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Mammals and Other Vertebrates from Late Quaternary Archaeological Sites on Pulau Kobroor, Aru Islands, Eastern Indonesia

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Introduction

Excavations in each of Liang Lemdubu and Liang Nabulei Lisa, limestone caves on Pulau Kobroor, Aru Islands, produced substantial quantities of bone and other vertebrate faunal remains. Together, these provide a rich record of the late Pleistocene to Holocene vertebrate fauna of Pulau Kobroor, important new information on local environmental conditions through the period of human occupation of the sites, and some insights into the economic activities that were undertaken from each site.

In this chapter we provide a systematic review of the prehistoric vertebrate fauna, giving justification in support of the more controversial determinations and providing a brief commentary on the likely ecological associations of each taxon. This information is provided as background for archaeological and palaeoecological interpretation of the faunal sequences and associated cultural remains from Liang Nabulei Lisa and Liang Lemdubu, elaborated in two companion chapters in this volume (Chapters 7 and 9). An earlier paper by O'Connor et al. (2002) gave a brief summary and preliminary interpretation of the vertebrate faunal remains from Liang Lemdubu.

Contemporary Vertebrate Fauna of the Aru Islands

Knowledge of the contemporary vertebrate fauna of the Aru Island group is surprisingly incomplete. Despite the early attention given to the island group by biological explorers such as Alfred Russell Wallace (1857), Hermann von Rosenberg (1867) and Orlando Beccari (1873), the focus of subsequent biological effort shifted to the main island of New Guinea and to major island groups to the east. During the last half-century, relatively few biologists have visited the islands and none for more than a few weeks.

Szalay (1995) compiled a species list for the terrestrial mammal fauna, based mainly on the historical records. Van Strien (1996) summarized the routes taken by each of the historical collectors and provided an updated species list that includes material collected in recent decades by several Australian biologists (most notably, Drs R.A. How and D.J. Kitchener of the Western Australian Museum, and Dr P. Woolley of La Trobe University). Woolley in 1992 collected two samples on Kobroor from 'kitchen middens and hunters', coming from the villages of Jilkai and Namara (see Appendix 3.1 for details of localities and content). These consist primarily of lower jaws and resemble 'trophy' collections from elsewhere in Melanesia.

An updated list of the extant mammal fauna is given in Table 3.1, with species listed separately for each of the major and several of the smaller islands. Taxonomic differences from previous lists are chiefly due to recent generic changes among murid rodents, along with some revised identifications (see below). The combined list for all islands includes 10 marsupials, five native rodents and 15 bats. Seven introduced mammals are recorded from feral populations.

The avifauna of the Aru Islands is more completely known, in part from the efforts of numerous amateur ornithologists. No attempt has been made to tabulate this element of the fauna.

The herpetofauna remains poorly documented. The classic works of van Kampen (1923) on amphibians and de Rooij (1915, 1917) on reptiles remain the major sources of information for this region.

The ichthyofauna of the Aru Islands was last reviewed comprehensively by Weber (1911).

The Archaeological Vertebrate Fauna

The great bulk of the archaeological remains comes from a relatively small number of mammal and reptile species. However, a total of 29 mammal species are represented, together with an unknown number of reptiles, frogs, and birds. We focus here on the mammal species which are most readily identified from fragmentary remains. Future study of the bird, reptile and frog remains might prove rewarding.

Modern reference specimens are identified by the following prefixes: 'AM' (Australian Museum, Sydney); and 'CM' (Australian National Wildlife Collection, CSIRO Division of Sustainable Ecosystems, Canberra).

Family Tachyglossidae

Tachyglossus aculeatus (Shaw and Nodder 1792) Short-beaked Echidna

Current status: No historical or contemporary records.

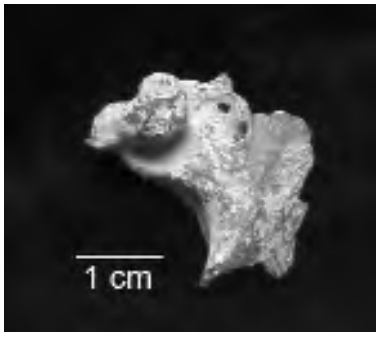

Figure 3.1 Liang Lemdubu: partial humerus of *Tachyglossus aculeatus* from Spit 9

Referred material: This taxon is consistently represented between Spits 5 and 25 in Lemdubu (see Fig. 3.1). Only one specimen was identified in the Nabulei Lisa fauna: a distal tibia in Spit 35.

Wider distribution and habitat associations: The Short-beaked Echidna is known from scattered records in lowland to mid-montane New Guinea and from all major regions of Australia. Although most New Guinean records come from open or drier habitats, the species is present in all major habitats in Australia and is reported from lowland and lower montane rainforest localities in Papua New Guinea.

Table 3.1 List of mammal species recorded as living animals on each of the major islands in the Aru Group, compiled from the following sources: Flannery (1995b), Van Strien (1996), Kitchener (n.d.) and Woolley (Appendix 3.1; pers.comm.). Species believed to be present as a result of deliberate or accidental human introduction are indicated with an (I)

TAXON	WARILAU	WAMAR	WOKAM (W)	KOBROOR (K)	WORK	MAIKOOR	TRANGAN	KOBA	PENAMBULAI	WORKAN	UNKNOWN
DASYURIDAE											
Murexia longicauda				+							
Myoictis wallacei					+						+
Sminthopsis virginiae											+
PERORYCTIDAE											
Echymipera rufescens			+	+							+
PHALANGERIDAE											
Phalanger gymnotis			+	+							
Phalanger mimicus				+							+
Spilocuscus maculatus		+	+	+		+	+				+
PETAURIDAE											
Dactylopsila trivirgata			+	+							+
Petaurus breviceps		+									+
MACROPODIDAE											
Thylogale brunii		+	+				+				
MURIDAE											
Hydromys chrysogaster		+	+								
Melomys rufescens			+								
Mus musculus (I)		+					+				
Paramelomys naso			+								
Paramelomys platyops											
Rattus leucopus			+								
Rattus rattus (I)		+	+								
Uromys caudimaculatus				+							+
SORICIDAE											
Crocidura maxi (I)			+								
Suncus murinus (I)			+								
VIVERRIDAE											
Paradoxurus hermaphroditus (I)											+
SUIDAE											
Sus scrofa (I)											
CERVIDAE											
Cervus timorensis (I)		+	+	+							
PTEROPODIDAE											
Dobsonia moluccensis			+	+							
Macroglossus minimus		+	+	+							
Nyctimene albiventer			+								
Pteropus macrotis			+								
Pteropus melanopogon			+	+							
Syconycteris australis			+	+							
HIPPOSIDERIDAE											
Hipposideros ater					+						
Hipposideros cervinus				+			+				
Hipposideros diadema				+							
RHINOLOPHIDAE											
Rhinolophus euryotis											
VESPERTILIONIDAE											
Miniopterus australis				+							
Miniopterus schreibersii											+
Pipistrellus javanicus											+
Pipistrellus papuanus											+
EMBALLONURIDE											
Emballonura nigrescens				+							

Family Dasyuridae (Marsupial mice and native cats)

Dasyurus albopunctatus (Schlegel 1880) New Guinea Quoll

Current status: There are no historical of contemporary records of this or any other species of *Dasyurus* on the Aru Islands.

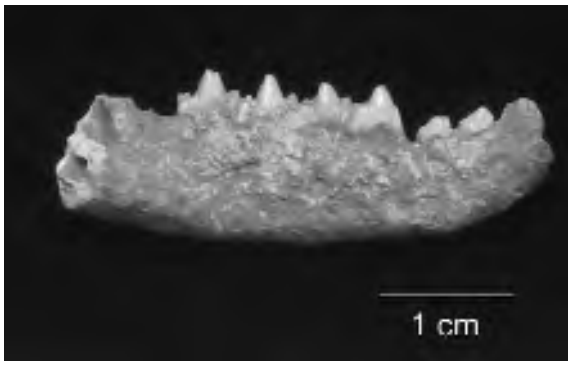

Figure 3.2 Liang Lemdubu: partial dentary of *Dasyurus albopunctatus* from Spit 27

Referred material: Two partial lower jaws (see Fig. 3.2) and a proximal femur from the lower levels of the Lemdubu deposit (Spits 27 and 37) represent a species of *Dasyurus.* An edentulous lower jaw from Spit 37 of Nabulei Lisa is also referred to the same taxon. The lower jaws were compared directly with specimens of *D. albopunctatus* from various localities in Papua New Guinea and Indonesian Papua, and to published accounts only of *D. spartacus* (Van Dyck 1988). They are referred to *D. albopunctatus* on account of the shorter toothrow, relatively reduced metaconids, and crowded premolars. They differ most convincingly from *Dasyurus spartacus* in the proportions of the toothrow: this taxon has a proportionally longer, more spaced out premolar row, reflecting its more elongate rostrum. The illustrated specimen from Spit 27 (Fig. 3.2) has a molar row of 16.9mm; the premolar row measures 6.1mm.

