

Description of a new subspecies of *Pseudomys* (Rodentia: Muridae) from Northern Territory

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Abstract

Pseudomys laborifex calabyi subsp. nov. is described from six specimens collected in 1973 from near the Uranium Development Project (UDP) Falls, Northern Territory. On skull and dentary characters it is generally larger but most similar in form to *Pseudomys laborifex laborifex* Kitchener and Humphreys, 1986. On external characters it is readily distinguished, using either univariate or discriminant function analysis, from *P.l. laborifex* and from other tropical and subtropical small (< 20 gm) *Pseudomys* with which it could be confused.

Introduction

Kitchener and Humphreys (1986) drew attention to the unsettled taxonomic situation regarding *Pseudomys* and described the new species, *Pseudomys laborifex*. This species is uncommon in the Western Australian Museum collection but widely distributed in the Kimberley, from the moist northwest to the more arid Ord River Region.

In January and July 1973 Dr John Calaby and Mr Tony Wolfe collected six specimens of *Pseudomys* from near UDP Falls, Northern Territory, which Dr Calaby considered to be a unique form (pers. comm.). Our examination of these specimens supports this view.

We are unable to compare directly measurements of externals of the UDP Falls form with other specimens because only scientific skins are available of the new form. We consider that a comparison of external measurements based on scientific skins to be unsatisfactory because different preparation methods alter the overall size and relative dimensions of such skins. However the field measurements of the new form, recorded by Dr Calaby just after their death, were compared with our measurements of formalin fixed and ethanol preserved specimens. Again such measurements will differ but they are a much better basis for comparison.

We consider the UDP Falls form to be most similar to *P. laborifex*, although easily distinguishable from that form on external measurements — certainly at least to the extent of warranting subspecific distinction using Mayr's 'seventy-five percent rule' (Mayr 1969). When additional specimens become available of this new form it may well be seen to warrant the status of a species. As no specimens of this new form have appeared in the last 14 years we have proceeded herein to recognise it as a subspecies of *P. laborifex*.

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Methods

Measurements

Twenty-one skull (including dentary and teeth) and six external characters (listed in Table 1) were recorded from six adult *P. laborifex calabyi* (4 ♂, 2 ♀). The measurements, in millimetres, were recorded as shown in Kitchener (1985: Figure 1). Measurements of the holotype of *P. laborifex calabyi* are presented in Table 1. Terminology for vibrissae and other external characters follows Wood Jones (1923). Hair counts on the tail were taken as the number of hairs round the circumference of the tail at a point 1 cm from the anus. Measurements for *P. l. laborifex* (Kimberley, Western Australia), *P. chapmani* (Pilbara District, Western Australia), *P. hermannsburgensis* (central Northern Territory), *P. delicatulus* (Kimberley and Pilbara districts, Western Australia), *P. johnsoni* (central Northern Territory) and the type specimens examined are those presented in Kitchener (1985) and Kitchener and Humphreys (1986). Registration numbers of specimens are of the Australian National Wildlife Collection, CSIRO, Canberra.

Ageing

All specimens were regarded as adult after consideration of ossification of cranial sutures and tooth wear.

Univariate analysis

Means and standard deviations were obtained for all adult skull and external body characters. For each species all characters were examined for sexual dimorphism using t-test for unequal sample size. *A posteriori* multiple comparisons were conducted using analysis of variance and the GT2 follow up procedure at $\alpha = 0.05$ (Sokal and Rohlf 1981).

Multivariate analysis

Cranial and external characters were examined separately using multiple discriminant analysis (Davies 1971) and the centroids tested for significance using Hotelling's T^2 (Sneath & Sokal 1973). Five individuals from the comparative forms and three variables (body weight, nasal length, and coronoid-angle length) were dropped from the analysis due to missing data. Dendrograms were drawn from WP GMA cluster analysis of the range scaled data (Sneath and Sokal 1973) using euclidian distance.

