsi (UWBM 1252, 1253, 1652), Unit 6, IIA (2 bones); T9/500E, Unit 23, IIIA.

REMARKS. As reported by Steadman (1990), these bones are larger than those of any species of shearwater that resides today in tropical Polynesia. They agree in all osteological details with bones of *Puffinus griseus*, a species that probably migrates through the Samoan region today (Harrison 1983:260, 420; Pratt et al. 1987:55), although there are no records from American Samoa. The Sooty Shearwater nests today only on islands off New Zealand, southern Australia, and extreme southern South America (Harrison 1983:260, 420). Most of the nesting localities of *P. griseus* are temperate or subantarctic, although in Australia nesting occurs at least as far north as 32° 40' S on the subtropical Broughton Islands.

Three possible explanations for the unexpected presence of *Puffinus griseus* on Ofu were proposed by Steadman (1990): (1) the bones represent migrant birds taken at sea by fishermen; (2) *P. griseus* once resided on Ofu and, like other procellariids, was extirpated through predation in their nesting burrows by humans and rats; (3) the bones represent an extinct, resident shearwater that differs specifically or subspecifically from modern *P. griseus* but is osteologically very similar. Regarding the first explanation, I am aware of no ethnographic accounts of Polynesians capturing seabirds while fishing. The data now available, particularly that fifteen bones (nine different skeletal elements) are osteologically indistinguishable from modern skeletons of *P. griseus*, suggest that the second explanation may be correct, even though the oceanographic conditions near Ofu are warmer than those

of the warmest localities where *P. griseus* nests today. That this large shearwater (or an osteologically indistinguishable subspecies [explanation 3 is not necessarily incompatible with explanation 2]) was once resident rather than migrant on Ofu is indicated by the presence at To'aga of two bones of *P. griseus* (UWBM 1645, 1653) that, based upon porosity of the external surface, are from volant juveniles unlikely to have dispersed far from their place of birth. The former residency of *P. griseus* on Ofu is supported further by the abundance of its bones at To'aga (15 of 74, or 20% of identifiable bones). Sooty Shearwaters are represented as well among the few bird bones from a Lapita site on *Niuatoputapu (Tonga), southwest of American Samoa (Steadman 1990).

Pterodroma rostrata (Tahiti Petrel)

MATERIAL. Two mandibles (UWBM 1250, 1682), Unit 4, IIB; T9/500E, Unit 21, IIB. Scapula (UWBM 1684), T9/500E, Unit 21, IIB. Humerus (UWBM 1657), T9/500E, Unit 20, IIB. Ulna (UWBM 1242), Unit 5, IIA. Tarsometatarsus (UWBM 1247), Unit 4, IIB.

REMARKS. This large petrel nests today at a few widely scattered localities in the Marquesas Islands, Tahiti, New Caledonia, and American Samoa. Its presence on the latter is based upon a colony of about 500 individuals discovered in 1976 in the montane cloud forest of Ta'u, a single nesting bird discovered on Tutuila in 1986, and a few birds heard on Olosega in 1986. An onshore record in 1972 from Taveuni (Clunie et al. 1978) suggests that *Pterodroma rostrata* may nest in Fiji as well. Elsewhere in Polynesia, *P. rostrata* has been identified from archaeological sites on *Ua Huka and Tahuata (Marquesas), *Huahine (Society Islands), *Aitutaki (Cook Islands), *Lifuka and *'Eua (Tonga), Tikopia (Solomon Islands), and New Caledonia.

Pterodroma sp. (unknown petrel,
size of *P. heraldica*)

MATERIAL. Radius (UWBM 1670), T9/500E, Unit 21, IIB. Femur (UWBM 1676), Unit 21, IIB.

REMARKS. These specimens, although not adequate for species-level identification, represent a species of *Pterodroma* in the approximate size range

of *P. heraldica* (Herald Petrel, which often is considered conspecific with *P. arminjoniana*) or perhaps the slightly larger *P. externa* (Juan Fernandez Petrel), both of which are significantly smaller than *P. rostrata*. In American Samoa, *P. externa* is known only from uncommon sightings at sea, while *P. heraldica* nests on Ta'u. Regardless of species-level identification, UWBM 1670 and 1676 indicate that a species of petrel other than *P. rostrata* probably once nested on Ofu.

