

## A new species of *Rattus* from Gunung Mutis, South West Timor Island, Indonesia.

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### Abstract

A new species of murid rodent is described from a single, aged individual, collected in montane forest at ca.1900 m elevation on Timor. It is small bodied, with a bicoloured tail, 3 pairs of mammae and a distinct skull morphology. It is tentatively placed in the genus *Rattus*.

### Introduction

Since September 1987 there have been seven collaborative expeditions to Nusa Tenggara by the Western Australian Museum and the Museum Zoologicum Bogoriense. These expeditions have greatly increased knowledge of the distribution of species of terrestrial vertebrates in this region (Kitchener *et al.* 1990a, b) and several new species have been discovered. These include one nyctophiline and one cynopterine bat (Kitchener *et al.* 1991a; Kitchener and Maharadatunkamsi 1991) and the first unquestionably native species of *Rattus* in Nusa Tenggara (Kitchener *et al.* 1991b). Additionally, a specimen of the endemic murid *Paulamys* c.f. *P.naso*, known previously only from fossil dentary fragments, was collected on Flores Island (Kitchener *et al.* 1991c).

On the last expedition, a single specimen of a distinctive small rodent was collected in a remnant patch of montane forest on the slopes of Gunung Mutis, South West Timor. This specimen clearly represents a new species, however we remain uncertain as to its generic affiliations. It is tentatively allocated to the genus *Rattus*. Although the new species is the first extant native rodent recorded from Timor, a number of fossil murids (including *Coryphomys buehleri* Schaub, 1937) are recorded from several Pleistocene and Holocene localities on the island (Hooijer 1965; Glover 1971; Musser 1981b).

### Methods

*Measurement and descriptions:* external measurements and weight were recorded from WAM M34827 in the field prior to its fixation in formalin. Cranial and dental measurements were taken with digital calipers to the nearest one hundred millimetre. Measurement points are illustrated in Musser (1970) and described in Musser and Newcomb (1983). The terminology of cranial bones and foramina is that of Musser (1981a, b).

*Phylogenetic analysis:* Phylogenetic relationships were examined between WAM M34827 and 16 genera including *Rattus* and some closely related genera listed in Table

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11 of Musser (1981a), as well as *Bunomys*, *Paulamys* and *Komodomys*. Minimum length cladograms were constructed using the tree-building phylogenetic computer package HENNIG 86 (Farris, 1988). The search for the most parsimonious tree was conducted using the exhaustive branch and bound algorithm, based on the Wagner method.

The character matrix consists of 15 skull characters and two characters related to number of molar roots (see Appendix). These correspond to the first 16 characters in Musser (1981a; Table 11), except that his character number 11 was divided into two separate characters by separating the shape of the pterygoid fossa from the presence or absence of sphenopterygoid vacuities. Character state data for most genera are taken from Musser (1981a); for *Paulamys* from Kitchener *et al.* 1991; for *Bunomys* from descriptions in Musser (1981a) and *Komodomys* from Musser and Boeadi (1980). Wherever possible, previous character state assessments were checked against actual specimens of the taxa involved.

The tree was rooted using a hypothetical ancestor scored as plesiomorphic for all 17 characters.

*Colour*: Pelage and skin colour where they follow Ridgway (1912) are capitalised.

### Systematics

#### *Rattus timorensis* sp. nov.

(Figures 1-7)

#### Holotype

Western Australian Museum catalogue number WAM M34827\* ; adult female; skin prepared as 'cabinet specimen'. Carcass fixed in 10% formalin and preserved in 70% ethanol; liver, kidney, blood samples in ultrafreeze at Western Australian Museum.

#### Type Locality

West facing valley between two ridges near the top of Gunung Mutis at altitude *ca.* 1900 m; *ca.* 7 km east of Desa Nenas (*ca.* 9°31'S, 126°16'E) (Figure 1).

#### Diagnosis

*Rattus timorensis* is distinguished from all other species of *Rattus* by a combination of its small size (112 gm); 1 postaxillary and 2 inguinal pairs of mammae; bicoloured tail with white ventral surface; skull with long narrow rostrum; poorly developed ridging along dorsal margins of interorbital, postorbital and temporal regions; absence of sphenopterygoid vacuity; relatively large bulla; anterior expansion of infraorbital canal; and relatively short projection of palatal bridge posterior of M<sup>3</sup>.

It differs from *Komodomys rintjanus* by its smaller body size; soft dark brown fur rather than semi-spinous, sandy coloured fur on dorsum; 6 rather than 10 mammae; dorsal profile of skull not strongly arched; dorsal ridges outlining interorbital region poorly developed; lacrimal bones small, smoothly curved, rather than large and

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\*Final disposition of specimen will be Museum Zoologicum Bogoriense.