Systematics

Pseudomys laborifex calabyi subsp. nov.

Tables 1, 2; Figures 1 - 3

Holotype

Australian National Wildlife Collection registration number CM7895, adult male, dry scientific skin, skull and dentaries separate.

Type locality

3 km SE Uranium Development Project (UDP) Falls, Northern Territory, 13°27'S, 132°26'E, altitude c. 100 m, collected on 14 July 1973 by J. Calaby and T.O. Wolfe.

Paratypes

(all dry scientific skins with skull and dentary separate, all collected by J. Calaby and T.O. Wolfe.) UDP Falls (13°26'S, 132°25'E): CM7633, adult male, collected on 20 January 1973; CM7907, adult male, collected on 15 July 1973. 3 km SE UDP Falls (13°27'S, 132°26'E): CM7875, adult female, collected on 13 July 1973; CM7880, adult female, collected on 13 July 1973; CM7898, adult male, collected on 14 July 1973.

Diagnosis (mean and range values)

Field measurements of *P.l. calabyi* tail, body and pes lengths are followed in brackets by measurements from scientific skins.

Pseudomys laborifex calabyi differs from *P. l. laborifex* in having its tail to vent length relatively shorter than snout to vent length 0.92 (0.88) [0.90 (0.80) - 0.95 (0.91)] v. 1.19 (1.05-1.35); snout to vent length much greater 85.2 (82.9) [82 (78.4) - 90 (87.4)] v. 64.5 (56.4-71.1); pes generally longer 17.8 (17.5) [16.7 (16.6) - 18.6 (18.3)] v. 16.6 (16.1-17.8); body weight generally heavier 16.4 (15.3-19.2) v. 11.8 (8.3-17.0); tail generally with more hairs/scale row 44.0 (35-51) v. 37.5 (31-41); generally larger in all skull and dentary measurements: greatest skull length 24.3 (22.9-25.1) v. 22.9 (22.2-23.5), M^{1-3} length 4.4 (4.2-4.5) v. 4.1 (3.8-4.3) and M_{1-3} length 3.8 (3.7-3.9) v. 3.6 (3.4-3.9).

Pseudomys laborifex calabyi differs from other small *Pseudomys* as outlined in the diagnoses of *P. laborifex laborifex* (Kitchener & Humphreys 1986: 422-425) except for the following additional details.

It differs from *P. hermannsburgensis* in having tail to vent length relatively shorter than snout to vent length v. 1.15 (1.07-1.31); anterior palatal foramen shorter relative to palatal length 0.32 (0.30-0.35) v. 0.37 (0.34-0.41); braincase narrower relative to greatest skull length 0.45 (0.45-0.46) v. 0.48 (0.47-0.50).

It differs from *P. delicatulus* in having tail to vent length relatively shorter than snout to vent length v. 1.22 (0.99-1.39); snout to vent length much greater v. 55.1 (50.2-61.7); tail with more hairs/scale row v. 33.9 (30-38); braincase narrower relative to greatest skull length v. 0.49 (0.45-0.50).

It differs from *P. chapmani* in having tail to vent length relatively shorter than snout to vent length v. 1.33 (1.07-1.43); snout to vent length longer v. 60.5 (52.2-67.7); braincase width narrower relative to greatest skull length v. 0.48 (0.45-0.50); bulla shorter v. 5.8 (5.5-6.0).

It differs from *P. johnsoni* in having tail to vent length relatively shorter than snout to vent length v. 1.20 (1.06-1.38); tail with more hairs/scale row v. 36.8 (30-44).

Description

As for *Pseudomys laborifex laborifex* (Kitchener and Humphreys 1986) except for the following details:

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Table 1 Skull, dentary and external body measurements of the *Pseudomys laborifex calabyi* types. External measurements given (apart from hairs/scale row) are field measurements taken by J. Calaby and our measurements from scientific skins (in brackets).

