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Mammalian and Reptilian Fauna from Emily and Cemetery Bays, Norfolk Island

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ABSTRACT. Large mammal remains described from the prehistoric settlement at Emily Bay consist of elephant seal and turtle. *Rattus exulans* remains similar to those elsewhere in Polynesia were the only rodent remains found throughout excavations at Emily and Cemetery Bays: there is no evidence that this animal was eaten. A partial dog mandible from Emily Bay is described: it may be prehistoric but neither its date nor osteometry are definitive. An intrusive recent pig is noted.

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Mammal and reptile remains were scarce in the excavations at Emily and Cemetery Bays. Identification of all bone recovered was taken to the lowest possible taxonomic level for two reasons: first, to see what animals had been brought by people to the island and second, to see what native animals were available for exploitation.

Our joint authorship of this paper is the result of an amalgamation of Smith's work on large mammals and reptiles, White's on rodents from Emily and Cemetery Bays, and Clark's on a *Canis familiaris* mandible from Emily Bay.

Large mammals and reptiles

All large mammalian and reptilian remains recovered in the excavations are summarized in Table 1. These consisted of 95 bone fragments and one piece of tooth. The latter was the crown and part of the root of a human maxillary incisor from a depth of 72 cm at Cemetery Bay. The bones were mostly in a dry, friable and fragmentary state that made species identification impossible. Identifications were made by comparison with reference specimens in the Otago Archaeological Laboratories (OAL).

Nearly three-quarters of the number of bones were from Spit 3 in one square of Trench EB97:24 at Emily Bay, and came from the cranium of a Southern Elephant Seal (*Mirounga leonina*). These included the left frontal bone, right tympanic bulla and numerous unsided fragments from the occipital, parietal, frontal and nasal regions. In size they are closely similar to a sub adult male in the OAL collection.

This identification constitutes the northern-most (29°S) documented occurrence of elephant seal in the Pacific Ocean. The modern distribution of this species is confined largely to subantarctic waters south of c. 40°S (Jefferson *et al*., 1993: 287), although they formerly occurred as far north

Table 1. Large mammal and reptile bones from Emily Bay (EB), West Emily Bay (WEB), Cemetery Bay (CB) and Limekiln.

NIPP no.	site	trench	sq.	cultural layer	other provenance	taxon	element	side	portion	NISP	notes
1	Limekiln	outcrop	—	—	—	turtle	carapace	—	fragment	1	appears to be cut at one end
15	WEB	new toilet	—	—	c. 1.3 m b.s.	turtle	fibula	—	fragment	1	not sure of element identification
50	CB	CB95:01	A3	—	72 cm b.s.	*Homo sapiens*	I'	right	crown and part root	1	—
65	EB	EB95:02	A1	Spit 3	17/12/95	mammal or turtle	—	—	fragments	3	—
109	EB	EB96:10	B4	Spit 2	9/4/96	turtle	pelvis	—	fragments	2	not sure of element identification
125	EB	EB96:10	A5	Spit 1	8/4/96	turtle	vertebra	—	fragments	3	—
128	EB	EB96:10	B1	Spit 1	9/4/96	turtle	vertebra-cervical		centrum	1	—
141	EB	EB96:10	A2	Spit 4	8/4/96	mammal or turtle	—	—	fragments	2	—
150	EB	EB96:10	B3	Spit 4	10/4/96	turtle	vertebra-cervical	—	complete	1	—
156	EB	EB96:11	A2	Spit 3	12/4/96	turtle	vertebra-cervical	—	neural arch	1	—
162	EB	EB96:11	A2	Spit 2	12/4/96	turtle	carapace	—	fragment	1	—
162	EB	EB96:11	A2	Spit 2	12/4/96	mammal or turtle	—	—	fragment	1	—
606	EB	EB97:23	E13	Spit 3	—	turtle	carapace	—	fragments	2	—
630	EB	EB97:23	F9	Spit 4	—	turtle	carapace	—	fragments	4	—
632	EB	EB97:23	F9	Spit 5	—	turtle	carapace	—	fragments	3	—
15	EB	EB97:23	E7	Spit 1	—	pig	mandible	right	tooth row fragment	1	modern
762	EB	EB97:24	Z6	Spit 3	bag 1	elephant seal	cranium	left	frontal	1	—
762	EB	EB97:24	Z6	Spit 3	bag 1	elephant seal	cranium	right	tympanic bulla	1	—
762	EB	EB97:24	Z6	Spit 3	bag 2	elephant seal	cranium	—	occipital and frontal fragments	30	—
762	EB	EB97:24	Z6	Spit 3	bag 3	elephant seal	cranium	—	parietal and nasal fragments	37	—