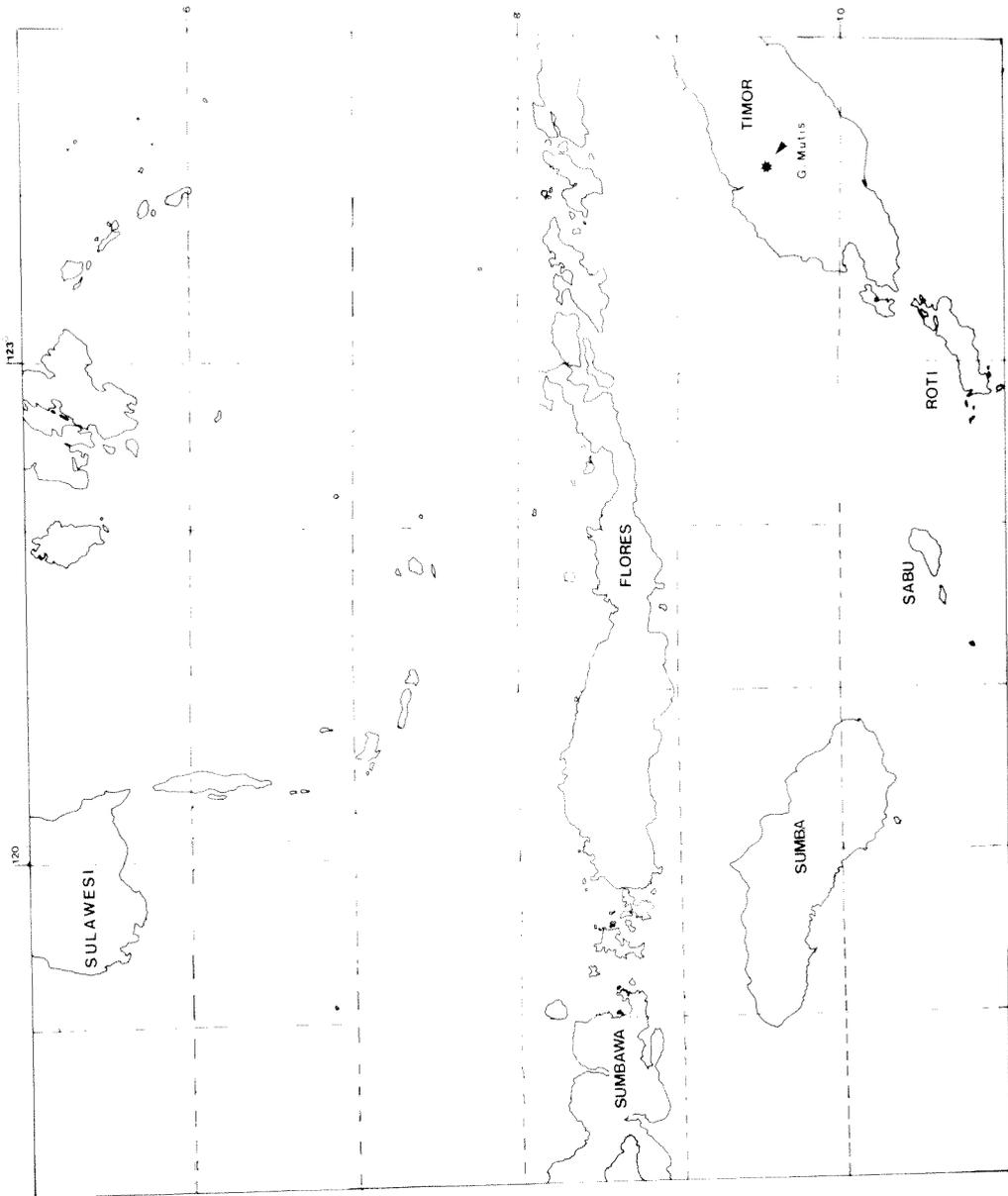


Figure 1. Map of Nusa Tenggara showing collection locality of *Rattus timorensis* holotype.



**Figure 2.** Photograph of Gunung Mutis showing the patch of mixed montane forest (arrowed) in which the holotype of *Rattus timorensis* was collected.

squarish; zygomatic plates with leading edge more gently sloping anteriorly; interparietal larger; incisive foramen broader; palatal bridge extending slightly further posterior of  $M^3$  posterior face (0.9 v. 0.5); sphenopterygoid vacuities absent; teeth smaller relative to palatal bridge.

It differs from the similarly-sized *Paulamys* cf. *P.naso* (e.g., snout to vent length 157 v. 164 and weight 112 v. 122 gm) in having considerably shorter hind foot (30 v. 39.3) and ear (20.5 v. 24.2); a broader skull: e.g., zygomatic breadth relative to greatest skull length (0.50 v. 0.45); upper incisors wider at tips (2.2 v. 1.9); incisor foramen longer (8.9 v. 7.4) terminating posterior to  $M^1$  anterior face rather than anterior to it, palatal bridge extending slightly further past  $M^3$  posterior face (0.9 v. 0.5); sphenopterygoid vacuity absent; and infraorbital canal wider.

It differs from *Bunomys* spp. in having 6 rather than 4 mammae; incisive foramen terminating posterior to  $M^1$  anterior face; palatal bridge extending beyond  $M^3$  posterior face; and infraorbital canal wider.

It differs from *Coryphomys buehleri*, the only described fossil murid from Timor, in its much smaller size ( $M_{1-3}$  6.3 v. 19.9 in *C.buehleri*; Schaub 1937).

## Description

Measurements (in mm) of the holotype WAM M34827 are as follows: tip of rhinarium to vent length 157; distal tip of tail to vent length (broken) 77+; hind foot length 30; ear length 20.5; greatest skull length 38.72; condylobasal length 36.53; zygomatic breadth 19.37; interorbital breadth 6.10; nasal length 14.97; nasal breadth 3.86; rostrum length 14.43; rostrum breadth 6.28; braincase breadth 16.40; braincase height 12.57; zygomatic plate breadth 3.94; interparietal breadth 9.43; interparietal length 4.84; breadth across upper incisor tips 2.16; diastema length 11.08; palatal length 20.89; postpalatal length 12.86; palatal bridge length 6.71; palatal bridge breadth at M<sup>1</sup> 3.64; palatal bridge breadth at M<sup>3</sup> 4.31; mesopterygoid fossa breadth 2.53; incisive foramen length 8.91; incisive foramen breadth 2.26; bulla length 7.31; bulla height 6.57; M<sup>1-3</sup> length (cusp) 6.62; M<sup>1-3</sup> length (alveolar) 6.90; M<sup>1</sup> breadth (cusp) 2.15; M<sup>1</sup> breadth (alveolar) 1.87; M<sup>2</sup> breadth (cusp) 1.95; M<sup>2</sup> breadth (alveolar) 1.66; M<sup>3</sup> breadth (cusp) 1.55; M<sup>3</sup> breadth (alveolar) 1.15; M<sub>1-3</sub> length (crown) 6.30; dentary condyle to dorsal incisor base 23.32; dentary height below M<sup>1</sup> anterior labial cusp 5.56. Body weight 112 gm.