Wider distribution and habitat association: *Dasyurus albopunctatus* is recorded from across a wide altitudinal range and diverse habitats on the main island of New Guinea (Flannery 1995a). *Dasyurus spartacus* is known only from the Morehead region of the Fly Plains of Papua New Guinea, a region of low mixed savannah (Waithman 1979; Van Dyck 1988), although Flannery (1995a) notes unconfirmed reports of the species from similar habitats in Wasur National Park, Indonesian Papua. Given the strong evidence for savannah habitats on the Aru Islands during late Pleistocene times, it is somewhat surprising to find that *D. albopunctatus* was present throughout this period.

Myoictis wallacei (Gray 1858) Aru Island Three-striped Dasyure

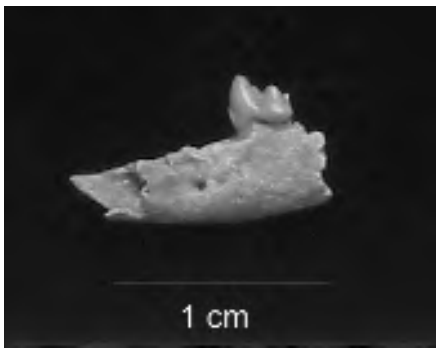

Figure 3.3 Liang Lemdubu: partial dentary of *Myoictis wallacei* from Spit 27

Current status: There are historical records of this species on Kobroor. More recently, Dr P. Woolley collected two specimens on Kobroor and Wokam. Recognition of *M. wallacei* as a distinct species follows the impending revision of this genus by Woolley and her colleagues.

Referred material: This species is represented by two lower jaws retaining single molars. A specimen from Spit 27 of Lemdubu has an unworn M_1 that displays the typical reduced para- and metaconids of a dasyurine (Fig. 3.3).

Wider distribution and habitat association: All members of this genus are associated with closed forest types.

Sminthopsis virginiae (Tarragon 1847) Red-cheeked Dunnart

Current status: This species is still known from the Aru Island group only from the type series of *Sminthopsis rufigenis* that Thomas (1922) collected from an unspecified locality.

Referred material: This species is not definitely represented in the archaeological faunas. However, several dentary fragments lacking teeth (e.g. from Lemdubu Spit 5 and Nabulei Lisa Spit 32) are smaller than *M. wallacei* and might belong to *Sminthopsis virginiae*.

Wider distribution and habitat association: In northern Australia this species inhabits grassland and savannah woodland habitats (Woolley 1995).

Family Peroryctidae (New Guinean Bandicoots)

Echymipera spp.

Current status: *Echymipera rufescens* (Peters and Doria 1875) has been recorded on several occasions from each of Wokam and Kobroor. Van Strien (1996) includes *E. kalubu* (Lesson 1828) in lists of taxa collected by each of Bik, Wallace, von Rosenberg and Kowalevsky. However, the subsequent taxonomic listing includes only *E. rufescens*, making it likely that the other entries are an oversight. A third member of this group, *E. echinista* (Menzies 1990), is recorded from two localities in the Fly-Strickland region of Papua New Guinea.

Referred material: This genus is represented in both sites by moderate numbers of fragmented jaws and teeth, and other cranial and postcranial remains. Further comparative study is needed to resolve final identifications of this material; in the interim, the following observations are warranted.

Among the more complete dentaries, several specimens are very close in size and morphology to a modern series of *E. rufescens* from Kobroor (CM29405-406, 29409, 29411, 29413). However, until direct comparisons have been made also with *E. echinista*, it is not possible to provide a confident allocation of this material to either taxon. The best preserved dentaries come from Spits 15 and 19 in Lemdubu but two well-preserved calcanea from Spits 1 and 4 are also referred to this species based on a close match to CM29506, a skeletal specimen of *E. rufescens* that is labelled as coming from 'West New Guinea'. As reported by Flannery (1990) for other samples of this species, the modern Aru Island sample of *E. rufescens* shows only slight sexual dimorphism in overall cranial size and relative premolar size.

Several dentary fragments appear to be too small to belong to the same taxon. These include two clearly adult specimens in which the molar alveolae are positioned well forward of the anterior root of the coronoid process. Other specimens also display a more crowded premolar series than occurs in *E. rufescens*. These specimens most likely represent *E. kalubu*, which possesses smaller molar teeth, a more slender lower jaw and a less elongate rostrum (hence more crowded premolar series) than either *E. rufescens* or *E. echinista* (Menzies 1990). All three *Echymipera* species are recorded from the Trans-Fly region, along with a fourth bandicoot with Australian affinities, *Isoodon macrourus* (see below).

Wider distribution and habitat association: *Echymipera rufescens* is widely distributed in lowland New Guinea and also on the Kei Islands, and is found locally on Cape York Peninsula, Australia. In New Guinea, *Echymipera rufescens* is primarily a rainforest inhabitant (Flannery 1995a). On Cape York Peninsula its distribution is centred on patches of closed forest. However, it also utilizes 'adjacent heath and eucalypt-woodland and low-layered open forest' (Gordon 1995a). The endemic New Guinean *Echymipera kalubu* is widespread in low to mid-montane rainforests but it also inhabits anthropogenic grassland and woody regrowth. It is recorded on the Fly Plateau as *E. oriomo* (Tate and Archbold 1935). The few capture records for *E. echinista* indicate an association with lowland rainforest either as a dominant community or as gallery forest.

Peroryctes sp. A previously unknown peroryctid

The most remarkable element of the Aru archaeological fauna is a previously unknown peroryctid bandicoot species (Figs 3.4 and 3.5). The preserved material of this taxon includes

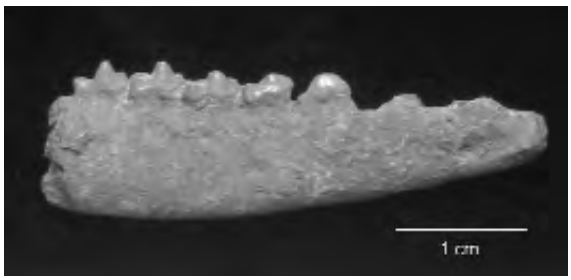

Figure 3.4 Liang Lemdubu: partial dentary of an unknown bandicoot species (*Peroryctes* sp.) from Spit 21. This individual is probably a female, based on the lack of premolar hypertrophy

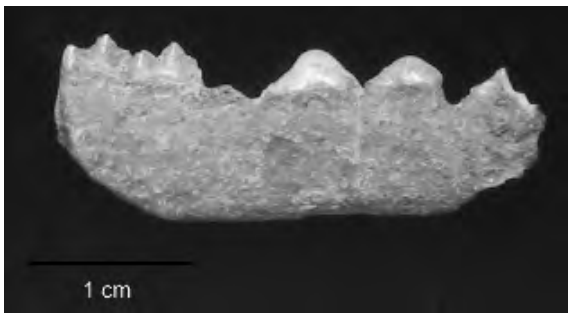

Figure 3.5 Liang Lemdubu: partial dentary of an unknown bandicoot species (*Peroryctes* sp.) from Spit 21. This individual shows marked premolar hypertrophy and is probably a male

several relatively complete dentaries with all postcanine teeth intact (eg Figure 3.4) and two partial maxillae, one with P^3–M^4 in a moderate state of wear, and the other with P^3–M^4 in a virtually unworn condition. Additionally, through a process of elimination of *I. macrourus* and *Echymipera* spp., it has been possible to allocate isolated petrosal elements and calcanea to this taxon. The cranio-dental and postcranial material suggests an animal with a body size somewhat exceeding that of *E. rufescens*. The sample of dentaries shows a strongly bimodal variability in premolar size relative to the molar teeth; this is interpreted as a manifestation of sexual dimorphism in the taxon.

The fossil taxon is most similar in dental morphology to species of *Peroryctes* but shows unusual features of upper molar morphology that preclude referral to this or any other previously recorded genus of bandicoot. It further differs from the altitudinally widespread *P. raffrayana* (Milne-Edwards, 1878) in its extreme premolar hypertrophy of putative male specimens. Sexual dimorphism in premolar size does occur in several species of peroryctid bandicoots, most notably *Peroryctes broadbenti* (Ramsay, 1879) of southeastern Papua New Guinea and *Echymipera clara* Stein, 1932 of the northern lowlands, but these taxa differ in other important respects from the fossil taxon.

The unknown taxon is moderately abundant in the Liang Lemdubu fauna, being second only to *Isoodon macrourus* in number of referred specimens. It is consistently present through the Liang Lemdubu sequence, with examples in all spits between 25 and 18, and isolated specimens in higher levels (Spits 14 and 6). All of the bandicoot material is more fragmented in Nabulei Lisa; however, dentary fragments and pedal elements in Spits 40 to 33 are referred to the new taxon with a high level of confidence.