as 16°S at St Helena in the Atlantic Ocean (King, 1990: 264). In the Pacific the northernmost modern records are from the Bay of Islands New Zealand (King, 1990: 265), and archaeologically they have previously been recorded as far north as c. 35°S at Houhora, New Zealand (Smith, 1989: 85–86). The modern records from New Zealand are predominantly of occasional individuals hauling out to moult or rest, and it is likely that this was the case for the Norfolk Island example.

This is the third recent case of seal remains found in an early archaeological context in the southwest Pacific. They occurred in a probable fourteenth century A.D. context at the Low Flat site, Raoul Island (Anderson, 1980). A New Zealand fur seal in a fourteenth century A.D. site in the Cook Islands was interpreted as an isolated vagrant, wandering northward from a breeding range that then included the northern tip of New Zealand (Walter and Smith, 1998). The extension of the pelagic range of the elephant seal to Norfolk Island may indicate that before European arrival in the Pacific Ocean this species was also breeding further north than it does today.

Turtle remains were present in four of the Emily Bay trenches, although never in great abundance. No turtle remains occurred close to the *marae*, although this might have been expected given the high status of this structure in many parts of Polynesia. Eleven pieces were fragments of carapace, and another six were parts of at least three vertebrae. Fragments of a pelvis and fibula were also probably present. None of these could be identified to species. The Green Turtle (*Chelonia mydas*) is the most common species in the southwest Pacific, but the Hawksbill (*Eretmochelys imbricata*), Leatherback (*Dermochelys coriacea*) and Loggerhead (*Caretta caretta*) are also present (South Pacific Commission, 1979). It is of interest to note that Emily Bay was formerly known as Turtle Bay, because of the abundance of breeding turtles there (Hunter, 1793: 317).

The only other large mammal represented was the pig (*Sus scrofa*), by part of the tooth row of a right mandible. Although this specimen appeared to be in a secure prehistoric context, in the top spit of the cultural level, Trench EB97:23, a radiocarbon date of 50±35 (OxA8750) on it shows that it must be from the historic period.

Table 2. Number and type of rodent bones by trench.

Trench	n	mandible	maxilla	femur	tibia	innominate	humerus	other
EB95:02	60	13	9	10	14	9	4	1
EB96:10	29	8	2	5	4	7	2	1
EB96:11	21	1	2	7	5	4	0	2
EB97:21	1	0	0	0	0	0	1	0
EB97:22	1	1	0	0	0	0	0	0
EB97:23	369	86	12	103	51	67	46	4
EB97:24	88	19	3	30	14	10	12	0
Cemetary Bay	13	1	2	4	2	3	1	0
total	582	129	30	159	90	100	66	8

Rodents in the Emily and Cemetery Bay excavations

A total of 569 identified rodent bones were recovered from all excavations in Emily Bay and 13 from Cemetery Bay. Their distribution by trench is given in Table 2.

The bones were studied for three reasons. First, how many species were represented? It could be predicted that *Rattus exulans*, the "Polynesian rat" was present, as this has been found on all other Pacific islands reached by Polynesian voyagers (Roberts, 1991). Were there others?

Second, did these species differ from those found in the potential source region of the Norfolk Island settlement, New Zealand (as determined by other archaeological evidence)?

Third, were the animals eaten, as was common elsewhere in Polynesia, notably New Zealand (Roberts, 1991)?