### *Skull and dentary* (Figure 3)

Skull small (greatest length 38.7) but moderately robust; cranium with broad zygoma; infraorbital canal wide and flared when viewed dorsally, slightly asymmetrical with left side leading edge more flared; interorbital region moderately wide (6.1); lacrimal small, smoothly rounded; neurocranium suboval dorsal outline, moderately inflated and deep (12.6); interparietal moderately large (4.8 x 9.4); ridges absent from dorsal margins of interorbital region, this region outlined by very faint beading which extends along postorbital margin to most anterior corner of parietal; rostrum long relative to greatest skull length (0.37), narrow; from interorbital region to nasal tip relatively straight in lateral profile; nasals narrow, distal ends slightly flared and rounded; zygomatic plate moderately wide, leading edge slopes gently forward; bulla relatively widely spaced, moderately long relative to greatest skull length (0.19); eustachian tube projects anteromedially to level of bulla anterior edge; incisive foramina long (8.9), narrowing slightly posteriorly, extending to a point almost level to anterior edge of M<sup>1</sup> anterolingual root; premaxilla-maxilla suture in anterior one third of incisive foramen; palatal bridge short, extends only 0.9 posterior to M<sup>3</sup> cusp posterior face; ventral surface generally smooth with several tiny vascular foramina; posterior palatal foramen oval, level with M<sup>2</sup> and M<sup>3</sup> interface, sited in moderately deep palatal grooves that extend the length of palatal bridge; squamosal dorsal to bulla complete, not divided by squamosal-mastoid foramen; stapedia foramen moderately large; sphenopalatine foramen small, oval, *ca.* 1.9 anterior to small slit-like dorsal palatine foramen; zygomatic arch squamosal roots originate low on sides of braincase, without posterior horizontal ridge to mastoid; braincase sides almost vertical; postglenoid vacuity moderately wide, separates dorsal and anterior margins of periotic and bulla from squamosal; alisphenoid canal lateral part open, not covered by strut of alisphenoid bone; mesopterygoid fossa moderately wide, 60% of palatal breadth at M<sup>3</sup>; perforated by large sphenopalatine



Figure 3. Photograph of vegetation close to place where *Rattus timorensis* holotype was collected.

vacuities that are visible laterally in orbit; pterygoid fossa wide, slants toward midline; sphenopterygoid vacuities absent on both sides. Dentary with strong masseteric ridge terminating close to and above masseteric foramen; angular process relatively deep and strongly produced.

*Dentition and palate* (Figures 4 and 6)

Upper molars small relative to palatal bridge; M1, M2 and M3 with 5, 4, 3 roots respectively, these roots located as for *Rattus*. The wear on these molars is such that it is not possible to evaluate much of the occlusal cusp pattern. However, the size of the upper and lower molars gradually reduce in size from M1 to M3; comparison with equally worn teeth of *R. rattus diardi* suggests M<sup>1</sup> cusp t7 and M<sup>2</sup> cusp t3 absent.

The palate (Figure 6) is closely similar to that of *Rattus norvegicus* as described by Kutuzov and Sicher (1952).

*Pelage and skin*

The predominant colour of dorsal pelage is Olive Brown. This derives from Chaetura Drab (dark brown) of the guard hairs mixing with the Tawny Olive (orange brown) tip to hairs. The basal hair on head is ca. 9 long increasing to 13 at neck, and to 19 on back and rump. Occasional longer guard hairs on head; these more abundant on neck, (up to

