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Editor’s note

It is great that Treubia volume 37 can be published in year 2010. Recently, it was difficult to get appropriate papers since animal taxonomy has not been an attractive subject in the field of biology. There was a lack of submitted manuscripts in 2009 that made Treubia could not be published in year 2009.

This volume of TREUBIA contains five papers of vertebrates and invertebrates. Three papers (nematode, rats and land snail) were from the results of field works in eastern part of Indonesia i.e. West Papua which was rarely explored.

Also, this year Indonesian zoologist’ community lost the pioneer and expert in parasite taxonomy, Dr. Sampurno Kadarsan. His name has been used to name new species of leeches, tick, rat, lizard and frog by his successors to acknowledge his impact and contribution. He served as an editor of Treubia from 1992 to 1997 and was a proof reader for some years until his permanent retarded eye sight. So, his death was a great lost for all of us especially for the Museum Zoologicum Bogoriense.

Finally, I would like to thank all of the co-editors, referees, computing assistant, secretary and administrative assistant for their collaborative work. I acknowledge financial support from the Director of Research Centre for Biology LIPI to publish this precious journal.

Cibinong, 15 December 2010

Dewi M. Prawiradilaga
Chief Editor

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MORPHOMETRIC VARIATION OF *RATTUS PRAETOR* (THOMAS, 1888) COMPLEX FROM PAPUA, WITH THE DESCRIPTION OF NEW SPECIES OF *RATTUS* FROM GAG ISLAND

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ABSTRACT

Thirty specimens of *Rattus* collected from Gag Island, Papua were compared directly with two specimens from Gebe Island, one from Salawati Island and six specimens from mainland of Papua. All cranial, dental, dentary and external characters were measured and analysed using multiple regression and discriminant function. The multiple regression showed that only incisive foramina length was influenced by sexual dimorphism. Discriminant function analysis indicated that the form from Gag island was different from the other populations collected from mainland of Papua, Gebe and Salawati, and thus was described as *Rattus nikenii* sp. nov.

INTRODUCTION

Genus *Rattus* has radiated into endemic species, one or more of which occurred virtually throughout this New Guinea large island (Taylor *et al.* 1982). According to Musser (1981) *Rattus* is an assemblage of great morphological diversity and geographically widespread and inadequately defined. Musser (1981) also stated that the rats from New Guinea may prove to be generically distinct from *Rattus*.

Flannery (1995) and Suyanto *et al.* (2002) recorded that New Guinea and its small adjacent islands had five extant species from genus *Rattus* namely

R. exulans, R. nitidus, R. tanezumi, R. argentiventer and *R. norvegicus* which were established in New Guinea as commensal species passed through by human or introduced by the indigenous people. The New Guinean Murinae of *R. nitidus* was only previously known from Vogelkop (Flannery 1995a) and *R. argentiventer* morphologically has close affinities to those populations collected from Java (Maryanto 2003).

The native species of rats from mainland of New Guinea were *R. giluwensis* Hill, 1960, *R. leucopus* (Gray, 1867), *R. mordax* (Thomas, 1904), *R. novaguineae* Taylor & Deusen, 1982, *R. praetor* (Thomas, 1888), *R. steini* Rummler, 1935, *R. sordidus* (Gould, 1858) and from western Pacific in Indonesia were *Rattus feliceus* Thomas, 1920, *R. jobiensis* Rummler, 1935, *R. leucopus* (Gray, 1867), *R. morotaiensis* Kellogg, 1945, *R. praetor* (Thomas, 1888) (Corbet & Hill, 1982; van Strien, 1986; Flannery, 1995a, 1995b; and Suyanto *et al.*, 2002). The mammary formula of *R. elaphinus, R. feliceus, R. jobiensis, R. leucopus, R. giluwensis, R. mordax, R. novaguinea,* and *R. praetor* are 2 + 2; *R. morotaiensis* (2 + 3); *R. sordidus* (3 + 3); *R. leucopus* (1 + 2); and *R. s. steini* (1 + 2).

R. praetor was described by Thomas (1888) from specimen collected from New Guinea and known as *Mus praetor.* The detailed description of *R. praetor* was made by Thomas (1889) from holotype and paratype specimens. Furthermore, Thomas (1916) and Tate (1936) examined and revised this rat as genus *Rattus*. *R. praetor* distributes in New Guinea and small adjacent islands located at the coast of northeastern New Guinea, precisely near the mouth of Sepik and Ramu rivers, through to northward of Bat island, New Britain and the Solomon islands, and until as far southeastern as Aola, Guadalcanal (type locality) (Taylor *et al.* 1982). *R. praetor* was found from lowland at sea level to 1900 m asl and also recorded from western part of New Guinea at Mamberamo, West Papua, Indonesia. This species was divided into two subspecies namely *R. p. praetor* which distributes in New Britain and Solomon islands and *R. p. coenorrum* which distributes in West Papua.