The rodent bones consisted almost entirely of mandibles, maxillas and the four most robust and readily identifiable post-cranial bones—femur, tibia, innominate and humerus. All mandibles and maxillas were identified as *Rattus exulans* on the basis of comparative material from New Ireland and Vanuatu in the Archaeology Laboratory, University of Sydney. The post-cranial bones were compared with already identified material in terms of length, robustness and morphology (White *et al*., 2000). No anomalies were noted, confirming that the material is all from the same species.

Measurements taken were on $M_{1–3}$ lengths. For these the material was divided into mandibles with at least M_1 and M_3 present, so that measures could be taken on actual teeth, (n=27) and those for which measurements had to be made on the alveoli (n=81). Results are given in Table 3. As has been demonstrated elsewhere (White *et al*., 2000), the alveoli results are slightly larger than measurements made directly on teeth, but both fall comfortably within the range of modern *R. exulans*. The Norfolk Island animals are similar in size to animals from Vanuatu, but somewhat smaller overall than those from elsewhere in Polynesia (White *et al*., 2000), including New Zealand (Matisoo-Smith and Allen, in press). This runs counter to the current pattern where sub-tropical *R. exulans*, without competition from other rodents, are larger (Atkinson and Moller, 1998). Comparison with a clearly contemporary data set from New Zealand would be of interest.

Table 3. $M_{1–3}$ lengths (mm) from Norfolk Island compared with other Pacific *Rattus exulans*. "Polynesian" and Vanuatu data from White *et al*. (2000), New Zealand data from Matisoo-Smith and Allen (in press).

	n	mean	s.d.	median	max	min
NI, on teeth	27	5.26	0.18	5.27	5.58	4.81
NI, on alveoli	81	5.70	0.24	5.69	6.37	5.21
"Polynesian"	178	6.0	0.5	—	7.2	4.9
Vanuatu	76	5.3	0.3	—	5.9	4.5
New Zealand	42	6.22	0.51	—	7.3	5.35

In terms of distribution over the site the only noticeable concentration of material was in the upper spits of squares D9 and D10 of Trench EB97:23 (Table 4). These two squares contained one-third of the total specimens (n=123) in the 37 square metre trench. Trench EB97:23 showed a greater concentration of rat bones overall (10/m^2) than the rest of the site, notably Trench EB97:24 (5.5/m^2). This suggests a rodent focus on the "house" rather than the "platform" area. This is to be expected given the commensal nature of *R. exulans* and may thus provide support to this interpretation of these features. However, bones from the site showed no evidence of burning and were largely unbroken, suggesting natural death. Unlike New Zealand, there is no evidence that people were eating these animals (and even in New Zealand the evidence is ethnographic rather than archaeological).

Table 4. Rodent bones (NISP) in Trench EB97:23, squares D9 and D10 (n = 123).

Spit	1	2	3	4	5	6	7
D9	1	28	14	10	0	5	1
D10	10	8	19	8	10	9	0

Finally, I note that *R. exulans* is still present on the island, and was noted as common by the first European settlers in 1788, providing evidence of continuity. While the radiocarbon determinations on rat bone are in some respects contradictory, and therefore unreliable, the weight of data confirm the stratigraphic interpretation that *Rattus exulans* was introduced in the Polynesian settlement era (see Anderson, Higham and Wallace, this vol.).

A *Canis familiaris* mandible from Emily Bay

A dog mandible thought to be associated with the prehistoric Polynesian settlement site on Norfolk Island was recovered by Bevan Nicolai at a depth of approximately 80 cm during the digging of a toilet hole, subsequently unused, at Emily Bay in 1986. The hole lay just on the southern edge of the site within 10 m of excavation Trench EB95:06. A broken *Canis* carnassial tooth identified by A. Anderson and I. Smith during excavation of the cultural layer at Trench EB96:10 at Emily Bay has not been relocated in the material returned to the ANU.

This note describes the mandible and attempts to clarify its cultural affinity. Contextual details for the mandible recorded on the plastic bag containing the bone were: "West Emily Bay, New toilet, Nov. 86, Brown earthy layer, B.N., NIPP 15 [number allocated to this collection of specimens]".

