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Two New Species of *Halmaheramys* (Murinae: Rattini) from Archaeological Deposits on Morotai Island, North Moluccas, Indonesia

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Abstract. Two new species of murine rodents (*Halmaheramys funderus* sp. nov. and *H. bellwoodi* sp. nov.) are described from remains in an archaeological site on Morotai Island in North Maluku (Maluku Utara) Province of Indonesia. Both species are approximately the same size, (about the size of a Norway or brown rat, *Rattus norvegicus*) but they differ from each other in the degree of elongation of the snout and in molar size relative to osseous structures. These morphological contrasts are suggestive of dietary differences. Both species survived into the Holocene, and because the modern mammal fauna of Morotai is very little studied, it is possible that these species may still be extant on the island. Recognition of these taxa helps to demonstrate the distinctive nature of the Morotai murine fauna, which has unique species of *Rattus* and *Halmaheramys* compared to Halmahera-Bacan on one hand, and to Obi-Bisa on the other. The subfossil record (and modern fauna) of Morotai also lacks other Australo-Papuan genera that characterize other North Moluccan islands, such as *Hydromys* and *Uromys* (known from Obi) and *Melomys* (known from Halmahera and Obi-Bisa).

Abstrak (Bahasa Indonesia). Dua spesies baru tikus kelompok murinae (*Halmaheramys funderus* sp. nov. and *H. bellwoodi* sp. nov.) dideskripsi dari peninggalan di situs arkeologi di Pulau Morotai, Provinsi Maluku Utara, Indonesia. Kedua spesies tersebut kurang lebih memiliki ukuran yang sama, (seukuran dengan Tikus Norwegia atau Tikus Coklat, *Rattus norvegicus*), namun keduanya memiliki perbedaan pada tingkat pemanjangan moncong dan ukuran gigi geraham dibandingkan dengan struktur tulang.

Keywords: biogeography, *Rattus*, rodents, taxonomy, Wallacea
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Perbedaan morfologi ini menunjukkan perbedaan pola makan. Kedua spesies bertahan hidup sampai pada zaman Holosen, dan dikarenakan fauna mamalia modern di Morotai masih jarang dipelajari, ada kemungkinan spesies-spesies tersebut masih ada di pulau ini. Pengenalan terhadap taksa ini membantu dalam menunjukkan sifat alami yang berbeda dari fauna tikus murinae Morotai, yang mempunyai spesies unik *Rattus* dan *Halmaheramys* dibandingkan dengan Halmahera-Bacan di satu sisi, dan Obi-Bisa di sisi lain. Catatan subfosil (dan fauna modern) Morotai juga tidak terdapat genera Australo-Papua lain yang mencirikan pulau-pulau lain di Maluku Utara, seperti *Hydromys* dan *Uromys* (diketahui dari Obi) dan *Melomys* (diketahui dari Halmahera dan Obi-Bisa).

Introduction

The contemporary vertebrate fauna of the northern Moluccan islands (North Maluku Province of Indonesia; Fig. 1) includes several native murine rodents, some of which are endemic to these islands. These rodent faunas have remained very poorly known until recent years. The current report focuses on the rodents of the island of Morotai, the northernmost of the largest islands in the North Moluccas. Morotai lies immediately north of Halmahera and is separated from the latter island by a relatively narrow strait (15 km across) but quite deep water, perhaps up to 585 m (Bellwood *et al*., 2019). Current understanding of this considerable depth between these islands, and their differential tectonic histories (e.g., Hall *et al*., 1988; Hall, 2013) means that it is unlikely that a land bridge has connected these islands (Bellwood *et al*., 2019). Much remains to be learned about the biodiversity of all islands in the region, but Morotai is probably the least biologically explored of the major islands of the north Moluccas, which also include Halmahera, Bacan, and Obi (Fig. 1).