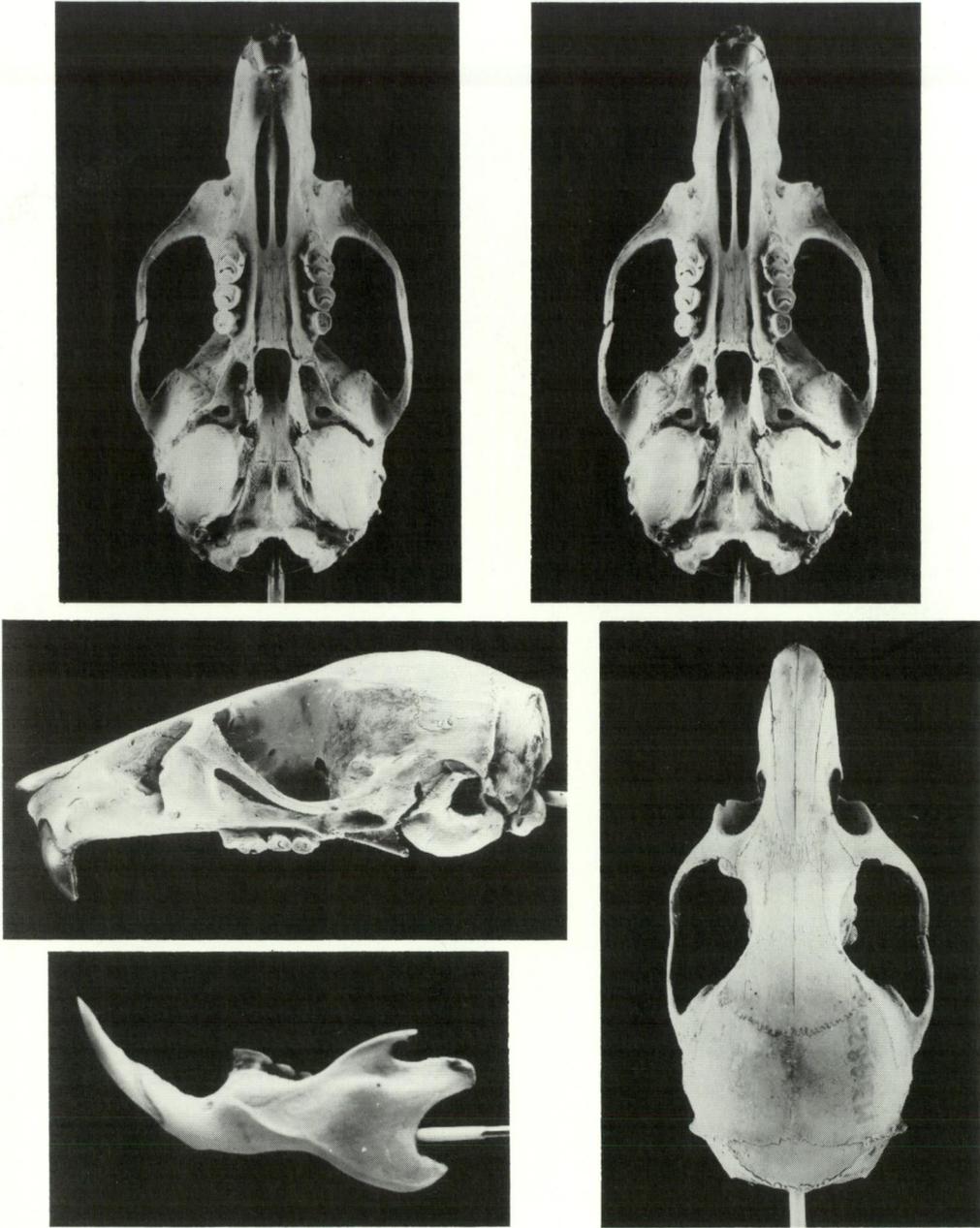


Figure 4. Photograph of skull dentary and teeth of *Rattus timorensis* holotype; ventral aspect of skull as stereopairs.

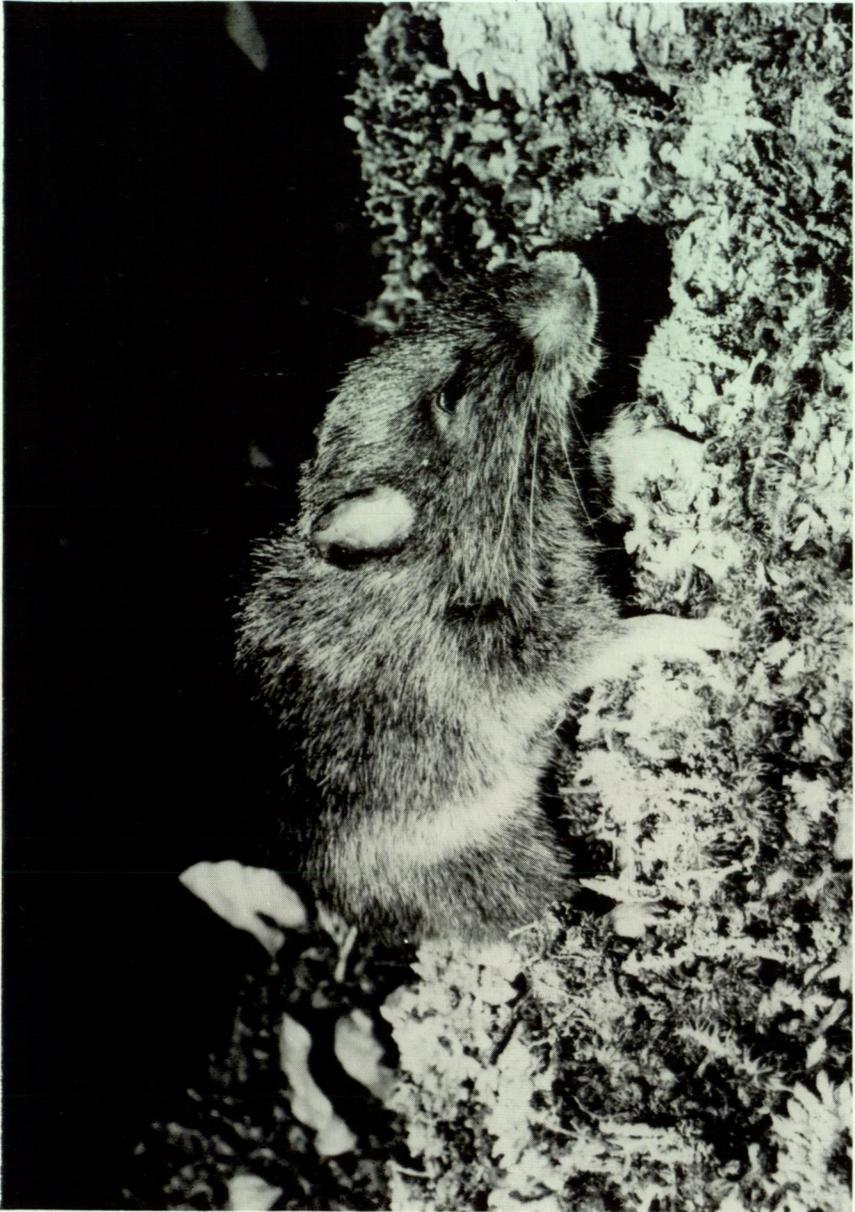


Figure 5. Photograph of *Rattus timorensis* holotype.

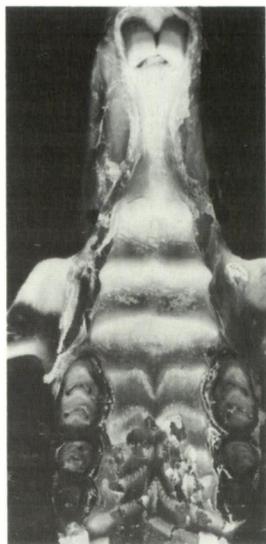


Figure 6. Photograph of soft palate and plantar surface of pes of *Rattus timorensis* holotype.