Procellariidae sp. (unknown petrel/shearwater)

MATERIAL. Coracoid (UWBM 1633), T5/100E, Unit 16, II. Five ulnae (UWBM 1243, 1258, 1634, 1662, 1669), Unit 9, IIB; Unit 5, IIB; T5/100E, Unit 16, I; T9/500E, Unit 20, IIIB; T9/500E, Unit 21, IIB. Radius (UWBM 1249), Unit 4, IIB. Two carpometacarpi (UWBM 1239, 1677), Unit 9, IIB; T9/500E, Unit 21, IIB.

REMARKS. These fragmentary bones cannot be identified beyond the family level. They do not represent a taxon separate from those already identified.

Order Pelecaniformes
Family Sulidae

Sula sula (Red-footed Booby)

MATERIAL. Radius (UWBM 1656), T9/500E, Unit 20, IIIC.

REMARKS. *Sula sula* nested on Ofu as recently as 1975-76 (only twenty-five birds), but the small colony no longer existed in 1986. This booby still nested in 1986 on Tutuila and Rose islands. It is widespread in tropical oceans. Other Polynesian archaeological records of *S. sula* are from *Henderson (Pitcairn Group); *Ua Huka, *Hiva Oa, and *Tahuata (Marquesas); *Huahine (Society Islands); *Aitutaki (Cook Islands); Niuaotupapu (Tonga); and *Tikopia and *Anuta (Solomon Islands).

Family Fregatidae

Fregata sp. (unknown frigatebird)

MATERIAL. Humerus (UWBM 1254), Unit 14, IIIa-4. Ulna (UWBM 1675), T9/500E, Unit 21, IIB.

REMARKS. These specimens cannot be distinguished from those of *Fregata minor* or *F. ariel*, both of which visit but do not nest on Ofu today (total of thirteen birds counted in 1975-76; still recorded as a visitor in 1986). The bones of *F. minor* males and *F. ariel* females are similar in size and difficult to distinguish from each other (Steadman et al. 1990). Both species of *Fregata* occur fairly commonly in Polynesian archaeological sites.

Order Charadriiformes
Family Laridae

Anous stolidus (Brown Noddy)

MATERIAL. Humerus (UWBM 1668), T9/500E, TP 21, IIB.

REMARKS. This tern is common and widespread today in American Samoa as well as most of Polynesia. The Ofu population was ca. 500 in 1975-76 and was not accurately estimated in 1986. Other Polynesian archaeological records of *Anous stolidus* are from Henderson (Pitcairn Group); Ua Pou, Ua Huka, and Tahuata (Marquesas); Huahine (Society Islands); Mangaia and Aitutaki (Cook Islands); Niuaotupapu, Lifuka, and 'Eua (Tonga); 'Upolu (Western Samoa); Tikopia and Anuta (Solomon Islands); and Mussau (Papua New Guinea).

Gygis alba (Common Fairy-Tern)

MATERIAL. Humerus (UWBM 1631), T5/100E, Unit 16, I.

REMARKS. This distinctive tern is common and widespread today in most of Polynesia including American Samoa. The Ofu population was ca. 100 in 1975-76, and at least 500 in 1986. Other Polynesian archaeological records of *Gygis alba* are from Henderson Island (Pitcairn Group), Ua Huka and Tahuata (Marquesas), Huahine (Society Islands), Mangaia (Cook Islands), and Niuaotupapu and 'Eua (Tonga).

Sternae sp. (unknown tern)

MATERIAL. Ulna (UWBM 1257), Unit 14, IIIB-5.

REMARKS. This eroded, fragmentary specimen represents a tern smaller than either of the above species. UWBM 1257 is approximately the

size of the ulna in *Sterna sumatrana* or *Anous minutus*, both of which occur today in American Samoa, although only the latter nests on Ofu (just ten birds in 1975-76, and perhaps about the same in 1986).

Order Ciconiiformes
Family Ardeidae

Egretta sacra (Pacific Reef-Heron)

MATERIAL. Coracoid (UWBM 1655), T9/500E, Unit 22, I.

REMARKS. *Egretta sacra* resides throughout American Samoa and most of Polynesia today. It is uncommon on Ofu, where only dark-phase birds have been recorded. Other archaeological records are from Nuku Hiva and Ua Huka (Marquesas), Huahine (Society Islands), Mangaia and Aitutaki (Cook Islands), and 'Eua (Tonga).

Order Charadriiformes
Family Scolopacidae

Numenius tahitiensis (Bristle-thighed Curlew)

MATERIAL. Coracoid (UWBM 1635, 1636; originally believed to be two separate bones), T5/100E, Unit 15, IIID.