The mandible was dated by the AMS method to 205±40 years (OxA-8749). At one standard deviation the calibrated date's lower distribution is pre-European (cal A.D. 1658–1682, 1747–1805, 1935–1954), and a Polynesian origin, while unlikely, cannot be ruled out, although it does not have the same stratigraphic associations as the dog tooth from Trench EB96:10. The date is younger by several hundred years than most reliable determinations from the Emily Bay site.

The left demi-mandible weighs 8.50 g and is light yellow in colour. No teeth remain in the alveoli. Post-depositional damage is suggested by sharp edged and unweathered breaks across the anterior infradentale and posterior ramus. Light microscopy showed pale yellow sand grains trapped in the alveoli and this, along with the bone colour, suggests that the mandible was interred in a loose yellow-brown sand rather than a "Brown earthy layer". This is significant as the site is capped by a layer of yellow-brown hummocky dune sand that overlies the thin grey prehistoric occupation horizon. The lower layer is distinguished from the upper by its dark-grey colour caused by charcoal staining, and its faunal and artefactual content. Thus, while the mandible cannot be confidently assigned either to the pre-European or European period deposits, the good bone preservation and colour of the trapped sand grains suggest interment in the latter.

It is not possible to establish whether the bone belongs to a male or female dog but it is reasonable to assume that it came from a small-to-medium sized adult using as a guide the size of the mandible, the development of the condyle process, and the degree of mineralization observed on the bone surface. No dental abnormalities in the alveoli were noted except for the possibility that P_1 was impacted into P_2.

Table 5. Mandibular measurements (mm) of the Norfolk Island dog mandible, Polynesian dog (*kuri*) from New Zealand (n = 117–118) and Hawaii (n = 71–83).

sample	M_3-P_1 length	corpus M_1 height	corpus P_2 height	premolar length	molar length
NIPP 15	62.6	16.8	14.6	28.9	31.9
NZ—mean	64.2	22.8	18.5	35.1	29.7
NZ—min	56.3	17.4	14.6	24.8	23.0
NZ—max	72.5	28.2	27.7	53.7	35.4
Haw—mean	60.3	18.6	16.0	31.8	30.0
Haw—min	53.1	13.6	12.6	27.0	26.2
Haw—max	67.0	22.8	19.1	37.7	33.7

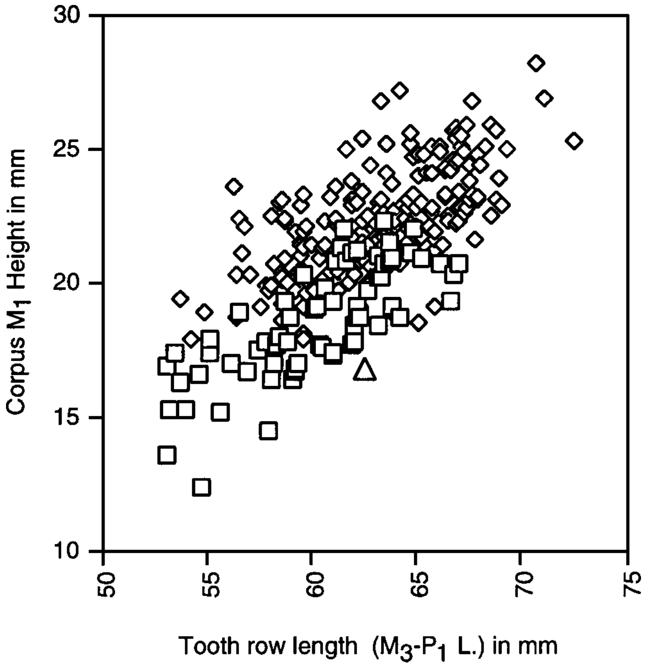

Figure 1. Bivariate plot of mandibular measurements of the Norfolk Island dog (triangle), New Zealand *kuri* (diamonds) and Hawaiian dog (squares).