Catalogue Number	CM7895 Holotype	CM7633	CM7898	CM7907	CM7875	CM7880
Sex	♂	♂	♂	♂	♀	♀
Character						
Skull						
greatest length	24.1	24.9	24.4	24.6	25.1	22.9
nasal length	8.9	9.7	8.7	9.3	9.5	8.5
nasal width	2.4	2.5	2.4	2.2	2.2	2.3
interorbital width	3.5	3.4	3.7	3.4	3.3	3.4
zygomatic width	11.7	12.1	11.6	11.7	11.3	11.0
mastoid width	9.0	9.2	9.1	9.0	8.9	8.6
braincase width	10.6	11.0	10.7	10.8	10.5	10.3
braincase depth	7.4	7.5	7.7	7.3	7.3	7.3
interparietal width	7.3	7.1	7.3	6.9	6.4	7.9
palatal length	13.0	13.4	12.9	12.9	13.2	11.9
ant. palatal for- amen length	4.3	4.2	4.3	4.5	4.0	3.7
basicranial length	20.5	21.2	20.3	20.7	20.8	19.1
bulla length	4.9	4.8	4.9	4.8	5.0	4.7
bulla width	10.7	10.8	10.8	10.5	10.4	10.4
M ¹⁻³ length	4.2	4.4	4.2	4.5	4.4	4.4
M ¹ length	2.3	2.5	2.3	2.5	2.5	2.6
M ¹ width	1.2	1.2	1.2	1.3	1.2	1.2
M ³ length	0.8	1.0	1.0	0.9	0.9	0.9
Dentary						
M ₁₋₃ length	3.7	3.9	3.8	3.8	3.8	3.8
coronoid-angle length	5.2	5.3	NA	5.3	5.1	5.3
condyle-incisor length	15.2	15.8	15.3	15.1	15.5	14.6
Externals						
snout-vent length	82 (87.4)	90 (85.9)	82 (84.3)	87 (78.4)	86 (82.0)	84 (79.4)
tail-vent length	78 (70.1)	82 (78.1)	77 (74.5)	78 (71.7)	81 (73.1)	76 (NA)
pes length	18.3 (18.0)	18.6 (18.3)	18.4 (17.7)	18.0 (17.2)	17.0 (17.4)	16.7 (16.6)
ear length	12.7 (9.4)	13.8 (11.4)	13.7 (8.8)	13.3 (9.6)	13.2 (9.5)	13.1 (8.9)
weight	17.0	19.2	15.8	15.3	15.5	15.4
hairs/scale row	47	43	41	35	47	51

Table 2 Discriminant function scores for the variables used for both skull and external characters of five species of *Pseudomys* (*laborifex laborifex*, *laborifex calabyi*, *hermannsburgensis*, *delicatulus*, *chapmani* and *johnsoni*). Canonical variate values for an individual specimen are calculated by the summation of the products of each character value with its function score.