REMARKS. This widespread but rather uncommon migrant shorebird has not been recorded previously from Ofu, although undoubtedly it still occurs there occasionally. American Samoan records of *Numenius tahitiensis* are confined to Tutuila, Ta'u, Swains, Rose, and Olosega. Other Polynesian archaeological records for *N. tahitiensis* are from Henderson Island (Pitcairn Group), Ua Huka (Marquesas), Huahine (Society Islands), Mangaia and Aitutaki (Cook Islands), and Tikopia (Solomon Islands).

During the autumn wing molt, thirteen of twenty-nine individuals of *N. tahitiensis* captured on Laysan (Leeward Hawaiian Islands) were flightless (Marks et al. 1990). This adaptation would seem to be viable only in a predator-free setting. It may have led to reductions in the distribution and abundance of *N. tahitiensis* following the human colonization of Polynesia.

Order Galliformes
Family Megapodiidae

Megapodius sp. (Unknown Megapode)

MATERIAL. Ulna (UWBM 1637), T5/100E, Unit 15, IIID. Femur (UWBM 1649), Unit 30, IIID.

REMARKS. These two fragmentary specimens (fig. 14.2) are most similar quantitatively and qualitatively to modern specimens of *Megapodius freycinet*, a widespread species that now reaches its eastern limit in Vanuatu. UWBM 1649 is indistinguishable qualitatively from the femur in modern *M. freycinet*, while UWBM 1637 differs from the ulna of *M. freycinet* in having a slightly deeper sulcus radialis and in lacking a diagonal trough on the cranial surface of tuberculum carpalis.

Like the archaeological specimens of *Megapodius freycinet* from *Tikopia (Solomon Islands; Steadman et al. 1990), the specimens of *Megapodius* from To'aga are at the extreme small end of the size range of *M. freycinet* (table 14.2). Among living subspecies of *M. freycinet*, there is no indication that individual body size decreases eastward in Oceania. For example, the tarsus (in skins) of the Vanuatu population is not smaller than that from Australia (table 14.3). The bones from To'aga are larger than in *M. pritchardi* (confined to Niuafu'ou, Tonga) and *M. laperouse* (found only in Palau and Mariana Islands), but much smaller than in two extinct species recently described from late Holocene archaeological and paleontological sites—*M. molistructor* of New Caledonia and Lifuka and *M. alimentum* of Lifuka and 'Eua (Balouet and Olson 1989; Steadman 1989b, pers. obs.). *Megapodius pritchardi* is the only species of megapode that survives east of Vanuatu.

Both To'aga specimens of *Megapodius* are from one of the site's deepest and oldest strata, Layer IIID in units 15/29/30. This suggests that megapodes may have been lost from Ofu not long after prehistoric colonization of the island. These bones provide the first unequivocal, well-documented record of a megapode from Samoa. There is, however, complicated historical evidence that a megapode, described as *M. stairi* by Gray (1861), may have existed in the mid-1800s on 'Upolu or Savai'i (Western Samoa). Gray (1861) also described *M. burnabyi* from