As the mandible's stratigraphic association and origin were in doubt, five measurements from it were compared with the same dimensions from the Polynesian dog of New Zealand and Hawaii (Clark, 1997a,b) to determine whether or not the specimen was potentially of Polynesian origin. Because of selective breeding the dog is the most morphologically varied animal on earth today (Wayne, 1986: 382), and a comparison with heterogeneous European dog populations will tell us little about the affinities of a particular specimen, and begs the question of what form a comparative sample of "European dogs" should take given the degree of phenotypic variation. An alternative approach to examine specimen affiliation is to compare its dimensions with the osteometric parameters of suspected source populations and this method is followed here (Clark, 1997a: 115, 1998). If the Norfolk Island specimen falls outside the known population dimensions of Polynesian dogs then a European origin or non-regional derivation must be suspected. Mandibular measurements (mean, minimum and maximum) for the samples are listed in Table 5 and a bivariate plot of tooth row length (M_3-P_1 Length) versus the height of the corpus at M_1 (Corpus M_1 Height) is shown in Fig. 1.

A univariate comparison of the Norfolk Island dog mandible shows that most measurements fit comfortably within the metric parameters of the prehistoric dog of Hawaii and New Zealand. The exceptions are the mandible height variables (Corpus M_1 and P_2 Height) which are less than, or the same as, those from the smallest New Zealand dogs (Table 5). However, the plot of the mandibular dimensions of the Norfolk Island dog indicates that it is not especially "Polynesian like" (Fig. 1) and plots of other dimensions produced a similar result, placing NIPP 15 on the plot periphery closest to Hawaiian dogs and away from the New Zealand *kuri* (e.g., premolar length × P_2 Height). The measurement comparison does not therefore rule out a Polynesian origin. However, the specimen's marginal position in bivariate plots lends further support to its European derivation.

To summarize, both the radiocarbon date and the metrical comparison are ambiguous in relation to the mandible's origin. If it is pre-European, it would represent the only direct evidence of Polynesians bringing a domestic animal to Norfolk Island.

As part of the domestic landscape, dogs were seldom mentioned in early accounts of European life on Norfolk Island and it is not known when they were first introduced. That they were present is shown by the abandonment of about a dozen male and female dogs at the end of the First Settlement in 1814 (Nobbs, 1988: 164–165). It is possible that a similar event occurred at the end of Polynesian occupation leaving a resident population that rapidly reverted to a feral state. The existence of such a population could have been tied to the seasonal availability of ground-nesting seabirds and hunting of the introduced Pacific rat (*Rattus exulans*), but long-term survival would seem unlikely.

The prehistoric distribution of domestic and commensal animals in the Pacific provides a valuable insight into the subsistence strategy, maritime ability and approach to island settlement by colonizing groups. It is therefore important to carefully examine the remains of introduced species and to differentiate prehistoric Polynesian from European introductions—particularly bones from the pig, dog and chicken that were transported through the Pacific in the past by Oceanic peoples and more recently by Europeans. The provenance and age of the Emily Bay dog mandible does not provide a strong link to the East Polynesian settlement deposits. Additionally, five measurements were used to further explore its affinities to Polynesian dogs from Hawaii and New Zealand and these suggest that a New Zealand derivation is unlikely. The mandible has greater similarity to the Hawaiian dog sample but a definitive Polynesian origin cannot be determined. Unless the missing carnassial tooth is relocated or new *in situ* dog remains from prehistoric contexts are recovered, there must remain some doubt as to whether Polynesians transported the dog, along with the ubiquitous commensal *Rattus exulans*, to Norfolk Island.

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References

Anderson, A.J., 1980. The archaeology of Raoul Island (Kermadecs) and its place in the settlement history of Polynesia. *Archaeology and Physical Anthropology in Oceania* 15: 131–141.

Atkinson, I.A.E., and H. Moller, 1998. Kiore, Polynesian rat. In *The Handbook of New Zealand Mammals*, ed. C.M. King, pp. 175–192. Auckland: Oxford University Press.

Clark, G., 1997a. Osteology of the *Kuri* Maori: the prehistoric dog of New Zealand. *Journal of Archaeological Science* 24: 113–126.