25 long), and on back and rump (up to 35 long); guard hairs on rump Chaetura Drab tipped with Light Cinnamon Buff. Flanks Tawny Olive peppered with Cinnamon Buff, merging gradually into Light Buff venter. Basal portion of ventral fur (ca. 12 long) Neutral Gray, this showing through apical wash on the chest and throat. Forearm fur predominantly Neutral Gray tipped with white or Light Buff; wrist and manus laterally white, dorsally Neutral Gray of skin prominent through short white hairs; toes white dorsally; palmar surface Light Ochraceous-Salmon (orange pink). Dorsal surface of pes to base of toes Neutral Gray of skin prominent through short white hairs; toes white-skinned with long white hairs slightly overhanging claws; plantar surface Light Ochraceous-Salmon.

Tail broken and heavily scarred; "bicoloured" with colour of skin prominent: dorsally deep Neutral Gray, ventrally White; hairs short (ca. 2.5): dorsally Chaetura Drab, ventrally white. 14 scales per cm at basal part.

Ears short (20.5), evenly rounded, skin Dark Mouse Gray, lightly furred with short hairs Chaetura Drab externally and Light Buff internally.

#### *Vibrissae*

Facial vibrissae long: *ca.* 30 Pairs of long (to 60), mystacials, the lateral and ventral ones white, the central and dorsal ones black brown; *ca.* 2 pairs of moderate length (to 20) dark brown interramals; 2 pairs of dark brown genals (20 long); 2 pairs of long (to 30) dark brown supraorbitals and one pair of short (to 7) dark brown submentals; forearm with 7 short (up to 12 long) white ulnar carpals. Antebrachial and calcaneal vibrissae not evident.

#### *Pes and manus* (Figure 7)

Typically *Rattus* like. Manus claws long (4.1); pollex with nail; all palmar pads prominent; three interdigital pads: outer and inner kidney-shaped, central pad triangular-shaped; thenar pad approximately one-half area of hypothenar, both large. Pes claws moderately long (4.8); pads, smooth but with sub-epidermal lamellae; inner plantar pad elongate, *ca.* 4 long; outer plantar pad 1.2 behind nearest interdigital pad and approximately three-quarters size of this front pad; outer interdigital pad broadly kidney shaped with smaller posterolateral subcircular accessory pad.

#### **Etymology**

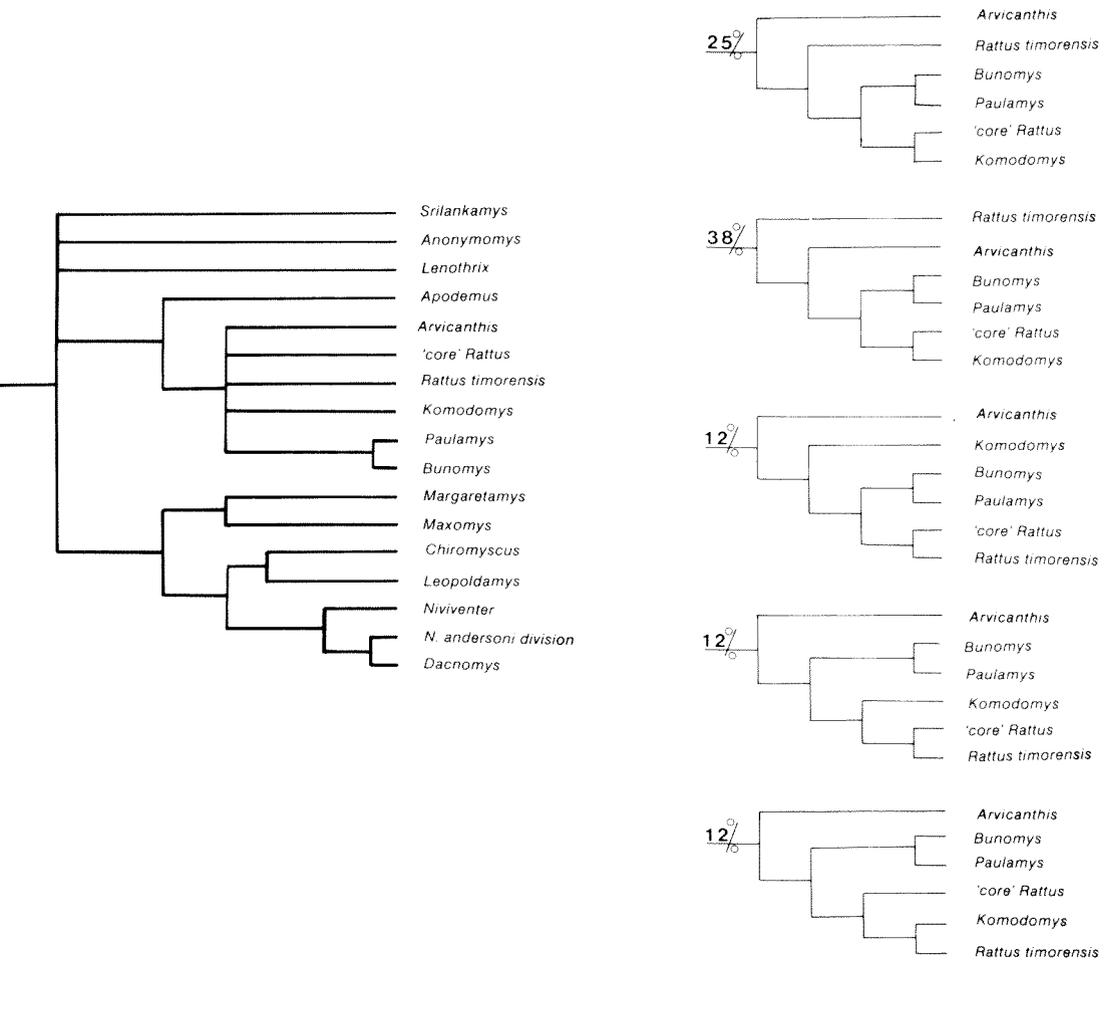
*Rattus timorensis* is named after the island on which it was collected.