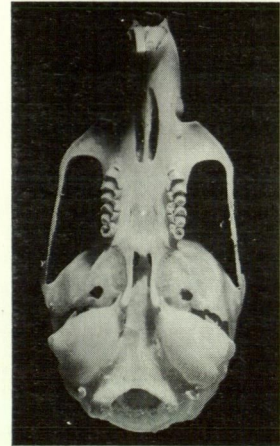
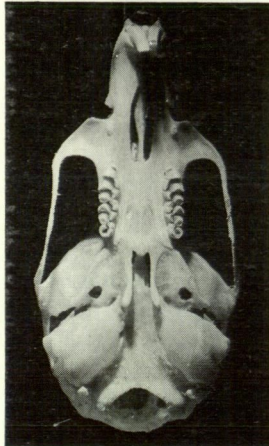
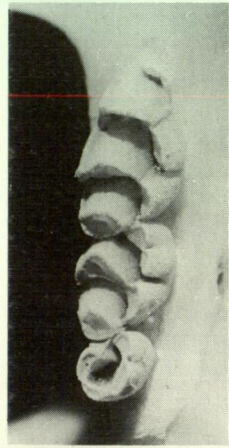
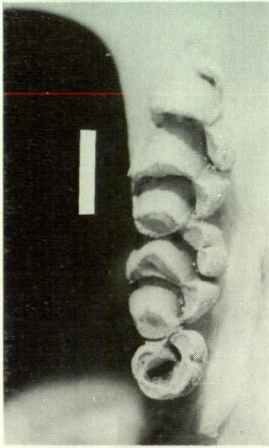
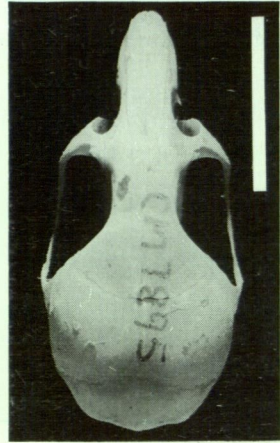
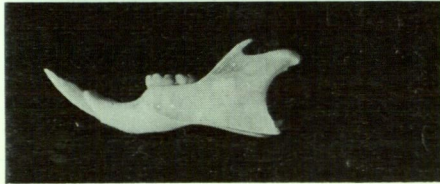
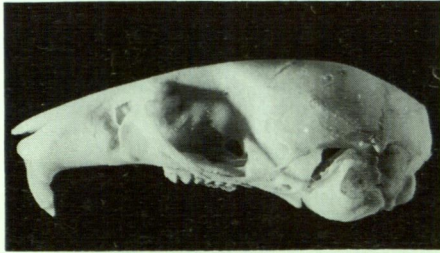
SKULL CHARACTERS	VECTORS				
	I	II	III	IV	V
greatest skull length	-.262	-.010	-.097	-.010	-.176
nasal width	-.173	-.028	-.062	-.281	-.014
interorbital width	-.173	-.011	-.026	-.094	-.124
zygomatic width	-.061	-.065	-.146	-.037	-.116
mastoid width	-.165	-.025	-.145	-.111	-.032
braincase width	-.049	-.309	-.207	-.026	-.007
braincase depth	.320	.151	.055	.069	-.069
interparietal width	-.032	.160	.144	.054	.012
palatal length	.545	.155	.059	-.006	.440
ant. palatal foramen length	-.201	.296	.130	-.193	-.072
basicranial length	.053	-.058	.124	.014	-.034
bulla length	-.008	-.009	.017	-.027	.035
bulla width	.108	-.237	.067	.035	.062
upper molar row length	.066	-.184	-.217	-.079	-.128
M ¹ length	.236	.133	-.413	-.202	-.297
M ¹ width	.467	.559	.755	.691	.769
M ³ length	.033	.548	-.044	.555	.064
lower molar row length	.315	.039	.187	-.126	-.156
condyle-incisor length	.034	.026	-.097	.022	-.043
χ^2	133.2	115.8	87.3	56.8	37.5
df	23	21	19	17	15
% variation explained	44	30	16	7	4

EXTERNAL CHARACTERS	I	II	III
snout-vent length	.228	-.071	-.037
tail-vent length	-.112	-.080	.101
pes length	.907	.085	-.837
ear length	.262	.990	.532
hair/scale row	.208	-.008	.050
χ^2	106.9	62.1	17.4
df	9	7	5
% variation explained	70	24	4

Skull and dentary (Figure 1)

Blunt projection of occipital intrudes approximately three quarters length of dorsal edge of postsquamosal sinus; anterior palatal foramen short, extending posteriorly to a point level with or just anterior to a line joining anterior edge of M¹ alveoli, although extends just posterior to this line in CM7907; mesopterygoid fossa with parallel sides for most of its length and slightly widened posteriorly.

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Dentition (Figures 1 and 2)

M¹ occlusal surface oval in outline differing slightly from *P. l. laborifex* (Figure 2; but see Corbet 1986).