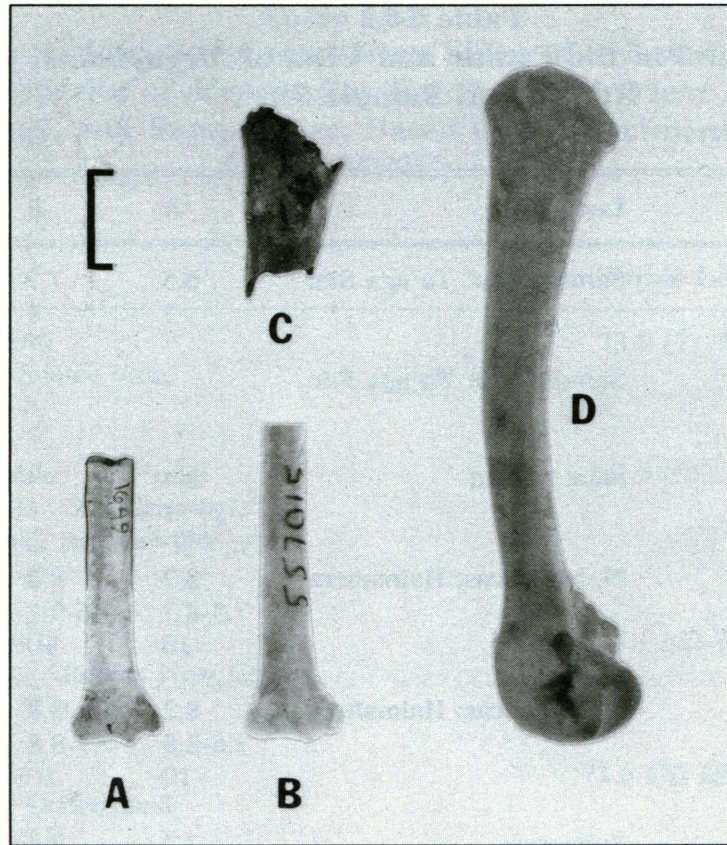


Figure 14.2 Comparison of megapode bones: ulna in ventral aspect (A, B) and femur in lateral aspect (C, D). A, C. *Megapodius* cf. *freycinet*, archaeological specimens (UWBM 1637, 1649), To'aga site, Ofu, American Samoa. B, D. *M. freycinet*, modern specimen, USNM 557015, male, Halmahera, Northern Moluccas. Scale = 20 mm.

Ha'apai (Tonga). The true identities of *M. stairi* and *M. burnabyi* are uncertain because only a single egg ever was collected of each, and these two eggs cannot be assigned unequivocally to *M. pritchardi*, *M. freycinet*, or any other species of megapode (Steadman 1991). One or both of these eggs may represent the same species as the bones from Ofu, which also are at the very lower limit of the size range of *M. freycinet* and larger than, or at the uppermost size limit of, *M. pritchardi*.

The original, handwritten data slip with the holotypical egg of *Megapodius burnabyi* in the British Museum notes that this egg was "called the 'chief's egg' as they are only allowed to eat them." Such a chiefly tabu might suggest rarity of the bird and a knowledge that overexploitation, which probably was the cause of the rarity, would eventu-

ally lead to extinction. Alternatively, being called the "chief's egg" could suggest that megapode eggs were prestigious trade items brought to Ha'apai from another island. An extensive exchange network operated among Fiji, Tonga, and Samoa in late prehistoric and early historic times (Kirch 1984:238-42; 1988:257-60). The Samoan voyages recorded by Stair (1895) included Fiji and Tonga as well as much of East Polynesia. Bennett (1862:247) noted that the nesting grounds of *M. pritchardi* on Niuafou'ou were "under the protection of the king or chief, and by his permission only can the birds or eggs be procured." Even if megapodes of the Fiji/Tonga/Samoa region were confined by the nineteenth century to Niuafou'ou, they would have been known to Tongans in Ha'apai, as well as to Samoans.

Unless additional evidence comes forth, neither

Table 14.2
Measurements (in mm) of the Femur and Ulna of *Megapodius*, with Mean, Range, and Sample Size

Specimen	Locality	A	B	C	D	E
<i>Megapodius</i> sp. UWBM 1637 (U)	Samoa: Ofu: To'aga Site	6.5 1	7.7 1	-	-	-
<i>Megapodius</i> sp. UWBM 1649 (U)	Samoa: Ofu: To'aga Site	-	-	4.4 1	3.3 1	6.8 1
<i>M. f. cf. eremita</i> Lab #: 66, 68 (U)	New Ireland	8.4 1	-	4.9 1	-	7.3 1
<i>M. f. freycinet</i> USNM 556995-557002 557016, 557017 (M)	N. Moluccas: Halmahera	8.2 7.5-8.7 10	8.2 7.6-9.1 10	5.0 4.7-5.3 10	3.8 3.3-4.1 10	7.4 7.0-7.9 10
<i>M. f. freycinet</i> USNM 557006-557008 557010-557013, 557019-557022 (F)	N. Moluccas: Halmahera	8.2 7.6-8.8 10	8.3 7.7-8.8 10	4.9 4.6-5.4 10	3.7 3.5-4.1 10	7.3 7.0-7.8 10
<i>M. f. gilberti</i> USNM 226175, 226176 (F, M)	Sulawesi	7.2 6.9-7.5 2	7.4 7.3-7.6 2	4.3 4.3 2	3.2 3.2-3.3 2	6.5 6.5 2
<i>M. f. cumingi</i> BM(NH) 1862.2.10.2 (U)	Philippines: island unknown	8.1 1	8.0 1	5.2 1	4.1 1	7.4 -1
<i>M. f. nicobariensis</i> USNM 19686, 19700 (M)	Nicobar Islands	8.3 8.0-8.6 2	8.3 8.2-8.4 2	5.0 4.9-5.0 2	3.8 3.6-4.0 2	7.8 7.6-7.9 2
<i>M. pritchardi</i> USNM 319633, 319634 (U)	Tonga: Niuafu'ou	5.6 5.4-5.7 2	6.0 5.9-6.1 2	3.4 3.3-3.5 2	2.8 2.8-2.9 2	5.2 5.0-5.3 2
<i>M. laperouse</i> USNM unnumbered (U)	N. Mariana Islands: Rota: Payapai Cave	-	-	3.4 1	2.5 1	5.4 1
<i>M. alimentum</i> UWBM 2100 (U)	Tonga: 'Eua: 'Anatu (Ground-Dove Cave)	-	-	6.0 1	4.4 1	-