#### Remarks

##### *The genus Rattus*

Recent years have seen considerable refinement of the generic concept *Rattus*, resulting in a sharp reduction in the number of contained species from over 600 (e.g., Chasen 1940; Ellermen 1949; Tate 1951) to little more than 50 (Musser and Newcomb 1983; with additions by Musser and Heaney 1985). This reduction results principally from the work of Misonne (1969), Musser and Boeadi (1980), Musser *et al.* (1979), Musser (1981 a, b, c' 1982 a, b) and Musser and Newcomb (1983) through whose collective efforts many of the more discrete generic groupings have been set apart from *Rattus*. Additionally, Musser (1971), Musser (1973 a, b; 1986), Musser and Califia (1982) and Taylor *et al.* (1982) have revised a number of groups within *Rattus*, leading to the detection of many junior synonyms.

While monophyly of those taxa currently included within *Rattus* is still not resolved (Musser and Newcomb 1983) and possibly will not be until the wider application of modern genetic techniques, the 'core' species of *Rattus* (i.e., those that appear to be closely related to its type species, *R. rattus*) have been diagnosed by Musser and Boeadi (1980: 397) to have the following combination of characters: cranium and mandibles with basic configuration of *R. rattus* and *R. argentiventer*; incisive foramen long and terminate between first molars; palatal bridge long, terminates well beyond tooththrow; sphenopalatine vacuities large such that anterior process of basisphenoid and presphenoid appear suspended in air; bulla relative to cranium of medium to large size; incisor anterior face with orange pigment; tooththrows narrow relative to palatal bridge;



**Figure 7.** Cladogram of relationship between *Rattus timorensis* holotype; 'core' members of *Rattus* and other related genera. The consensus tree from the 24 equally parsimonious trees is in bold; other equally parsimonious combinations for the clade involving *Rattus timorensis* are shown, along with their proportional representation in the total sample.

M<sup>1</sup> with 5 tooth roots; M1-3 occlusal pattern as in *R. rattus* and *R. argentiventer*; M3 reduced relative to M1 and M2; and the extent to which M<sup>1</sup> overlaps M<sup>2</sup> overlaps M<sup>3</sup>. This diagnosis is further amplified for the 'core' *Rattus* species in Musser and Newcomb (1983: 345-349).

As discussed by Musser and Newcomb (1983), strict adherence to this diagnosis would effectively preclude a number of the Sulawesian, Sundaic and Australo-Papuan species currently included within *Rattus*. On the other hand, sufficient broadening of the generic diagnosis to accommodate these taxa would result in a considerable blurring of the generic distinction between *Rattus* and its close relatives.

Based on the available evidence, *Rattus timorensis* likewise appears to lie close to, though probably not strictly within, the genus *Rattus sensu stricto*. Regrettably the holotype has extremely worn molars so that it is not possible to discern their cusp morphology, however it differs from 'core' *Rattus* species in having a relatively long narrow rostrum; a relatively short palatal bridge which extends only 0.9 mm beyond the posterior edge of M<sup>3</sup> and does not form a long and wide shelf beyond the teeth; a bicoloured tail, contrasting with the more typical even brown colour; poorly-developed ridging along the dorsal margins of the interorbital, postorbital and temporal regions of cranium; a wide infraorbital region; 3 pairs of mammae; and in lacking sphenopterygoid vacuities.

In order to obtain a relatively objective picture of phylogenetic affinities, we examined the cladistic relationship between WAM M34827 and species of *Rattus*, *Paulamys*, *Bunomys*, *Komodomys* and 12 other murid genera (see Musser 1981a, b; Kitchener *et al.* 1991). The data set (see Appendix) consists of various characters proposed by Musser (1981a) as of value for primary evaluation of *Rattus* and related genera. These characters were related to the skull and numbers of molar roots only; cusp morphology could not be scored for WAM 34827.

An exhaustive branch and bound analysis produced a series of twenty-four, equally parsimonious phylogenetic trees, each with a Consistency Index of 0.51. A Strict Consensus tree derived from this series (Figure 7) shows *Rattus timorensis* in an unresolved polychotomy with *Arvicanthus*, 'core' *Rattus*, *Komodomys*, *Paulamys* and *Bunomys*. In the majority (63%) of the 24 trees produced (Figure 7) *Rattus timorensis* lies outside the clade including 'core' *Rattus*, *Komodomys*, *Paulamys* and *Bunomys*. When placed within that clade, however, *R. timorensis* is the sister taxon to 'core' *Rattus* in 6 trees, and to *Komodomys* in 2 trees. A similar analysis using the full (cranial + dental) character set, but with *R. timorensis* scored as unknown for all dental characters, gave a smaller number of trees with fewer variants but an essentially similar Strict Consensus topology. Because the greater resolution implied by the fewer trees is not gained through any additional information on *R. timorensis*, we prefer to accept the less fully resolved outcome of the cranial analysis.

The phylogenetic analysis indicates that we should be cautious in placing WAM M34827 in the genus *Rattus*, and we do so only with considerable reservation. Revision of its generic status must await firstly the recovery of a younger specimen of this taxon to enable clarification of its molar cusp morphology, and secondly, the results of an

ongoing immunological (Microcomplement Fixation) study, incorporating material from this specimen, which is being carried out by Dr C. Watts and his colleagues at the South Australian Museum.