External morphology (Figure 3)

Small 16.4 (15.3-19.2) gm; tail length from field measurements 92 (90-95) percent of total body length; ear and pes lengths, from field measurements, moderate 13.3 (12.7-13.8) and 17.8 (16.7-18.6) respectively.

Pelage and skin colour

Described following Ridgeway's (1912) colour standards (capitalised).

Hairs on shoulder, back and flanks average 6 mm long, base of hairs Neutral Gray, distal 2 mm Tawny Olive, lightly tipped with Sepia. Hairs on forehead, rostrum and sides of face shorter (3.0-3.5 mm) with distal one-third Tawny Olive, tipped with Sepia. Ears lightly furred with 1.0-1.5 mm long hairs, these Warm Sepia on outer surface and Light Ochraceous Salmon tipped with white on inner surface. Guard hairs on dorsum numerous, up to 11 mm long, Black - on flanks less numerous, slightly shorter (10 mm), Black. Hairs on ventral surface of body, throat, chin, sides of mouth, manus and pes White - which contrasts sharply with Cinnamon Buff of lateral surfaces; ventral hair 5 mm long, basal half Light Neutral Gray. Guard hairs on venter and abdomen less numerous, up to 8.5 mm long, White. Hairs on tail 1.2 mm long, averaging 44 hairs/scale row; on dorsal surface of tail hairs Bister, on ventral surface White. No terminal tuft on tail. On each side up to 36 mystacial vibrissae, posteriorly these are up to 26.5 mm long, mostly Sepia, on edge of lips shorter (6 mm) and White. One genal vibrissa 10 mm long, Sepia; one long (16.5 mm) and one or two shorter (10 mm) supraorbital vibrissae; two short (7 mm) White interramal vibrissae. Skin of pes and manus Pinkish Buff. Skin of ear Hair Brown. Ventral skin of tail Pale Smoke Gray, dorsal skin Buffy Olive.

Etymology

Named after Dr John Calaby for his discovery of this subspecies and for his contribution to Australian mammalogy.

Distribution and habitat

Known only from the vicinity of UDP Falls, Northern Territory. It is separated from *Pseudomys l. laborifex* by approximately 560 km. (Figure 4).

The habitat of the holotype and paratypes is as follows (J. Calaby pers. comm.):

◀ **Figure 1** Skull, dentary and occlusal view of RHS upper molar row of *Pseudomys laborifex calabyi* holotype. Molar row and ventral aspect of the skull as stereopairs. Scale lines: upper molar row, 1 mm; skull and dentary, 10 mm.

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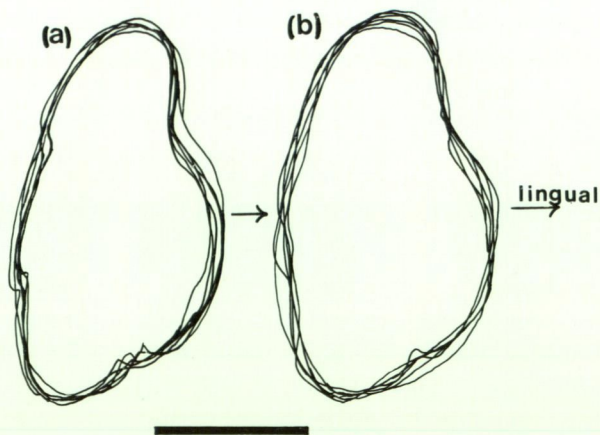


Figure 2 Outline of M¹ occlusal surface of six specimens showing approximately similar tooth wear of (a) *Pseudomys laborifex calabyi* and (b) *P.l. laborifex*. Scale line, 1 mm.