Clark, G., 1997b. Anthropogenic factors and prehistoric dog morphology: a case study from Polynesia. *Archaeology in Oceania* 32: 124–130.

Clark, G., 1998. Prehistoric contact between Australia and Polynesia: the Pukapuka dog re-examined. *International Journal of Osteoarchaeology* 8: 116–122.

Hunter, J., 1793. *An Historical Journal of the Transactions at Port Jackson and Norfolk Island*. Australiana Facsimile Editions. No. 148 (1968). Adelaide: Libraries Board of South Australia.

Jefferson, T.A., S. Leatherwood and M.A. Webber, 1993. *Marine Mammals of the World*. Rome: Food and Agriculture Organization of the United Nations.

King, C.M., ed., 1990. *The Handbook of New Zealand Mammals*. Auckland: Oxford University Press.

Matisoo-Smith, E., and J.S. Allen, in press. Name that rat: molecular and morphological identification of Pacific rodent remains. *International Journal of Osteoarchaeology*.

Nobbs, R., ed., 1988. *Norfolk Island and its First Settlement, 1788–1814*. Sydney: Library of Australian History.

Roberts, M., 1991. Origin, dispersal routes and geographic distribution of *Rattus exulans*, with special reference to New Zealand. *Pacific Science* 45: 123–130.

Smith, I.W.G., 1989. Maori impact on the marine megafauna: pre-European distributions of New Zealand sea mammals. In *Saying So Doesn't Make It So: Papers in Honour of B. Foss Leach*, ed. D.G. Sutton, pp. 76–108. New Zealand Archaeological Association Monograph 17. Dunedin: New Zealand Archaeological Association.

South Pacific Commission, 1979. *Joint SPC/NMFS Workshop on Marine Turtles in the Tropical Pacific Islands, Report*. Noumea: South Pacific Commission.

Walter, R.K., and I.W.G. Smith, 1998. Identification of a New Zealand fur seal (*Arctocephalus forsteri*) bone in a Cook Island archaeological site. *New Zealand Journal of Marine and Freshwater Research* 32: 383–487.

Wayne, R.K., 1986. Developmental constraints on limb growth in domestic and some wild canids. *Journal of Zoology, London (A)* 210: 381–399.

White, J.P., G. Clark and S. Bedford, 2000. Distribution, present and past, of *Rattus praetor* in the Pacific and its implications. *Pacific Science* 54: 105–117.

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Anderson and White, 2001, *Rec. Aust. Mus., Suppl.* 27: 1–9
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1335

Anderson et al., 2001, *Rec. Aust. Mus., Suppl.* 27: 11–32
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1336

Anderson et al., 2001, *Rec. Aust. Mus., Suppl.* 27: 33–42
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1337

Anderson and Green, 2001, *Rec. Aust. Mus., Suppl.* 27: 43–51
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1338

Marianne et al., 2001, *Rec. Aust. Mus., Suppl.* 27: 53–66
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1339

Schmidt et al., 2001, *Rec. Aust. Mus., Suppl.* 27: 67–74
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1340

Smith et al., 2001, *Rec. Aust. Mus., Suppl.* 27: 75–79
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1341

Matisoo-Smith et al., 2001, *Rec. Aust. Mus., Suppl.* 27: 81–84
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1342

Holdaway and Anderson, 2001, *Rec. Aust. Mus., Suppl.* 27: 85–100
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1343

Walter and Anderson, 2001, *Rec. Aust. Mus., Suppl.* 27: 101–108
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1344

Campbell and Schmidt, 2001, *Rec. Aust. Mus., Suppl.* 27: 109–114
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1345

Neuweger et al., 2001, *Rec. Aust. Mus., Suppl.* 27: 115–122
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1346

Macphail et al., 2001, *Rec. Aust. Mus., Suppl.* 27: 123–134
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1347

Anderson and White, 2001, *Rec. Aust. Mus., Suppl.* 27: 135–141
http://dx.doi.org/10.3853/j.0812-7387.27.2001.1348