Within the current taxonomic scope of *Rattus sensu* Musser and Newcomb (1983), *R. timorensis* is superficially similar to such widely separated taxa as *R. hoogerwerfi*, a species from the mountains of N. Sumatra (see Musser 1986), members of the 'Stenomys' group (*R. verecundus* and *R. niobe*) in the New Guinean Region, and a newly discovered, endemic *Rattus* species from Flores Island (Kitchener *et al.* 1991b).

*Rattus hoogerwerfi* is about the same size as *R. timorensis* (body length 170-196 v. 157) however its tail is markedly different (the distal half, rather than the ventral half, is white) and its pelage is long and soft, but brightly coloured and brown according to Chasen (1939), rather than a darker brown. It shares with *R. timorensis* the feature of a relatively short palatal projection posterior to M<sup>3</sup>, however from the work of Musser and his colleagues this is very likely a plesiomorphic state within Muridae. *Rattus timorensis* differs from *R. hoogerwerfi* in a number of skull features: zygomatic width slightly greater relative to greatest skull length (0.50 v. 0.47); rostrum longer relative to greatest skull length (0.37 v. 0.32); rostrum narrower relative to rostrum length (0.43 v. 0.51); bulla longer relative to greatest skull length (0.19 v. 0.15); braincase height greater relative to greatest skull length (0.33 v. 0.28); absence of dorsal ridges outlining interorbital region and extending laterally to postorbital and temporal region; and M<sup>1-3</sup> alveolar length shorter (6.9 v. 7.5-8.5).

Members of the Australo-Papuan "Stenomys" group (*R. verecundus* and *R. niobe*) and *Rattus* sp.nov. from Flores I. share with *R. timorensis* the feature of weakly developed dorsal ridges outlining the interorbital and more posterior cranial regions. Additionally, *R. verecundus* and *R. niobe* also have relatively long rostra relative to greatest skull length (e.g., *R. timorensis* v. *R. verecundus*: 0.37 v. 0.36 (0.35-0.37) N=6, measurements from WAM M25088, M25100, M25103, M25106, M25130, M25143).

On a more detailed level, *R. timorensis* is very obviously distinct from each of these species. For example, it differs from *R. verecundus* and *R. niobe* (see Taylor *et al.* 1982) in being generally larger in body and skull measurements; in having longer bullae relative to greatest skull length (0.19 v. <0.15); incisive foramen much longer; sphenopterygoid vacuity absent. It differs from the Floresian *Rattus* sp. (see Kitchener *et al.* 1991) in being larger in most body and skull measurements; in having a much longer rostrum and longer incisive foramina; relatively larger bulla; sphenopterygoid vacuity absent; ridges outlining interorbital region considerably reduced to a slight beading; rostrum considerably narrower dorsoventrally; zygomatic plate anterior edge more gently curved; neurocranium more ovate in dorsal profile.

#### Habitat and conservation status

The unique specimen of *R. timorensis* was collected in a triangular-shaped patch (ca. 30 ha.) of mixed montane forest, situated between two sharp ridges defining the southwestern face of Gunung Mutis (Figure 2, arrowed). Dominant tree species include *Podocarpus imbricatus* and several small-leaved angiosperms. The shrublayer is

relatively dense and includes *Daphniphyllum* spp., *Prunus arborea* and *Ilex* sp. Tree ferns to 3 m are abundant in moister situations. The ground layer includes dense stands of bracken and a "fishtail" fern; litter is sparse on steeper slopes but considerably thicker in sheltered positions. The area shows little evidence of direct human exploitation, but is traversed by horse and cattle trails

The animal was trapped in a 'breakback' trap, placed among a system of 'runs' and 'burrows' in the wall of a moist, densely-shaded gully; the trap was baited with uncooked meat. Ten specimens of *Rattus exulans* were captured in the immediate vicinity, from a combined trapping effort of 75 Elliot and 30 'breakback' trap-nights.

Adjacent, drier slopes of Gunung Mutis support extensive tall forests of *Eucalyptus urophylla*, in which the understorey is generally less dense though of similar floristic composition. Further downslope there are extensive stands of the *Eucalyptus urophylla* tall forest within which are found occasional elements of the montane forest community. Extensive, grassed clearings occur at ca. 1650m and ca. 1800m (the higher clearing is partly shown in Figure 2); these support grazing herds of Banteng cattle and horses, and are clearly of anthropogenic origin. Burning both around the margins of these clearings as well as within the main forest stands appears to be resulting in a progressive destruction of the mixed montane forest, and its replacement by the *Eucalyptus urophylla* community. The mixed montane community is therefore under considerable ecological threat. *Eucalyptus* forests are likewise dominant on all other high peaks in the Nenas area, and in wider Southwest Timor as a whole. Trapping in these areas resulted in capture of *Rattus exulans* and *R. rattus sumbae*.

Whether *Rattus timorensis* is confined to the mixed montane forest habitat is not known for certain, however there can be little question as to the endangered status of this newly discovered species.

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Photographs taken in the laboratory were by Norah Cooper, Western Australian Museum.