For most of the twentieth century, comparatively better information on Moluccan rodent faunas came from further south—from the island of Seram, which was first surveyed in some depth for rodents in 1920 (Thomas, 1920; Flannery, 1995; Helgen, 2003). Seram has the richest known murine fauna, with a total of six endemic species—four species of *Melomys* and two species of *Rattus* (Helgen, 2003; Fabre *et al*., 2017a, 2018, 2023; Turvey *et al*., 2023). The rodent assemblages present on the island groups of the Northern Moluccas have only more recently come into focal view. The major islands of the northern cluster—Morotai, Halmahera, Bacan, and Obi, and their smaller satellite islands, are now known to host 5 endemic rodents classified in the Rattini (the genus *Rattus* and its close relatives: Pages *et al*., 2010), all described since the Second World War and most described in the past decade. These are *Rattus morotaiensis* Kellogg, 1945, from Morotai; *Rattus halmaheraensis* Fabre *et al*., 2023, from Halmahera, Bacan, Ternate, and Moti; *Rattus obiensis* Fabre *et al*., 2023 from Obi; *Halmaheramys bokimekot* Fabre *et al*., 2013, from Halmahera; and *Halmaheramys wallacei* Fabre *et al*., 2018, from Obi and Bisa. Additional species of rodents classified in the Hydromyini, which have their centre of diversification in New Guinea and Australia, are known from some North Moluccan islands, but not yet from Morotai: the genus *Melomys* is known from Halmahera (*Melomys* sp. cf. *burtoni*—Fabre *et al*., 2017a) and Obi and Bisa (*Melomys obiensis* Thomas, 1911—Flannery, 1995), and *Hydromys chrysogaster* and an undescribed species of *Uromys* also occur on Obi (Flannery, 1995; Fabre *et al*., 2023).

Until now, the only native rodent recorded from Morotai is the living species *Rattus morotaiensis*, first documented by Kellogg (1945), which Fabre *et al*. (2023) have shown to be endemic to Morotai. However, an additional key resource for understanding Morotai's rodent diversity is a collection of murine remains deriving from archaeological excavation in 1991 of several sites on the island by archaeologist Professor Peter Bellwood and collaborators, particularly the Holocene site known as Daeo Cave no. 2 on the south coast of the island (Bellwood *et al*., 1993, 1998, 2019; Flannery e*t al*., 1998; Hull *et al*., 2019). Subfossil rodent material from Daeo Cave no. 2 was first studied by Flannery *et al*. (1998), who indicated that additional rodent diversity might have been present in the Quaternary fauna of Morotai. Flannery *et al*. (1998) noted the presence of three rodent taxa in this assemblage, one of which was identified as *Rattus morotaiensis*; the other taxa were referred to as "*Rattus* sp. 1" and "*Rattus* sp. 2." We have now re-examined this material and identify a total of four rodent species represented in this sample: the Morotai endemic species *Rattus morotaiensis* (a member of the Australo-Papuan *Rattus* + Sulawesi *Rattus xanthurus* clade; Fabre *et al*., 2013; Rowe *et al*., 2019); a commensal species, belonging to the *Rattus rattus* Species Complex (*sensu* Aplin *et al*., 2003, 2011); and two new species of the Northern Moluccan endemic genus *Halmaheramys. Halmaheramys* is a genus only recently characterized taxonomically, known by two previously described species, *H. bokimekot* of Halmahera, and *H. wallacei* of Obi and Bisa (Fabre *et al*., 2013, 2018). Here we describe the two new species of *Halmaheramys* from Morotai based on remains from Daeo Cave no. 2.

Materials and methods

The Morotai subfossil specimens are registered in the palaeontological collection of the Australian Museum, Sydney, as indicated by an AM F prefix. Modern voucher specimens cited in comparisons are from the mammal collections of the Australian Museum, Sydney (AM M), the Australian National Wildlife Collection, Canberra (ANWC), the Museum Zoologicum Bogoriense, Cibinong, Indonesia (MZB), and the South Australian Museum (SAM M). All measurements are expressed in millimetres (mm). The archaeological context of the remains was described by Bellwood *et al.* (1993, 1998, 2019) and Flannery *et al*. (1998). All of the material is of terminal Pleistocene to Holocene age, the bulk probably dating to within the last 6000 years or so (Bellwood, 2019; Hull *et al*., 2019). Molar cusp names and other anatomical terminology are used according to the conventions established especially by Guy Musser in numerous publications (e.g., Musser, 1981, 1991; Musser & Newcomb, 1983; Aplin & Helgen, 2010).