Family Peramelidae (Australian Bandicoots)

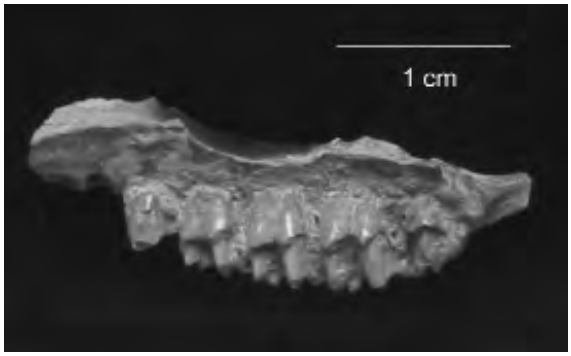

Figure 3.6 Liang Lemdubu: partial maxilla of *Isoodon macrourus* from Spit 23

Isoodon macrourus (Gould 1842) Northern Brown Bandicoot

Current status: No historical or contemporary records.

Referred material: Well-represented in the lower levels of both sites (Fig. 3.6). The reduced abundance of this species in the uppermost levels of Lemdubu and its absence in the upper half of Nabulei Lisa are consistent with the notion that it is locally extinct, at least on Kobroor.

Wider distribution and habitat association: Found in the Morehead region of the Trans-Fly and in the monsoonal woodlands and grassland habitats of southeastern New Guinea (Flannery 1995a). *Isoodon macrourus* is also widely distributed in northern and eastern Australia, where it occupies a wide variety of open and closed habitats (Gordon 1995b).

Family Phalangeridae (Cuscuses)

Phalanger gymnotis (Peters and Doria 1875) Ground Cuscus

Current status: The type specimen of *Phalangista gymnotis* Peters and Doria, 1875 was collected by Beccari at Jabulenga on Wokam. Subsequent examples were collected by Frost and Woolley on Kobroor (see Appendix 3.1).

Referred material: Consistently present through both sequences but often highly fragmented. A specimen showing the diagnostic large third premolar is illustrated in Figure 3.7.

Wider distribution and habitat association: The endemic New Guinean *P. gymnotis* has a broad altitudinal range on mainland New Guinea but it has not been recorded outside of rainforest habitats. There are no contemporary records from the Trans-Fly region.

Figure 3.7 Liang Lemdubu: partial dentary of *Phalanger gymnotis* from Spit 25

Phalanger mimicus (Thomas 1922) Southwestern Common Cuscus

Current status: Only certainly recorded from Kobroor, but probably widespread in the island group.

Referred material: Consistently present through both sequences with some well-preserved examples (see Fig. 3.8).

Wider distribution and habitat association: This species was reported by O'Connor et al. (2002) under the name *Phalanger intercastellanus* (Thomas 1895). Subsequent to submission of that article, the lowland cuscuses of New Guinea and Australia were revised by Norris and Musser (2001), who additionally distinguish *P. mimicus*, a smaller-toothed species that is found from the Trans-Fly area west to the Mimika River on the New Guinean mainland. Although Norris and Musser (2001) did not include Aru Islands material in their study, trophy specimens collected by Woolley on Kobroor (see Appendix 3.1) are consistent with their description of *P. mimicus* and with Cape York examples of this species (e.g. CM787-788 from Iron Range). On the Trans-Fly, this species occupies a mosaic of rainforest and savannah habitat. In Australia, it is largely confined to rainforests, although Winter and Leung (1995a:269) note that the species (as *P. intercastellanus*) will 'penetrate the acacia fringes of rainforest'. The Mimika River animals were presumably obtained from lowland rainforest.

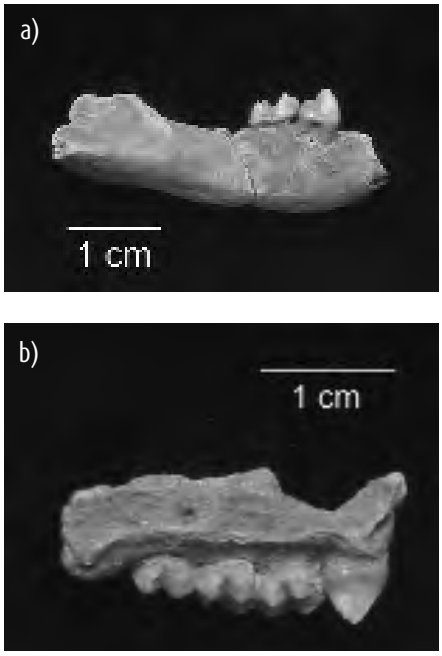

Figure 3.8 Liang Lemdubu: a) partial dentary and b) maxilla of *Phalanger mimicus*, both from Spit 20

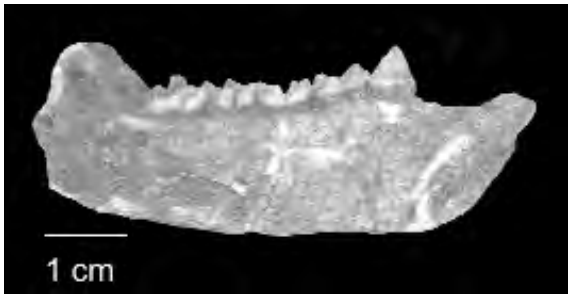

Figure 3.9 Liang Lemdubu: partial dentary of *Spilocuscus maculatus* from Spit 19.

Spilocuscus maculatus (Desmarest 1818) Common Spotted Cuscus

Current status: According to van Strien (1996), *S. maculatus* is 'probably the mammal most commonly collected in Aru, though all the recorded specimens were taken almost 90 years and more ago'. It is recorded from many large and small islands.

Referred material: *Spilocuscus maculatus* is represented by excellent material (Fig. 3.9). The sample is characterized by the small size of the teeth and jaws, in which regard they are consistent with Australian populations of this species.

Wider distribution and habitat association: *Spilocuscus maculatus* is more or less ubiquitous in lowland New Guinea and on all satellite islands. On mainland New Guinea it is generally associated with lowland to mid-montane rainforest habitats (Flannery 1995a). However, *S. maculatus* is also recorded from numerous localities in the Trans-Fly region where it occupies the mosaic of savannah and rainforest habitats (Waithman 1979). In Australia it has been observed 'in freshwater and saline mangroves, in larger paperbarks in thin riparian forest strips and in open forest up to half a kilometer from the nearest rainforest' (Winter and Leung 1995b:266).

Family Petauridae (Gliders and Striped Possums)

Dactylopsila trivirgata (Gray 1858) Striped Possum

Current status: The type specimen of *Dactylopsila trivirgata* (Gray 1858) was collected by Wallace and presumably comes from Wokam or Kobroor. Subsequent records confirm the presence of the species on both islands. Van Strien (1996) remarks that this species 'is not particularly rare in collections' and notes seven specimens in collections. Three additional specimens are held by the Western Australian Museum, collected by How and Kitchener. Woolley also collected one specimen on Kobroor (Appendix 3.1).

Referred material: O'Connor et al. (2002) reported that *Dactylopsila trivirgata* was absent from the Lemdubu fauna and this prompted their suggestion that it may have been a recent introduction to the Aru Islands. However, subsequent work on the Lemdubu collection led to the recognition of an incisor fragment from Spit 1. More significantly, better preserved specimens from Nabulei Lisa confirm a long prehistoric occurrence of *D. trivirgata* on Kobroor. Despite these new findings, the fact remains that this taxon is poorly represented in both sites compared to other, similar sized mammals (e.g. *Phalanger* spp. and bandicoots). Given the broad ecological tolerance of this species (see below), environmental factors including human disturbance seem unlikely to be responsible for its archaeological rarity. Across New Guinea, *Dactylopsila* spp. are generally regarded as desirable food items and they are well-represented in a number of archaeological faunas (White 1972; Aplin et al. 1999).

Wider distribution and habitat association: Widespread on New Guinea, from lowland to lower montane elevations; also found on Cape York Peninsula. In New Guinea the species is usually thought of as a denizen of lowland rainforest and hill forest. However, it is also recorded from numerous localities across the Trans-Fly where it presumably occupies gallery forest or savannah woodland. It is also recorded from secondary forests and old gardens, and therefore is moderately tolerant of human presence.

Family Macropodidae (Kangaroos and wallabies)

Macropus agilis (Gould 1842) Agile Wallaby

Current status: No historical or contemporary records. However, this species may persist on one or more of the poorly surveyed southeastern islands of the Aru group, where there is suitable open wooded habitat.

Referred material: Abundant archaeological remains from the earliest levels in both sites (Fig. 3.10). This species is represented up to Spit 27 in Nabulei Lisa, corresponding to around 10,200 BP, after which time it probably became locally extinct. Dental measurements of the Lemdubu sample shows no indication of changes in tooth size through the sequence (Fig. 3.11).