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References

- Chasen, F.N. (1939). Two new mammals from North Sumatra. *Treubia* 17: 207-208.
- Chasen, F.N. (1940). A handlist of Malaysian mammals (a systematic list of the mammals of the Malay Peninsula, Sumatra, Borneo and Java, including the adjacent small islands). *Bull. Raffles Mus., Singapore, Straits Settlements* 15: i-xx, 1-209.
- Ellerman, J.K. (1949). *The families and genera of living rodents*. Vol. 3, [British Museum, Nat. Hist., London], pp. i-v, 1-210.
- Farris, J.S. (1988). "Hennig 86" (version 1.5) - Distributed by J.S. Farris.
- Glover, I.C. (1971). Prehistoric research in Timor. Pp. 158-181 in: D.J. Mulvaney and J. Golson (eds) 'Aboriginal Man and Environment in Australia' (A.N.U. Press: Canberra).
- Hooijer, D.A. (1965). Note on *Coryphomys buhleri* Schaub, a gigantic murine rodent from Timor. *Israel J. Zool.* 14: 128-33.
- Kitchener, D.J., Boeadi, Charlton, L., and Maharadatunkamsi (1990a). Wild mammals of Lombok Island: Nusa Tenggara, Indonesia: Systematics and Natural History. *Rec. West. Aust. Mus. Suppl.* No. 33. pp. 129.
- Kitchener, D.J., How, R.A., Maharadatunkamsi and Suyanto, A. (1990b). Bats of the Malay Archipelago: Wallace's Line revisited. *Macroderma* 5: 17.
- Kitchener, D.J., How, R.A. and Maharadatunkamsi (1991a). A new species of *Nyctophilus* (Chiroptera: Vespertilionidae) from Lembata Island, Nusa Tenggara, Indonesia. *Rec. West. Aust. Mus.* 15: 97-107.
- Kitchener, D.J., How, R.A., and Maharadatunkamsi (1991b). A new species of *Rattus* from the mountains of West Flores, Indonesia. (Submitted).
- Kitchener, D.J., How, R.A., Maharadatunkamsi (1991c). *Paulamys* sp. cf. *P. naso* (Musser, 1981) (Rodentia: Muridae) from Flores Island, Nusa Tenggara, Indonesia — description from a modern specimen and a consideration of its phylogenetic affinities. *Rec. West. Aust. Mus.* 15: 171-189.
- Kitchener, D.J. and Maharadatunkamsi (1991d). Description of a new species of *Cynopterus* (Chiroptera, Pteropodidae) from Nusa Tenggara, Indonesia. *Rec. West. Aust. Mus.* (in press).
- Kutuzov, H. and Sicher, H. (1952). Anatomy and function of the palate in the white rat. *Anat. Rec.* 114: 67-84.
- Misonne, X. (1969). African and Indo-Australian Muridae. Evolutionary trends. *Mus. Roy. L' Afrique Cent. Tervuren. Zool.* 172: 1-219.
- Musser, G.G. (1971). Results of the Archbold Expeditions. No. 94. Taxonomic status of *Rattus tatei* and *Rattus frosti*, two taxa of murid rodents known from middle Celebes. *Am. Mus. Novit.* 2454: 1-19.
- Musser, G.G. (1973a). Zoogeographic significance of the rice-field rat, *Rattus argentiventer*, on Celebes and New Guinea and the identity of *Rattus pestivulus*. *Am. Mus. Novit.* 2511: 1-30.
- Musser, G.G. (1973b). Species limits of *Rattus cremoriventer* and *Rattus langbianus*, murid rodents of Southeast Asia and the Greater Sunda Islands. *Am. Mus. Novit.* 2525: 1-65.
- Musser, G.G. (1981a). Results of the Archbold Expeditions. No. 105. Notes on systematics of Indo-Malayan murid rodents, and descriptions of new genera and species from Ceylon, Sulawesi, and the Philippines. *Bull. Am. Mus. nat. Hist.* 168: 225-334.
- Musser, G.G. (1981b). The giant rat of Flores and its relatives east of Borneo and Bali. *Bull. Am. Mus. nat. Hist.* 169: 67-176.
- Musser, G.G. (1981c). A new genus of arboreal rat from West Java, Indonesia. *Zool. Verhandl.* 189: 1-40.
- Musser, G.G. (1982a). Results of the Archbold Expeditions. No. 107. A new genus of arboreal rat from Luzon Island in the Philippines. *Am. Mus. Novit.* 2730: 1-23.
- Musser, G.G. (1982b). Results of the Archbold Expeditions. No. 108. The definition of *Apomys* a native rat of the Philippine Islands. *Am. Mus. Novit.* 2746: 1-43.
- Musser, G.G. (1986). Sundaic *Rattus*: definitions of *Rattus baluensis* and *Rattus korinchi*. *Am. Mus. Novit.* 2862: 1-24.
- Musser, G.G. and Boeadi (1980). A new genus of murid rodent from the Komodo Islands in Nusa Tenggara, Indonesia. *J. Mamm.* 61: 395-413.

- Musser, G.G. and Calafia, D. (1982). Results of the Archbold Expeditions. No. 106. Identities of rats from Pulau Maratua and other islands off East Borneo. *Am. Mus. Novit.* **2726**: 1-30.
- Musser, G.G. and Heaney, L.R. (1985). Philippine *Rattus*: a new species from the Sulu Archipelago. *Am. Mus. Novit.* **2818**: 1-32.
- Musser, G.G., Marshall, Jr., J.T. and Boeadi (1979). Definition and contents of the Sundaic genus *Maxomys* (Rodentia, Muridae). *J. Mamm.* **60**: 594-606.
- Musser, G.G. and Newcomb, C. (1983). Malaysian murids and the giant rat of Sumatra. *Bull. Am. Mus. nat. Hist.* **174**: 327-598.
- Ridgway, R. (1912). 'Color standards and color nomenclature'. (Ridgway, Washington)
- Schaub, S. (1937). Eine neuer Muride von Timor. *Verh. naturf. Ges. Basel* **48**: 1-6.
- Tate, G.H.H. (1951). Results of the Archbold Expeditions. No. 65. The rodents of Australia and New Guinea. *Bull. Am. Mus. nat. Hist.* **97**: 183-430.
- Taylor, J.M., Calaby, J.H. and Van Deusen, H.M. (1982). A revision of the genus *Rattus* (Rodentia, Muridae) in the New Guinean region. *Bull. Am. Mus. nat. Hist.* **173**: 177-336.