F = Female, M = Male, U = Sex unknown

Column Headings:

A. Femur: width at deepest proximo-lateral muscle scar

B. Femur: depth at deepest proximo-lateral muscle scar

C. Ulna: minimum width of shaft

D. Ulna: minimum depth of shaft

E. Ulna: width of distal end

Table 14.3
Tarsal Length (in mm) from Skins of Selected
Subspecies of *Megapodius freycinet*, with Mean,
Range, and Sample Size. Based upon Specimens
from BM(NH).

Subspecies	Tarsal Length
<i>M. f. layardi</i> Vanuatu: Santo, Vate (F, 5M)	73.8 (71-76), 6
<i>M. f. eremita</i> Solomon Is.: San Cristobal, Guadacanal, Bouganville (3F, 2M, U)	72.2 (67-77), 6
<i>M. f. eremita</i> Papua New Guinea: New Britain (3F, 2M, 3U)	67.1 (62-71), 8
<i>M. f. yorki</i> Australia: Queensland (2F, 4M, 4U)	71.6 (70-74), 10

F = female, M = male, U = sex unknown

Megapodius stairi or *M. burnabyi* should be regarded as certain records of indigenous populations of megapodes in nineteenth century Samoa or Ha'apai, although this cannot be ruled out. The survival of *M. pritchardi* on Niuafu'ou has been due to chiefly control of exploiting eggs and birds at the conspicuous nest mounds, as first described by Bennett (1862). The people of Niuafu'ou must have realized that conserving megapodes, which probably occurred nowhere else in the region, would help to maintain their share of commerce in the Samoa-Tonga-Fiji trade network.

Family Phasianidae

Gallus gallus (Chicken)

MATERIAL. Sternum (UWBM 1261), Unit 11, II. Coracoid (UWBM 1654), T9/500E, Unit 23, IIIB. Scapula (UWBM 1663), T9/500E, Unit 20, IIIB. Ulna (UWBM 1255), Unit 14, IIIa-4. Radius (UWBM 1660), T9/500E, Unit 20, IIIB. Two pelves

(UWBM 1665, 1686, 1688; the last two originally believed to be separate bones), T9/500E, Unit 20, IIIB; T9/500E, Unit 21, IIB. Two femora (UWBM 1666, 1667), T9/500E, Unit 20, IIIB. Four tibiotarsi (UWBM 1632, 1644, 1658, 1661), T5/100E, Unit 16, I; T5/100E, Unit 29, IIIB; T9/500E, Unit 20, IIB; T9/500E, Unit 20, IIIB. Two tarsometatarsi (UWBM 1646, 1683), Unit 29, IIIB; Unit 21, III.

REMARKS. Feral and/or domestic populations of *Gallus gallus* occur nearly throughout Polynesia, including all inhabited Samoan islands. All chickens recorded on Ofu in 1986 were near human habitation and not from deep within forests. This non-native species has been found through virtually all of Polynesia in archaeological sites of any age, except that it is absent from all sites on Henderson Island (Schubel and Steadman 1989). Chicken bones occur throughout the To'aga sequence, but are especially well represented in the Layer IIIB occupation in Units 20/23 along Transect 9. This indicates that *G. gallus* was a commonly eaten bird during the Ancestral Polynesian phase, ca. 2500 yr B.P.

Order Columbiformes
Family Columbidae

Gallicolumba stairii (Shy Ground-Dove)

MATERIAL. Humerus (UWBM 1638), T5/100E, Unit 15, IIID. Ulna (UWBM 1658), Unit 30, IIID. Tarsometatarsus (UWBM 1690), T5/100E, Unit 29, IIID.