Wider distribution and habitat association: *Macropus agilis* is found in the savannah woodlands of the Trans-Fly and of southeastern New Guinea. It is also widespread across northern Australia. Throughout its range *M. agilis* is associated with open wooded habitats and grassy understorey. The species has been intensively hunted in coastal Papua both during prehistoric times and historically, and its numbers have declined in some areas as a consequence (Flannery 1995a).

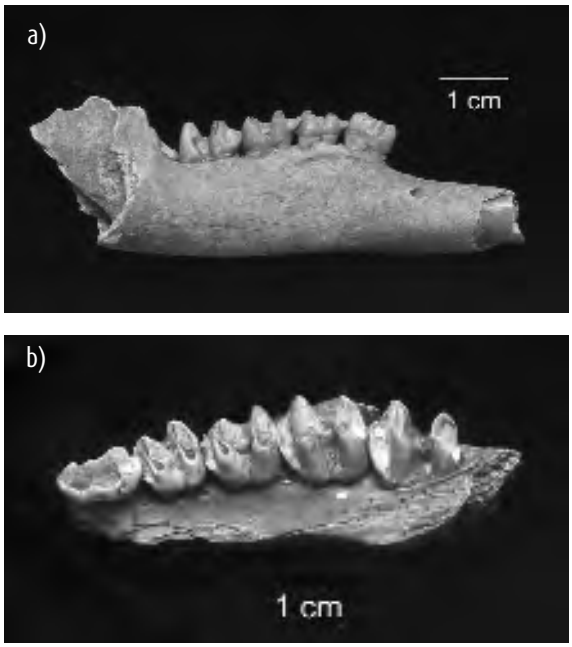

Figure 3.10 Liang Lemdubu: a) partial dentary and b) maxilla of *Macropus agilis* from Spits 22 and 20, respectively

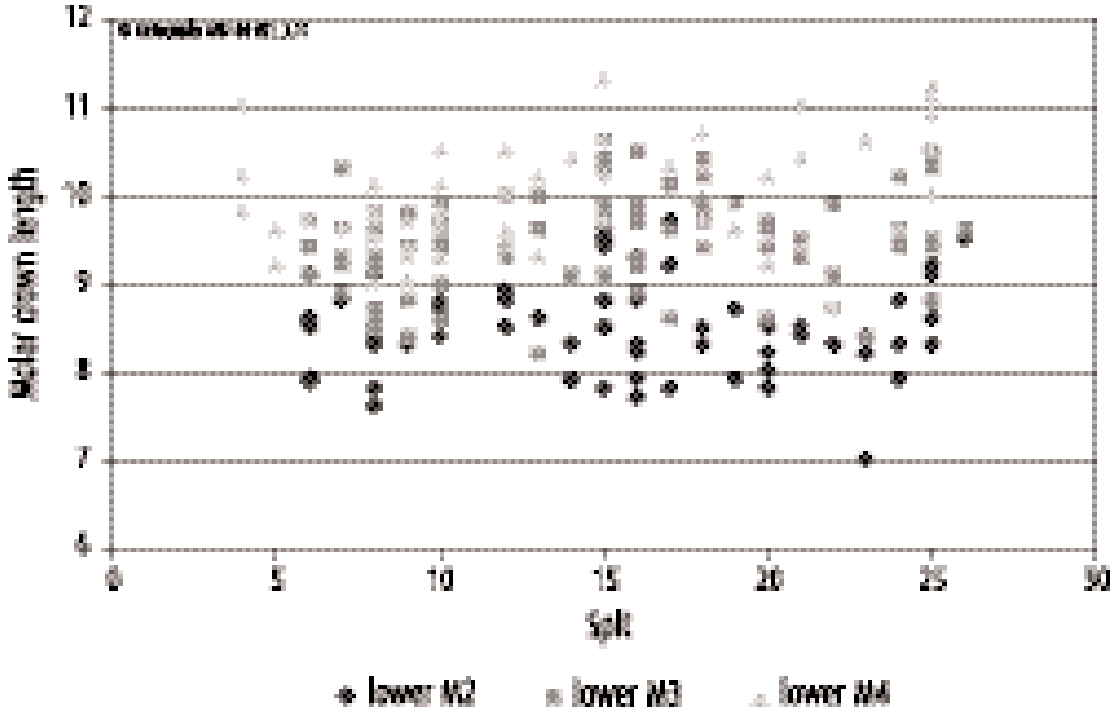

Figure 3.11 Liang Lemdubu: graph showing lower molar lengths of specimens of *Macropus agilis* from each level in the sequence. Values are plotted with different symbols for each of the second, third and fourth molars. The graph illustrates the fact that this species underwent no change in dental dimensions through the period 27,000–10,000 BP

Dorcopsis sp. Forest Wallaby

Current status: No historical or contemporary records.

Referred material: Fragmentary remains of this taxon include one heavily worn premolar from near the base of Lemdubu, and several molars and postcranial elements from the lower half of the Nabulei Lisa deposit. Unfortunately, the remains are too incomplete to identify the species involved. Today, the adjacent southern coastal lowlands of Indonesian Papua support populations of *D. muelleri*. However, another possible candidate is *D. luctuosa* that occurs west at least to the Trans-Fly region.

Wider distribution and habitat association: All species of *Dorcopsis* inhabit deep, closed forest habitats (Flannery 1995a), yet little detailed information is available on their ecology. In general, they are shy and secretive animals, intolerant of human presence.

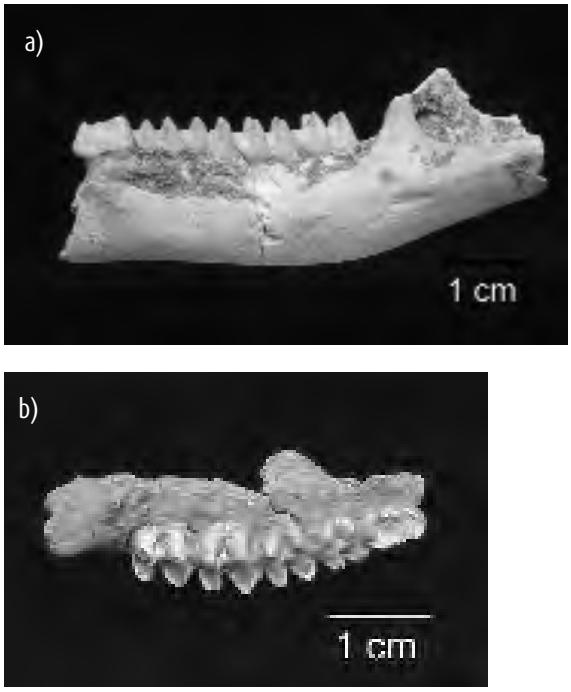

Figure 3.12 Liang Lemdubu: a) partial dentary and b) maxilla of *Thylogale brunii,* both from Spit 21

Thylogale brunii (Schreber 1778) Dusky Pademelon

Current status: *Didelphis brunii*, described from a captive animal seen in a menagerie on Java (Schreber 1778), is widely believed to refer to the 'true kangaroo' observed by Wallace and subsequently collected on Wokam, Kobroor, Wamar and Terangan (Van Strien 1996). The number of specimens in museum collections and in Woolley's 'kitchen midden' samples (see Appendix 3.1) suggests that this species can be locally abundant.

Referred material: Well-preserved remains from Lemdubu (see Fig. 3.12) compare closely with modern examples from the islands and from adjacent parts of the mainland.

Wider distribution and habitat association: The endemic New Guinean *T. brunii* is reported to occur in dense monsoonal rainforest in the Morehead area (Waithman 1979). In the recent past, it was apparently present in grassland / savannah habitats around Post Moresby (Flannery 1995a).

Thylogale stigmatica (Gould 1860) Red-legged Pademelon

Current status: No historical or contemporary records.

Referred material: This taxon is represented by abundant well-preserved material in both sites (Fig. 3.13). As reported previously in O'Connor et al. (2002), the large Lemdubu sample of this taxon shows a greater size variation than would normally be observed within a single population. The majority of specimens compare closely in size and morphology with north Queensland specimens of *Thylogale stigmatica*. Unfortunately, no material of the New Guinean race, *T. s. oriomo* (Tate and Archbold 1935), is available in Australia for direct comparisons. However, Tate and Archbold (1935) comment that *oriomo* is comparable in size to north Queensland *stigmatica.* As it was not possible to allocate many of the less complete specimens to either the larger or smaller form of *T. stigmatica*, the two groups are not distinguished in the analysis.

Wider distribution and habitat association: In Australia, *T. stigmatica* seems to prefer rainforest but it also occurs in wet sclerophyll and drier vine thicket communities (Johnson and Vernes 1995). Tate and Archbold (1935) described the species' habitat on the Oriomo Plateau of Papua New Guinea as 'mixed grasslands and gallery woods', while Waithman (1979:320) reports it to be uncommon in 'low-mixed savannah or woodland near swamps' in the Morehead area.