The exploration in Gag island (about 56 km^2) was conducted in July 1997 and August 2008. The survey resulted in collection of several specimens that morphologically similar to *R. praetor*. This island is characterized by ultrabasic rock type which geographically appears similar to ultrabasic Gebe Island, Maluku. This paper examines the hypothesis that there were significant variations between the collections of *Rattus* spp. with closest species of *R. praetor* complex from the same region in New Guinea. Detailed descriptions of the distinctive characters from these population resulted from morphological features that compared to the populations of *R. praetor* from the mainland of West Papua, Gebe and Salawati islands are presented.

MATERIALS AND METHODS

A total of 51 adult specimens of *R. praetor* and *Rattus* sp. deposited in the Museum Zoologicum Bogoriense (MZB), Indonesia were used in this study: 35 specimens from Gag island (21 males and 14 females) and 13 specimens from Papua island (8 males and 5 females), one male specimen (MZB 15277) from Gebe Island and a female (M 26353) from Gebe island (Maluku) and one female (M 29374) from Salawati island (West Papua) deposited at the Australian Museum, Sydney. The specimens examined were listed in the following Taxonomic Section and the locality was shown in Figure 1. Twenty four skull, dental and dentary characters and three body characters were used in this study. Details of the measurement points were provided in Taylor *et al.* (1982), except for three measurements. These were: palate length post of molar 3, which is the length of the palate projecting posterior to the posterior crown surface of the last upper molar: mesopterygoid fossa breadth, which is the maximum breadth of the mesopterygoid fossa; and zygomatic plate breadth, which is maximum breadth of zygomatic plate. The pelage descriptions were done by following the color terminology of Kornerup and Wanscher (1978) and are capitalized.

Statistical analysis was run in two steps, first multiple regression was run for the main effect of sex, age, location and their interactions; and secondly canonical discriminant function analysis (DFA) was run for all skull, dentary and dental characters with males and females combined using all characters that are not affected by sex. Because of only few external characters measured, the DFA for external characters were not considered in this study.

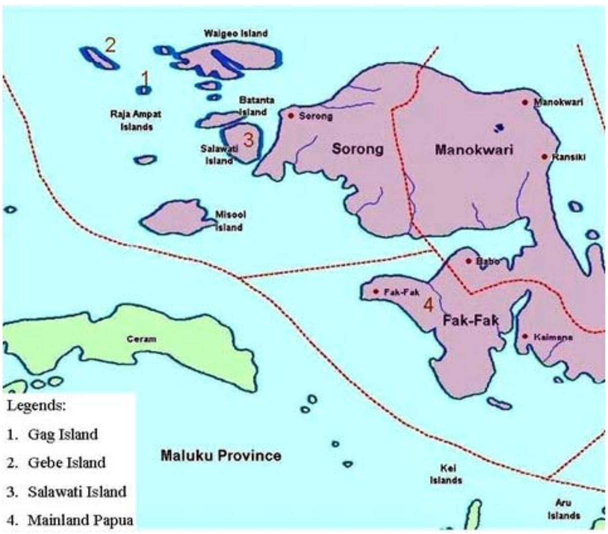

Figure 1. Locality of collected specimens

RESULTS

The measurements of skull, dental, dentary and external character are showed in Table 1. The results showed that six characters of males from Gag Island were shorter than that of the female. These are snout to vent length, upper molar$^{1-2}$ (crown), upper molar$^{1-3}$, incisive foramina width, interparietal breadth, and mesopterigoid fossa breadth. However, these measurements are not significant ($P>0.05$). Table 2 showed that the measurements of all characters indicated there are no sexual dimorphism within this population except for incisive foramina length ($P<0.05$). The results depicted that incisive foramina length in male are longer than in female.

Multiple regression analysis also showed that most characters are not significantly associated with sexes and locations. However, most character differed significantly between locations except for tail length, interorbital breadth, nasal breadth, incisive foramen width and zygomatic plate breadth ($P>0.05$).

As consequence of the above analyses, sexes were combined for subsequent discriminant analysis (DFA). Some characters that were affected by sexual dimorphism were excluded from the analysis (DFA). The DFA was carried out to analyze morphological distinctions between Gag Island group and mainland Papua group. The specimens from Gebe and Salawati Islands were not considered because of its small sample size (Gebe, n = 2 and Salawati, n = 1). The number of characters used on the discriminant analysis was reduced to five in order to minimize the effect of over fitting the data. These five characters were selected to minimize the value of Wilk's lambda. The reduced set of characters provided a similar cluster of islands (mainland Papua and Gag) in discriminant function space as did the full set of characters.