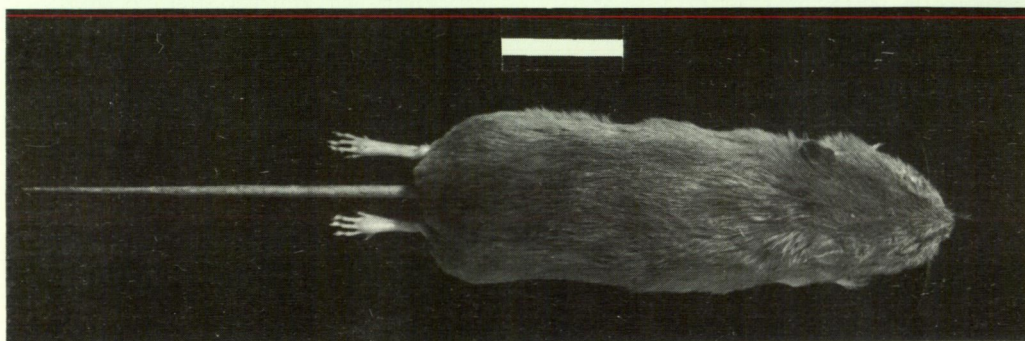


Figure 3 *Pseudomys laborifex calabyi* holotype: scientific skin. Scale line 2 cm.

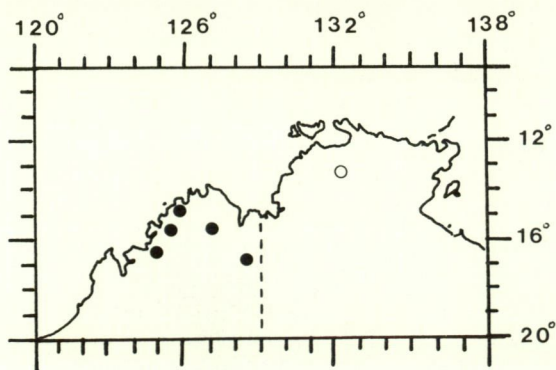


Figure 4 Locality records of *Pseudomys laborifex calabyi* (○) and *P.l. laborifex* (●).

CM7895 (holotype), CM(7875, 7880, 7898).

From edge of small 'swamp' at base of escarpment, or small watercourse flowing from 'swamp'. Swamp and watercourse dry in July 1973 at time of capture of these specimens but sandy-clay soil damp. Vegetation in depression and along watercourse predominantly large tussocks of a tall broad-bladed perennial grass, and other grasses. These were green in July. Vegetation surrounding and at edge of swamp was a tall open eucalypt forest grading to woodland on sandy or sandy loam soil. There were occasional *Pandanus* sp., *Erythrophleum* sp. and flowering *Grevillea* sp., tall shrubs and a ground stratum of moderately dense, long, dry annual grass with a few shrubs.

There were burrows in the sandy soil near the 'swamp' edge but these appeared to be those of *Rattus tunneyi* and "*Pseudomys gracilicaudatus*". *Pseudomys delicatulus* was trapped on the lighter soils in woodland.

CM7633 (January 1973), CM7907 (July 1973)

At UDP Falls at bottom of slope at base of escarpment. Sparse eucalypt woodland on moderately hard stony soil. Some larger boulders on slope. Understorey of moderately sparse short grass with some ephemeral herbs and vines. CM7633 caught in live trap on bare area at base of a very large mound nest of *Nasutitermes triodiae*. CM7907 caught on similar substrate within 200 m of trapsite of CM7633. These above habitats very close to a sparse eucalypt woodland on friable sandy soil covered with tall annual grass (dried out in July) and with sparse shrubs. *Pseudomys delicatulus* and other murids common in the latter habitat.

These habitats are similar to some of those occupied by *Pseudomys laborifex laborifex* (Kitchener and Humphreys 1986).

Morphometric Analyses: Results and Discussion

Univariate analysis.