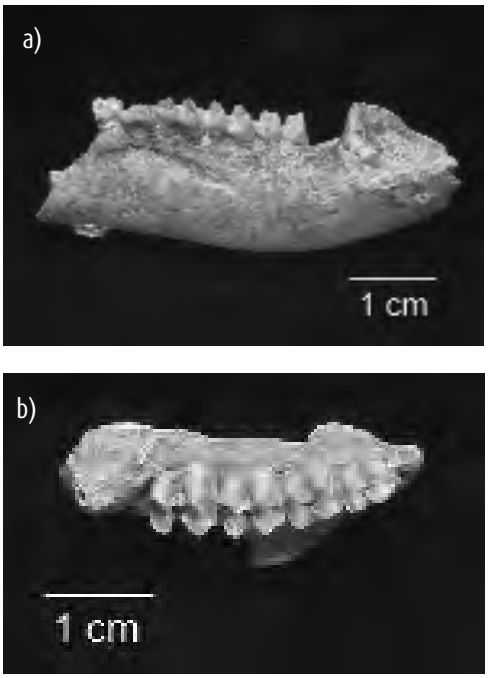

Figure 3.13 Liang Lemdubu: a) partial dentary and b) maxilla of *Thylogale stigmatica,* from Spits 22 and 12, respectively

Family Muridae (Rats and mice)

Melomys sp. cf. *M. burtoni* (Ramsay 1887)
Grassland Melomys

Current status: There are no historical or contemporary records of a small *Melomys* in the Aru Islands.

Referred material: Two specimens (both mandibles with molar teeth) from the lower levels of Lemdubu represent a small species of *Melomys.* These specimens were listed by O'Connor et al. (2002) as *M. lutillus*. With M_1 lengths of 5.5 and 5.7mm, this taxon is considerably smaller than *M. rufescens* (Alston 1877), the only species of this genus recorded in the modern fauna (Kitchener and Maryanto 1995; Van Strien 1996). The Lemdubu specimens were compared with examples of *M. burtoni* (Ramsay 1887) from localities in the Northern Territory Australia, and two specimens (CM29320, CM29336) referrable to the form *muscalis* (Thomas 1913) from the vicinity of Wipim on the Oriomo River, Trans-Fly region of Papua. The archaeological specimens are an excellent match with the northern Australian specimens, but differ from the Oriomo specimens in having narrower molars and a more elongate anterior cusp complex. Menzies (1996) was uncertain whether *muscalis* of the Trans-Fly region should be associated with the New Guinean taxon *M. littoralis* or with *M. burtoni* of northern Australia. Musser and Carleton (1993) included *littoralis* within *burtoni* but these authors now favour separation of these taxa, with placement of *muscalis* under *burtoni* (Musser pers. comm. 2004). Our limited observations on this group suggest that *muscalis* is distinct from *burtoni* and also point to the possibility that a form close to *burtoni* may persist in suitable habitats on the Aru Islands.

Wider distribution and habitat association: Across its range *M. burtoni* is associated with grassland habitats, including anthropogenic grassland patches within forested regions.

Parahydromys asper (Thomas, 1906) Waterside Rat

Current status: There are no historical or contemporary records of this species in the Aru Islands.

Referred material: A maxillary fragment from Spit 28 in Liang Lemdubu with an unworn M^1 probably represents this taxon (see Figure 3.14). The M^1 measures 7.0 mm in length and is substantially larger the M^1 of modern specimens of *Hydromys chrysogaster* Geoffroy, 1804 from the Aru and Kai Islands (M^1 length in four specimens is 5.65 to 5.9; K. Helgan, pers. comm.). These taxa are otherwise similar in cheek tooth morphology.

Wider distribution and habitat association: Widely distributed along the central cordillera of New Guinea, across a known altitudinal range of 700–2,000 m. It is also recorded from montane

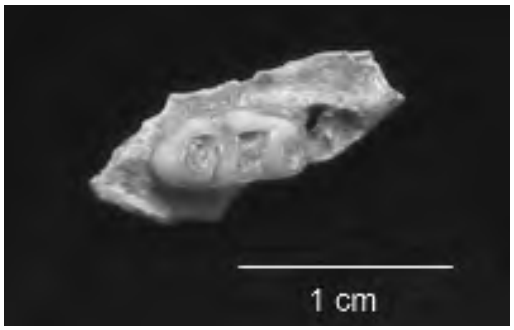

Figure 3.14 Liang Lemdubu: partial maxilla of *Parahydromys asper* from Spit 28

habitats in the Arfak and Torricelli Mountains. Aplin et al. (1999) reported a mid-Holocene sub-fossil from the Ayamaru Plateau on the Bird's Head Peninsula, at an elevation of c. 350 m.

Paramelomys naso (Thomas 1911) Long-nosed Melomys

Current status: Flannery (1995b) reported a specimen collected by Dr P. Woolley from Wokam as an example of *P. lorentzii* (Jentink 1907). Van Strien (1996) repeated this attribution. The correct allocation of the specimen to *P. naso* was reported by Menzies (1996).

Referred material: Two specimens from Lemdubu are tentatively referred to this species. A well-preserved maxilla with relatively unworn molars from Spit 26 has an M^1 that measures 4.4mm in length and 2.3mm in width. These dimensions are an exact match with the holotype of *P. naso*, as reported by Tate (1951). The taxon is considerably larger toothed than other possible candidate species including *P. platyops* (Thomas 1906), *P. moncktoni* (Thomas 1904) and *P. lorentzii*, all which are recorded from localities along the southern lowlands of New Guinea.

Wider distribution and habitat association: This poorly known species is otherwise recorded from a few localities in the lowlands and foothills of southwest New Guinea. All mainland records come from areas of lowland rainforest habitat.

Pogonomys sp. Tree-mouse

Current status: No historical or contemporary records.

Referred material: A species of *Pogonomys* is represented by a total of 19 tooth-bearing specimens from Lemdubu. These are evenly spread within the sequence from Spits 30 to 13. The molar teeth in these specimens are slightly smaller than those of north Queensland *Pogonomys*, which are usually identified as *Pogonomys mollipillosus* (Winter and Whitford 1995). The type specimen of *Pogomonys mollipilosus* that Peters and Doria (1881) collected at Katau on the lower Fly River, often has been associated with montane populations of the larger *Pogonomys* (eg, *P. loriae* Thomas 1897; *P. dryas* Thomas 1904). However, Musser (pers. comm. 2004) instead suggests an affiliation with *P. macrourus* (Milne-Edwards 1877), a taxon that is widespread through the lowland and mid-montane forests of New Guinea. The lack of taxonomic resolution within this group hinders any attempt to more precisely identify the Aru Island fossil sample.

Wider distribution and habitat association: All *Pogonomys* species are associated with rainforest habitats. They are highly arboreal animals but live communally in burrows dug in the forest floor or into the banks of small watercourses.

Pseudomys sp. cf. *P. gracilicaudatus* 'species group'

Current status: There are no historical of contemporary records of any member of this species group on the Aru Islands or anywhere on the New Guinean mainland.

Referred material: Two specimens only from Lemdubu derived from Spit 17 (a left dentary with M_1), and a mixed sample that combined material from Spits 21 and 23 (an unworn right M^1). The M^1 is a three-rooted tooth that measures 2.6mm by 1.8mm. The relatively simple cusp pattern of this tooth and the presence of only three roots identifies it as a member of the largely Australian assemblage of 'conilurins'. Within this group, it compares most favourably with members of the *P. gracilicaudatus* species group, both in size and in overall cusp pattern (including the presence of a well-developed anterior cingular cuspule). The two members of this group — *P. gracilicaudatus*

(Gould 1845) of eastern Australia and *P. nanus* (Gould 1858) of northern Australia — not only overlap in size but also appear to be indistinguishable from each other in cusp arrangement. The Lemdubu specimen differs from both of these taxa in many small details including the more discrete and angular nature of cusps t1 and t4, the smaller size of cusp t1 relative to cusp t4, and the more posterior placement of these cusps relative to the central row of cusps.

Another taxon that begs comparison on morphological and biogeographic criteria is *P. desertor* (Troughton 1932). However, the degree of morphological fit with this taxon is much less satisfactory, as the M^1 of *P. desertor* lacks a prominent anterior cingular cuspule (it sometimes has a low bulge or ridge), and has less prominent anterior buccal crests on cusps t6 and t9. There is also a general resemblance between the Lemdubu specimen and members of the *P. delicatulus* species group. However, all members of this group are considerably smaller in tooth size.

Wider distribution and habitat association: *Pseudomys nanus* is widely distributed across mainland northern Australia, from the Pilbara coastline to the Barkly Tableland in northwest Queensland. It is recorded from the Sir Edward Pellew Island group in the Gulf of Carpentaria. A variety of habitats are occupied but these usually feature tussock grasses as a major component of the understorey (Robinson 1995). *Pseudomys gracilicaudatus* is restricted to the eastern seaboard of Australia, north to the vicinity of Townsville (Watts and Aslin 1981); it occupies moister habitats including coastal heath and wetter forests.