REMARKS. This species occurs only in very old deposits at To'aga, primarily Layer IIID in Units 29/30. *Gallicolumba stairii* is extremely rare on Ofu today, with a very roughly estimated 100 birds surviving in 1975-76. Only two or three ground-doves were seen on Ofu during the 1986 surveys; no population estimate was made. Within American Samoa, only perhaps on Olosega does another small population of *G. stairii* survive. Similar declines or losses of populations of *G. stairii* have occurred in Tonga, where the only other archaeological record of *G. stairii* is from *Eua.

DISCUSSION

Virtually all of the bird bones from To'aga are broken, often with both articular ends missing. Most of these breaks are not fresh, although often it is difficult to distinguish whether human or sedimentary processes have caused the breakage. A few bones are rounded, suggesting some post-mortem sedimentary transport. The breakage and rounding might indicate that the calcareous sands at To'aga represent a somewhat higher energy deposit than the calcareous sands at certain other Polynesian archaeological sites, such as Hane (Ua Huka, Marquesas) or Tongoleleka (Lifuka, Tonga). Among the shearwaters and petrels, however, a systematic butchering technique is suggested by the fairly consistent pattern of both ends of the humerus, ulna, and tibiotarsus being broken off. Two of the chicken bones had been chewed by rats. None of the bird bones seems to have been modified into recognizable artifacts.

Among indigenous, resident species recorded from the To'aga site, five of ten seabirds and one of three landbirds are extirpated on Ofu (table 14.1). At least two of the surviving species (*Steminae* sp., *Gallicolumba stairii*) exist today on Ofu only in very small, threatened populations. Should these species be lost from Ofu, the proportion of bones of extir-

pated species at To'aga would increase from 85% (table 14.1) to 93%.

The majority of bird bones from To'aga (46 of 74, or 62%) are of at least five species of petrels or shearwaters (table 14.1), none of which nests on Ofu today (Amerson et al. 1982a:90). Only two of these species (Audubon's Shearwater and Tahiti Petrel) are known certainly to nest today anywhere in American Samoa. As seems to be case throughout Polynesia (Steadman 1989a, Dye and Steadman 1990), the island of Ofu had a diverse and probably abundant seabird fauna when humans first arrived. In the case of Ofu, not a single species of procellariid has survived the three millennia of human occupation.

Compared to avian assemblages from other Polynesian archaeological sites, the dominance of procellariids at To'aga would characterize a fairly early site, i.e., one that dates to within the first thousand years of human occupation (Dye and Steadman 1990). When compared to sites that seem to represent the initial human occupation of an island, however, such as the Hane site (Ua Huka, Marquesas; Steadman 1989a) or Tongoleleka site (Lifuka, Tonga; Steadman 1989b), the To'aga site's lower percentage and diversity of bones from native landbirds and higher percentage of chicken bones would suggest that this site may not represent the first 500 years of human occupation of Ofu. This suggestion is compatible with the radiocarbon chronology at To'aga which indicates occupation of the site from about 2800 to 1900 yr B.P. (see Kirch, chapter 6).

Although the bird bones from To'aga provide much new data on the prehistoric distribution of Samoan birds, a bone sample about an order of magnitude larger would be necessary to provide a fairly complete picture of the past birdlife of Ofu. That six of the fifteen taxa of birds from To'aga are represented by only a single bone indicates that more species await discovery if a larger bone sample were available. The 1987 sample of twenty-three bones yielded six taxa, which increased to fifteen taxa with the addition of fifty-one bones from the 1989 excavations. The point of diminishing returns is difficult to determine, however, from comparison with assemblages from other sites. For example, thirty-five species of birds are represented in a sample of ca. 350 bones from the Fa'ahia site (Huahine, Society Islands; Steadman and Pahlavan

1992), while thirty-nine species of birds are represented in a sample of ca. 12,000 bones from the Hane site (Ua Huka, Marquesas) (Steadman 1989a, pers. obs.). Twelve of the species from Hane are known from either one or two bones. Another gauge of the incompleteness of the To'aga avifauna is the low percentage of species in the modern avifauna of Ofu that are represented at the site. In this case, only two of sixteen possible species of resident landbirds (12.5%) are represented.

The To'aga site has given us an intriguing introduction to Samoa's prehistoric birdlife. Our understanding of the relationship between native birds and the first human inhabitants of Samoa undoubtedly will improve as more early archaeological sites are discovered and carefully excavated.

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