The sample size is too small to test for sexual dimorphism. Eighteen of the 24 characters differed ($p < .05$) between *P. l. laborifex* and *P. l. calabyi*; those not differing are:

interparietal width, anterior palatal foramen length, M^1 width, M^3 length and condyle-incisor length. Multiple comparison tests on the six data sets show: *P. l. calabyi* differs from *P. l. laborifex* on snout to vent length, pes length, greatest skull length, basicranial length, M^1 length; and from *P. johnsoni* on snout to vent length and M^1 length.

Multiple discriminant analysis:

This analysis extracted five significant vectors for skull and dentary characters and three for external characters. The discriminant function statistics are given in Table 2. While *P. l. calabyi* could be separated on skull characters from *P. hermannsburgensis*, *P. delicatulus*, *P. chapmani* and *P. johnsoni*, it could not be separated graphically from *P. l. laborifex* (Figures 5a, b and 6a). On the more dubious

external characters it is well separated from adjacent groups (Figure 6b). Examination of the three species overlapping on their skull and dentary characters using Hotellings' T^2 shows that *P. l. laborifex* differs significantly from *P. johnsoni* ($P=0.009$), but not from *P. l. calabyi* ($P=0.177$); too few data are available to test the difference between *P. johnsoni* and *P. l. calabyi*.

Phenetic analysis

This analysis on skull and dentary characters places *P. l. calabyi* closest to *P. johnsoni*, with *P. l. laborifex* closely grouped. On external characters *P. l. calabyi* is widely separated from all other species (Figure 7). The grouping on skull and dentary characters requires comment as we consider *P. l. calabyi* closest to *P. l. laborifex*. The phenetic grouping is the most robust obtained and the apparent anomaly results from the distribution of the data; the phenetic analysis is based

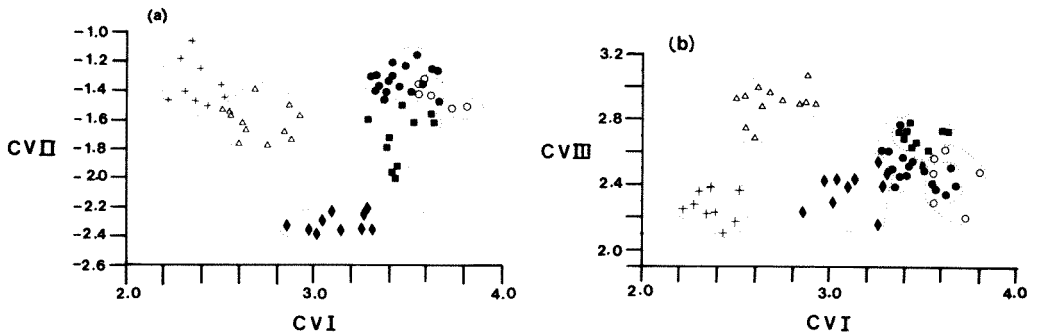


Figure 5 Discriminant function plots for combined male and female adult *Pseudomys* of (a) skull characters, vectors I and II and (b) skull characters, vectors I and III: *P. laborifex calabyi* (○), *P. laborifex laborifex* (●), *P. chapmani* (◆), *P. hermannsburgensis* (△), *P. delicatulus* (+) and *P. johnsoni* (■).

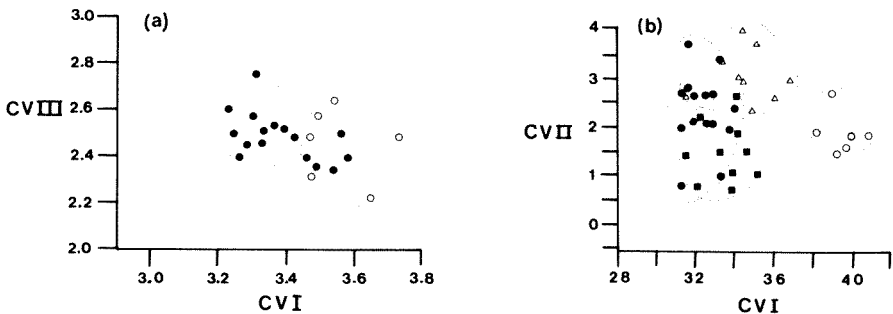


Figure 6 Discriminant function plot of (a) cranial characters of *P.l. laborifex* and *P.l. calabyi* on vectors I and III. (b) external characters of the four closest groups (see Figure 5) plotted on vectors I and II. *P.l. calabyi* (○), *P.l. laborifex* (●), *P. hermannsburgensis* (△) and *P. johnsoni* (■).