Rattus sordidus (Gould 1858) Canefield Rat

Current status: Not recorded in the contemporary fauna.

Referred material: A member of this species group is represented in Lemdubu by abundant, well-preserved remains, distributed more or less continuously between Spits 28 and 11. Several maxillae clearly show the deeply invasive anterior palatal foramen that distinguishes members of the *Rattus sordidus* group from all other native New Guinean *Rattus*. The molars are substantially larger than in examples of *R. colletti* from the Northern Territory, and slightly smaller than examples of *R. villossisimus* from the same area. They are a very close match to specimens of *R. sordidus aramia* (Troughton 1937) from localities in the Oriomo River area (e.g. CM29345, CM29350).

Wider distribution and habitat association: The closest populations are found on the Trans-Fly region of New Guinea and in Queensland on the Sir Edward Pellew Islands in the Gulf of Carpentaria. In New Guinea this species is associated with grassland and savannah woodland habitats (Flannery 1995a).

Uromys caudimaculatus (Krefft 1867) Mottled-tailed Giant Rat

Current status: Collected in the Aru Islands on several occasions, including the holotype of *Uromys aruensis* (Gray 1873), purchased by A.B. Meyer in 1870 from an unspecified locality. Subsequently recorded on Kobroor by Dr P. Woolley (Appendix 3.1) and others.

Referred material: This species is represented in both sites. Comparisons were made with Australian and New Guinean specimens of *U. caudimaculatus* and with examples of *Xenuromys barbatus*. Diagnostic remains from Lemdubu include a maxilla with M^2 from Spit 22, and unworn upper and lower first molars from Spit 1.

Wider distribution and habitat association: This species is widespread in lowland to mid-montane habitats in New Guinea and it is also found on Cape York Peninsula. It also occurs on the Kei Islands. On mainland New Guinea it occurs in both primary rainforest and associated secondary forests, and in areas of mixed rainforest and savannah, such as the Trans-Fly.

Family Suidae (Pigs)

Sus scrofa (Linnaeus 1758) Domestic Pig

Current status: Established as a feral animal on all major islands of the Aru group (Van Strien 1996).

Referred material: Fragmentary bones and teeth of pigs are confined to the uppermost levels of both sites.

Wider distribution and habitat association: Feral pigs are highly adaptable and can utilize a wide variety of both densely forested and more open habitats.

Family Cervidae (Deer)

Cervus timorensis (Quoy and Gaimard 1830) Rusa Deer

Current status: Feral populations are probably found on all of the major islands. Healey (1995:56) suggested that Rusa Deer may have been introduced by the Portuguese. However, Wallace does not mention this species at all, and it is unlikely that he would have failed to notice this species if it was abundant and as important a hunted animal then, as it is today. Van Strien (1996) reviewed the known history of introductions and mentioned museum specimens from Wokam and Wamar Islands and sight records from Ujir and Wasir.

Referred material: Deer remains are restricted to Spit 1 of Nabulei Lisa. Although no definite deer remains were found in Lemdubu, the upper few spits contain quantities of highly fragmented bone from pig- or deer-sized mammals, that might easily include some bone from this taxon.

Wider distribution and habitat association: In the Morehead region of Papua New Guinea this species is said to occur 'mainly on the grassland strips bordering the rivers' (Waithman 1979:325).

Family Canidae (Dogs)

Canis familiaris (Linnaeus 1758) Domestic Dog

Current status: There is no information on the status of feral dog populations in the Aru Island group. However, dogs are ubiquitous around human habitation areas.

Referred material: Dog remains are restricted to Spit 1 in Nabulei Lisa and Spit 2 in Lemdubu. The material is very fragmentary and provides no useful morphological information.

Wider distribution and habitat association: Waithman (1979) reported that domestic dogs were starting to become feral by the early 1970s in the Morehead region of Papua New Guinea, preying mainly on Rusa Deer.

Family Pteropodidae (Flying Foxes and Fruit Bats)

Dobsonia spp. Bare-backed Fruit-bats

Current status: *Dobsonia moluccensis* (Quoy and Gaimard 1830) was recorded by Anderson (1912) for the Aru Islands, based on specimens in the British Museum and in Leiden. Bergmans and Sarbini (1985) questioned the origin of these specimens and questioned the occurrence of the genus in the Aru Group. This doubt is maintained by Flannery (1995a) who does not record any *Dobsonia* species from Aru. The Western Australian Museum expeditions to the Kei and Aru Islands obtained *Dobsonia* in both island groups. These are tentatively identified as *D. moluccensis,* pending more detailed study. Van Strien (1996) reported specimens from Kobroor in several collections. One example is present in the 'kitchen midden' sample collected by Woolley on Kobroor (Appendix 3.1).

Referred material: Both sites produced the remains of megachiropteran bats, most often in a highly fragmented state. Fortunately, *Dobsonia* spp. possess a distinctive dental morphology that allows most isolated teeth to be distinguished from other comparable-sized pteropodids including species of *Pteropus*. The dentary of *Dobsonia* spp. is also distinctive in having closely adpressed

canines with reduced and anteriorly displaced incisors. From examination of all dentary fragments and isolated molars, it appears that the great bulk of the megachiropteran material from both sites is referrable to a large species of *Dobsonia*, here tentatively identified as *D. moluccensis*. However, a small number of isolated canine teeth and edentulous jaw fragments appear to represent a second, much smaller *Dobsonia* species. The most likely candidate is *D. viridis* (Heude 1896) which is recorded from the nearby Kei Islands (Flannery 1995b).

Wider distribution and habitat association: *Dobsonia moluccensis* is otherwise restricted to the Seram and Buru Island groups in the Central Moluccas. Apart from the fact that it is a cave roosting bat, little is known of its biology. *Dobsonia viridis* has a similar distribution but even less is known of its habits. Most, though not all, species of *Dobsonia* roost in caves.

Pteropus sp. cf. *P. macrotis* (Peters 1867) Big-eared Flying Fox

Current status: The only record in the Aru Group is the holotype of *Pteropus acrotis* (Peters 1867) collected by von Rosenberg in 1865.

Referred material: An isolated tooth from Lemdubu Spit 15 shows its closest match with posterior post-canine teeth of specimens of this species from mainland New Guinea. This record requires confirmation.

Wider distribution and habitat association: This species is recorded from widely scattered localities in lowland New Guinea (Flannery 1995a), and from Salawatti Island to the west of the main island (Flannery 1995b). Waithman (1979:320) reported it as common in the Morehead region where it was obtained by shooting 'mainly from low mixed savannah and the gardens of natives'.

Pteropus sp. cf. *P. melanopogon* (Peters 1867) Black-bearded Flying Fox

Current status: This species has been collected in the Aru Islands on two occasions, at 'Wonumbai' (this is probably 'Manumbai'; see Flannery 1995b:269) on Kobroor and on Wokam.

Referred material: A single edentulous lower jaw fragment from Lemdubu Spit 10 represents a very large pteropodid, consistent in size with *P. melanopogon*. However, various other large *Pteropus* are recorded from the adjacent mainland of Nw Guinea, including *P. alecto* (Temminck 1837), *P. conspicillatus* (Gould 1858), and *P. neohobernicus* (Peters 1876), and any one of them might have occurred in the vicinity of Lemdubu during the late Pleistocene.

Wider distribution and habitat association: The wider range of *P. melanopogon* includes the Kei Islands, and the Seram and Buru groups of the Central Moluccas.

Family Hipposideridae (Horseshoe-bats)

Hipposideros diadema (Geoffroy 1813) Diadem Horseshoe-bat

Current status: Van Strien (1996) reported one historical specimen collected by von Rosenberg, and other collected more recently by Mark van der Wal on Kobroor.

Referred material: A dentary with well-preserved M_{1-3} from Lemdubu Spit 23 provides the only prehistoric evidence of this taxon. This species is easily recognized by its large size relative to all other hipposiderids in the Australia–New Guinea region.

Wider distribution and habitat association: The nearest records of this widely distributed species are in the Kei Islands (Flannery 1995b) and along the southern lowlands of Indonesian Papua (Flannery 1995a). *Hipposideros diadema* is often encountered roosting in caves (Flannery 1995a) but a variety of other roosting sites are used in areas that lack caves.

Family Molossidae (Insectivorous Bats)

Chaerephon sp. cf. C. jobensis (Miller 1902) Northern Mastiff-bat

Current status: There are no historical or contemporary records of any molossid bat from the Aru Islands.

Referred material: A total of eight dentaries from Nabulei Lisa, several retaining one or more teeth, are tentatively referred to this species. They give a very close match in size and morphology to reference specimens (e.g. CM2175, CM7606) from localities in the Northern Territory. Key points of similarity include the tightly compressed lower molar trigonids, the broad talonid of M_3 and the V-shaped ectolophid crests. The presence of these specimens in the deposit presumably reflects the use of the cave as a roost site.

Wider distribution and habitat association: The nearest modern records of this species are from the Morehead area of Papua New Guinea (Flannery 1995a), and Seram in the Central Moluccas (Flannery 1995b). Waithman (1979:323) reported that the Morehead specimens (as *Tadarida jobensis*) 'were collected from holes in the trunks of coconut palms by local villagers'. Australian populations generally roost in hollow trees and buildings. However, some cave roosting populations are known (Richards 1995).

Non-mammalian vertebrates

None of the reptile, bird or fish material has been subject to close scrutiny. The abundant snake material in both sites is clearly dominated by the remains of pythons (Family Boidae), with much smaller numbers of colubroid snakes (e.g. Lemdubu Spits 10 and 14). Two python species are recorded from the Aru Islands, *Morelia amethystinus* and *M. viridis*. These attain maximum lengths of two and eight meters, respectively. The lizard material includes vertebrae and cranial elements of moderately large varanids, as well as vertebrae and dentigerous elements referable to the families Agamidae and Scincidae. A scincid dentary fragment from Spit 26 in Lemdubu has the characteristic pebble-like teeth of a member of the *Egernia–Tiliqua* assemblage of skinks. Judging from its size and morphology, it most likely represents *Tiliqua gigas*, a species which occurs on the Aru Islands today (de Rooij 1915). Two species of *Varanus* are recorded from the contemporary Aru Islands: the Mangrove Monitor, *V. salvator*, and the Black Tree Monitor, *V. beccarii* (de Rooij 1915; De Lisle 1996), both of which are arboreal and semi-aquatic, with head and body lengths well under one metre. The latter taxon is endemic to the Aru Islands.

A single osseous scute of a crocodile from Nabulei Lisa Spit 15 is the only evidence of this group in either site.

Small quantities of turtle carapace and associated bones were recovered from Spits 19 to 26 in Nabulei Lisa, and several levels in Lemdubu. These are referrable to the freshwater turtle family Cheluidae, several species of which are probably found on the Aru Islands today.

A small number of frog bones are also present in both sites. Variation in ilial morphology indicates that two or more taxa are represented.

Casuarius spp., the cassowaries, are represented in several levels of both sites. The better preserved material includes a partial vertebra from Spit 1 of Lemdubu. It also includes two pedal phalanges (Fig. 3.15) from Spits 20 and 21 that were mentioned by O'Connor et al. (2002) as potentially derived from a large macropodid species. This error occurred because Aplin previously compared the fossil specimens with reference skeletons of the Emu (*Dromaius novaehollandae*) as a surrogate for a cassowary. More recently, the fossil specimens were compared with a modern specimen of *Casuarius casuarius* in the collection of the Queensland Museum. This process now leaves us in no doubt that the two fossil bones are both second phalanges from the third digit of a large species of *Casuarius*. Additional highly fragmented material coming from various levels in Lemdubu is almost certainly derived from this taxon.

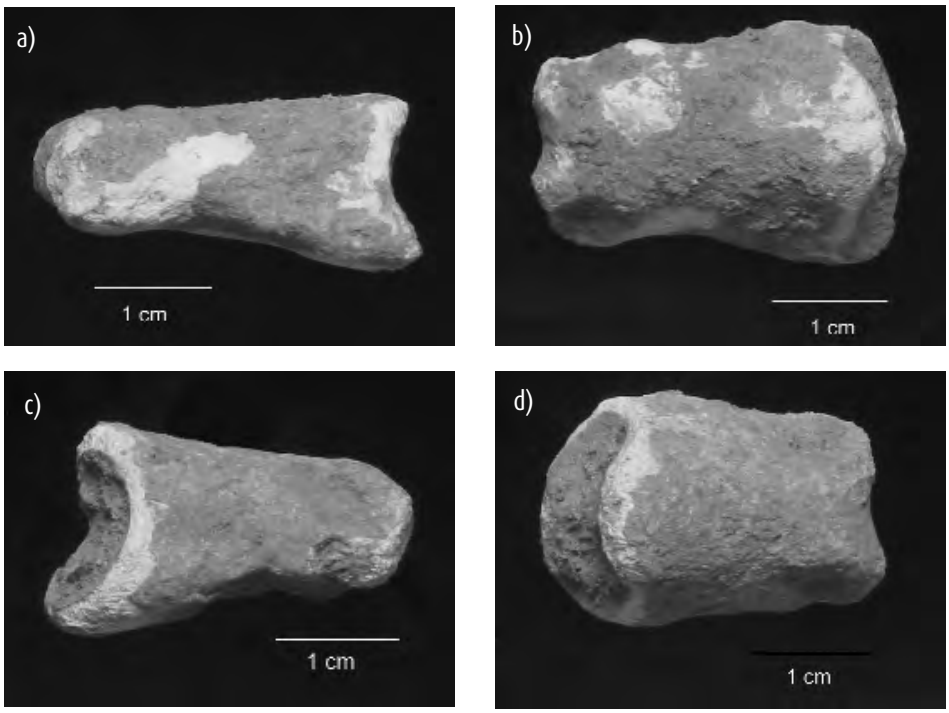

Figure 3.15 Liang Lemdubu: medial phalanges of *Casuarius* sp. cf. *C. casuarius* from Spits 20 (a–b), and Spit 21 (c–d). These specimens were previously reported as belonging to a large macropodid

Smaller birds are also represented by fragmentary remains in many levels. A lack of comprehensive reference material hinders attempts to identify material from sites in this area (Aplin et al. 1999).

The fish remains in Lemdubu are mostly derived from small to medium-sized fish and are badly fragmented. Other than for some fragmentary head shields of an ariid (freshwater to estuarine) catfish, very few potentially diagnostic elements are represented in this site. Fish remains are more abundant in Nabulei Lisa, especially in the upper half of the sequence, with representatives of the families Plotosidae, Labridae and Lutjanidae. More precise identification of this material has not yet been attempted.

Discussion

The archaeological fauna includes several mammal species not previously recorded from the Aru Islands, but it also lacks several species that are present today (summarized in Table 3.2). The major additions are the macropodids (*Macropus agilis*, *Thylogale stigmatica* and *Dorcopsis* sp.), the bandicoots (*Isoodon macrourus* and *Echymipera kalubu* — tentatively identified), the Short-Nosed Echidna (*Tachyglossus aculeatus*), a Native Cat (*Dasyurus albopunctatus*), several rodents (*Pogonomys* sp., *Melomys* sp. cf. *M. burtoni*, *Rattus sordidus*, *Pseudomys* sp., *Parahydromys asper*), at least one megachiropteran bat (*Dobsonia* sp. – small species), and one microchiropteran bat (*Chaerephon* sp. cf. *C. jobensis*). An important point to make is that the majority of these taxa are large and conspicuous mammals that are unlikely to have been missed by the various collectors to the Aru Islands.

In contrast, the contemporary species that are missing from the archaeological faunas are predominantly small-bodied species such as insectivorous bats (eight species), small megachiropteran bats (three species), small to medium sized rodents (five species), and small marsupials (two species — *Murexia longicaudata* and *Petaurus breviceps*). The largest of the unrecorded mammal species, the

Table 3.2 Composite list of mammal species recorded from both modern and archaeological contexts on the Aru Islands