on considerably less information than is the graphical analysis which shows clear separation between *P. johnsoni* and both *P. l. laborifex* and *P. l. calabyi* (Figure 5a).

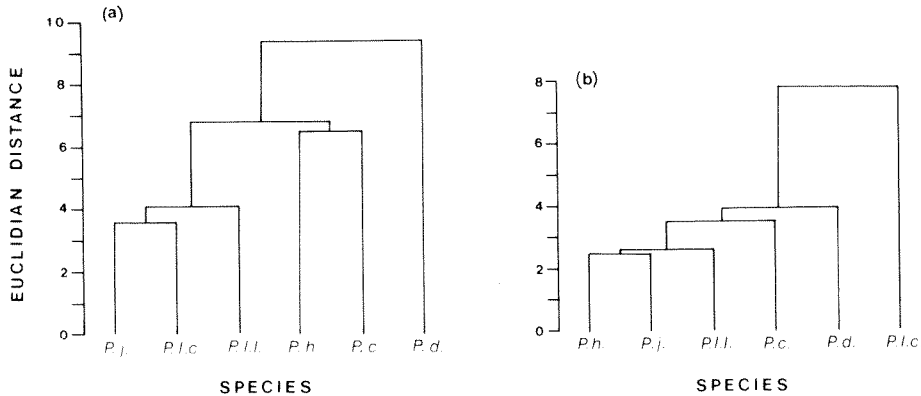


Figure 7 Dendrogram of the phenetic relationships for (a) skull characters and (b) external characters of combined male and female adult: *Pseudomys laborifex calabyi* (*P.l.c.*), *P.l. laborifex* (*P.l.l.*), *P. hermannsburgensis* (*P.h.*), *P. delicatulus* (*P.d.*), *P. chapmani* (*P.c.*) and *P. johnsoni* (*P.j.*).

Acknowledgements

Douglas Elford, Western Australian Museum, took the photographs. Barbara Jones produced Figure 2. Anne Nevin typed the MS.

References

- Corbet, G.B. (1986). Temporal and spatial variation of dental pattern in the voles, *Microtus arvalis*, of the Orkney Islands. *J. Zool., Lond.* **208**: 395-402.
 Davies, R.G. (1971). *Computer programming in quantitative biology*. (Academic Press, London).
 Kitchener, D.J. (1985). Description of a new species of *Pseudomys* (Rodentia: Muridae) from Northern Territory. *Rec. West. Aust. Mus.* **12**: 207-221.
 Kitchener, D.J. and Humphreys, W.F. (1986). Description of a new species of *Pseudomys* (Rodentia: Muridae) from the Kimberley Region, Western Australia. *Rec. West. Aust. Mus.* **12**: 419-434.
 Mayr, E. (1969). *Principles of systematic zoology*. McGraw-Hill, New York.
 Ridgeway, R. (1912). *Color standards and color nomenclature*. (Ridgeway, Washington).
 Sneath, P.H.A. and Sokal, R.R. (1973). *Numerical taxonomy. The principles and practice of statistics in biological research*. 2nd edition. (W.H. Freeman and Company, San Francisco).
 Sokal, R.R. and Rohlf, F.J. (1981). *Biometry. The principles and practice of statistics in biological research*. 2nd edition. (W.H. Freeman and Company, San Francisco).
 Wood Jones, F. (1923). *The mammals of South Australia* Part I. The Monotremes and Carnivorous Marsupials (Govt. Printer, Adelaide).