SPECIES	COMMON NAME	MODERN	ARCHAEOLOGICAL
TACHYGLOSSIDAE	(Echidnas)		
Tachyglossus aculeatus	Short-beaked Echidna	–	+
DASYURIDAE	(Marsupial mice and native cats)		
Dasyurus albopunctatus	New Guinea Quoll	–	+
Murexia longicauda	Short-furred Dasyure	+	–
Myoictis melas	Three-striped Dasyure	+	+
Sminthopsis virginiae	Red-cheeked Dunnart	+	–
PERORYCTIDAE	(New Guinean Bandicoots)		
Echymipera sp. cf. *E. kalubu*	Common Echymipera	–	+?
Echymipera rufescens	Long-nosed Echymipera	+	+
Peroryctes sp.	Previously unknown peroryctid	–	+
PERAMELIDAE	(Australian Bandicoots)		
Isoodon macrourus	Northern Brown Bandicoot	–	+
PHALANGERIDAE	(Cuscuses)		
Phalanger gymnotis	Ground Cuscus	+	+
Phalanger mimicus	Southwestern Common Cuscus	+	+
Spilocuscus maculatus	Common Spotted Cuscus	+	+
PETAURIDAE	(Gliders and Striped Possums)		
Dactylopsila trivirgata	Striped Possum	+	+
Petaurus breviceps	Sugar Glider	+	–
MACROPODIDAE	(Kangaroos and wallabies)		
Macropus agilis	Agile Wallaby	–	+
Thylogale brunii	Dusky Pademelon	+	+
Thylogale stigmatica	Red-legged Pademelon	–	+
Dorcopsis sp.	Forest Wallaby	–	+
MURIDAE	(Rats and mice)		
Hydromys chrysogaster	Common Water Rat	+	–
Melomys rufescens	Black-tailed Melomys	+	–
Melomys sp. cf. *M. burtoni*	Grassland Melomys	–	+
Parahydromys asper	Riverside Rat	–	+
Paramelomys naso	Long-nosed Melomys	+	+
Paramelomys platyops	Lowland Melomys	+	–
Pogonomys sp.	Tree-mouse	–	+
Pseudomys sp. cf. *P. nanus*	Chestnut mouse	–	+
Rattus leucopus	Cape York Rat	+	–
Rattus sordidus	Cane field Rat	–	+
Rattus rattus (I)	Black Rat	+	–
Uromys caudimaculatus	Mottled-tailed Giant Rat	+	+
SORICIDAE	(Shrews)		
Crocidura maxi (I)	Crocidura	+	–
Suncus murinus (I)	House Shrew	+	–
VIVERRIDAE	(Civets etc.)		
Paradoxurus hermaphroditus (I)	Palm Civet	+	–
SUIDAE	(Pigs)		
Sus scrofa (I)	Domestic Pig	+	+
CERVIDAE	(Deer)		
Cervus timorensis (I)	Rusa Deer	+	+
PTEROPODIDAE	(Flying Foxes and Fruit Bats)		
Dobsonia moluccensis	Bare-backed Fruit-bat	+	+
Dobsonia sp. (small species)		–	+
Macroglossus minimus	Northern Blossum-bat	+	–
Nyctimene albiventer	Common Tube-nosed Bat	+	–
Pteropus macrotis	Big-eared Flying Fox	+	+?
Pteropus melanopogon	Black-bearded Flying Fox	+	+?
Syconycteris australis	Common Blossum-bat	+	–
HIPPOSIDERIDAE	(Horseshoe-bats)		
Hipposideros ater	Dusky Horseshoe-bat	+	–
Hipposideros cervinus	Fawn Horseshoe-bat	+	–
Hipposideros diadema	Diadem Horseshoe-bat	+	+

continued over

Table 3.2 Continued

SPECIES	COMMON NAME	MODERN	ARCHAEOLOGICAL
RHINOLOPHIDAE	(Horseshoe-bats)		
Rhinolophus euryotis	New Guinea Horseshoe-bat	+	–
VESPERTILIONIDAE	(Insectivorous Bats)		
Miniopterus australis	Little Bentwing-bat	+	–
Miniopterus schreibersii	Common Bentwing-bat	+	–
Pipistrellus javanicus	Javan Pipistrelle	+	–
Pipistrellus papuanus	Papuan Pipistrelle	+	–
MOLOSSIDAE			
Chaerephon sp. cf. *C. jobensis*		–	+
EMBALLONURIDAE			
Emballonura nigrescens	Lesser Sheathtail-bat	+	–

Palm Civet (*Paradoxurus hermaphroditus*), is clearly an exotic element in the modern fauna. The fact of its absence from the deposits is a good indication of just how recently its introduction occurred. The same argument can be applied in the case of the Rusa Deer, *Cervus timorensis*, the remains of which are confined to the uppermost levels of both sites. In contrast, pig remains extend further into both deposits, although these too are confined to relatively recent contexts. Taken conversely, these results also give cause for confidence in regard to the stratigraphic integrity of both sites.

The species recorded only from the prehistoric context fall into two clear groups – those whose apparent decline or extinction on the islands probably occurred as a consequence of environmental change; and those whose decline or extinction is more difficult to explain in such terms. Taxa in the first group are *Macropus agilis*, *Isoodon macrourus*, *Rattus sordidus*, *Melomys* sp. cf *M. burtoni*, *Pseudomys* sp. cf *P. nanus* and *Parahydromys asper*. With the exception of *P. asper*, all of these taxa are found today in grassland or savannah habitats. Their former presence on the Aru Island constitutes strong evidence for considerably drier and more open conditions on the dissected Aru 'plateau' during late Pleistocene times. The available habitat for these species presumably shrank during and after the period of sea level rise, when warmer wetter conditions over the newly created Aru Islands favoured expansion of wetter, more closed forest types. *Parahydromys asper*, in contrast, is only recorded as a living animal from rainforest habitat at low to mid-montane elevations. We are unable to provide a satisfactory reason for its occurrence on the Aru Islands during late Pleistocene times, virtually at sea level and in the context of a predominantly open country fauna.

The second group includes several taxa that seem to be ecologically well-suited to the contemporary Aru environment. The two obvious examples are *Dorcopsis* sp. and *Dasyurus albopunctatus*, both of which are widely associated with lowland rainforest habitat on the New Guinea mainland. Other taxa that might also fit this profile are *Thylogale stigmatica* and *Tachyglossus aculeatus*, both of which are known to occupy lowland rainforest habitats in at least some part of their total geographic ranges. Why did these species decline and ultimately disappear from the Aru Islands? The answer to this question is almost certainly complex and may well be different in each case. Each of *T. stigmatica* and *Dorcopsis* sp. may have suffered from direct competition with *T. brunii* in an environment characterized by a progressive loss of heterogeneity. Hunting pressure might also have played a role, especially in the case of *Dorcopsis* sp. and *T. aculeatus*. Decline of the native predator, *D. albopunctatus*, is difficult to understand, except perhaps in terms of some general biogeographic principle of simplification in island faunas. However, such statements are unsatisfactory unless they invoke actual ecological mechanisms.

Biogeographic relationships of the prehistoric Aru Island vertebrate fauna

The late Pleistocene mammalian fauna of the Aru Islands shows evidence of strong biogeographic continuity with the contemporary fauna of the Trans-Fly region of southern New Guinea. This

continuity is demonstrated by the fact that all but one of the additional mammal species recorded from the prehistoric Aru island context are part of the contemporary fauna of the Trans-Fly area of southern New Guinea. The sole exception is the native rodent *Pseudomys* sp. cf. *P. gracilicaudatus* 'species group'. This species is widely distributed across northern Australia but previously has not been recorded in New Guinea or on any of its satellite islands. Surviving populations of this taxon should perhaps be sought in the Trans-Fly region or elsewhere in southeastern New Guinea, wherever savannah habitat is found.

The Trans-Fly area was identified by Flannery (1995a) as one part of a broader zoogeographic province that he labelled the 'Austral Province'. This province also includes several extensive tracts of savannah woodland in southeast Papua New Guinea, most notably around Port Moresby and Popondetta. Today, the Aru Islands lie far to the west of the boundaries of this province and instead, make up part of Flannery's 'Tumbunan Province'. However, during late Pleistocene times, the Austral Province clearly expanded to occupy a much larger area that included the Aru 'plateau', then situated on the edge of the exposed Sahul shelf. How much further west and north it extended is not known for sure. However, it is worth noting that a broadly contemporaneous archaeological fauna from Toé Cave, on the Ayamaru Plateau in the central Bird's Head, shows no indication of more open, savannah conditions or of any Austral faunistic influence (Pasveer and Aplin 1998; Pasveer 2004). Instead, the Toé Cave fauna documents a downward extension of montane forest faunal elements onto the lowland Ayamaru Plateau, an environmental change that might have resulted from more persistent cloud-lie over this area, perhaps coupled with a slight decrease in ambient temperature (Pasveer and Aplin 1998).

Although the late Pleistocene fauna of the Aru 'plateau' was certainly dominated by Austral faunal elements, it also contained a number of uncharacteristic elements that hint at biogeographic connections with Tumbunan New Guinea. These include such characteristic lowland rainforest elements as *Dorcopsis* sp., *Dasyurus albopunctatus*, *Echymipera rufescens*, *Phalanger gymnotis*, *Paramelomys naso*, and *Pogonomys* sp. At a local environmental level, these elements are taken as evidence for a complex mosaic of wetter, closed and drier, more open habitats (see Chapter 9, this volume). In a broader biogeographic context, the complex admixture of open and closed, and wet and dry faunal elements, suggests that the Aru Islands are positioned close to a major faunistic boundary and thus, experienced repeated episodes of faunistic change related to Pleistocene glacial cycles.

The discovery of a distinctive new kind of bandicoot in the Aru Islands archaeological assemblages gives further emphasis to the fact that our knowledge of the small to medium mammal diversity of late Pleistocene New Guinea remains very incomplete.

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Appendix 3.1: 'Kitchen midden and hunter' samples collected in October–November 1992 by Dr P. Woolley on Kobroor Island

JILKAI VILLAGE	5° 54′ S 134° 22′ E
Echymipera rufescens	3 individuals
Phalanger mimicus	1 individual
Spilocuscus maculatus	1 individual
Thylogale brunii	9 individuals
Varanus sp. cf. *V. salvator*	1 individual
NAMARA	6° 03′ S 134° 22′ E
Phalanger gymnotis	4 individuals
Phalanger mimicus	1 individual
Spilocuscus maculatus	2 individuals
Thylogale brunii	4 individuals
Dobsonia moluccensis	1 individual
Pteropus sp. cf. *P. melanopogon*	1 individual