Table 1. Mean and standard deviation of external body, cranial, dentary and dental measurements (in mm) of adult *Rattus* sp. Indet. From Gag island, and *Rattus praetor coenorum* from Papua, Gebe and Salawati island. Details of the measurement points are provided in Taylor *et al*. (1982), except for three measurements. These were: palate length post. M^3, which is the length of the palate projecting posterior to the posterior crown surface of the last upper molar: mesopt. Fossa breadth, which is the maximum breadth of the mesopterygoid fossa; and zyg. Plate breadth, maximum breadth of zygomatic plate. The molar lengths refer to the upper teeth (M). *f*, females; and *m*, males. N, sample size. NA, not any

Population	Snout to vent length		Tail length		Hind foot length		Skull occipitonasal l.		Condylobasal length		Basal length		Zygomatic width	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Gag Island														
N	20	10	20	10	20	10	20	10	20	10	20	10	20	10
Mean	167.70	176.20	153.70	151.00	33.90	32.70	42.10	41.40	41.80	41.80	39.80	39.10	20.60	20.40
SD	12.26	45.17	10.75	11.46	1.40	0.86	1.18	1.59	1.22	1.22	1.14	1.34	0.58	0.73
Minimum	147.00	135.00	141.00	138.00	31.00	32.00	35.03	39.43	34.20	39.23	32.50	37.62	17.41	19.46
Maximum	182.00	300.00	165.00	165.00	36.50	34.50	44.05	43.87	43.70	43.09	41.45	41.33	21.51	21.67
Mainland of Papua														
N	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Mean	NA	NA	NA	NA	NA	NA	48.3	46.2	48	45.8	45.9	43.9	22.3	22.2
SD	NA	NA	NA	NA	NA	NA	1.85	1.32	2.03	1.22	1.95	1.27	3.11	0.82
Minimum	NA	NA	NA	NA	NA	NA	46.99	45.23	46.54	44.92	44.56	42.96	5.63	21.61
Maximum	NA	NA	NA	NA	NA	NA	53.5	52.96	53.42	52.33	52.37	50.09	26.34	25.30
Gebe Island														
N	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mean	206	319	NA	142	38	36.3	46.3	44.97	46	43.54	44.1	43.06	22.9	21.67
SD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Salawati Island														
N	1	NA	1	NA	1	NA	1	NA	1	NA	1	NA	1	NA
Mean	250	NA	133	NA	45.6	NA	49.13	NA	48.17	NA	47.3	NA	24.86	NA
SD														
New Guinea (Taylor *et al., 1982*)														
N	30		30		30		30		30		30		30	
Mean	187		146.1		37.5		43.3		41		38.2		20.9	
SD	15.09		14.41		21.7		2.88		26.9		26.4		1.63	

Table 1. Continued

Population	Snout to vent length		Tail length		Hind foot length		Skull occipitonasal l.		Condylobasal length		Basal length		Zygomatic width	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Gag Island														
N	20	10	20	10	20	10	20	10	20	10	20	10	20	10
Mean	167.70	176.20	153.70	151.00	33.90	32.70	42.10	41.40	41.80	41.80	39.80	39.10	20.60	20.40
SD	12.26	45.17	10.75	11.46	1.40	0.86	1.18	1.59	1.22	1.22	1.14	1.34	0.58	0.73
Minimum	147.00	135.00	141.00	138.00	31.00	32.00	35.03	39.43	34.20	39.23	32.50	37.62	17.41	19.46
Maximum	182.00	300.00	165.00	165.00	36.50	34.50	44.05	43.87	43.70	43.09	41.45	41.33	21.51	21.67
Mainland of Papua														
N	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Mean	NA	NA	NA	NA	NA	NA	48.3	46.2	48	45.8	45.9	43.9	22.3	22.2
SD	NA	NA	NA	NA	NA	NA	1.85	1.32	2.03	1.22	1.95	1.27	3.11	0.82
Minimum	NA	NA	NA	NA	NA	NA	46.99	45.23	46.54	44.92	44.56	42.96	5.63	21.61
Maximum	NA	NA	NA	NA	NA	NA	53.5	52.96	53.42	52.33	52.37	50.09	26.34	25.30
Gebe Island														
N	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mean	206	319	NA	142	38	36.3	46.3	44.97	46	43.54	44.1	43.06	22.9	21.67
SD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Salawati Island														
N	1	NA	1	NA	1	NA	1	NA	1	NA	1	NA	1	NA
Mean	250	NA	133	NA	45.6	NA	49.13	NA	48.17	NA	47.3	NA	24.86	NA
SD														
New Guinea (Taylor *et al., 1982*)														
N	30		30		30		30		30		30		30	
Mean	187		146.1		37.5		43.3		41		38.2		20.9	
SD	15.09		14.41		21.7		2.88		26.9		26.4		1.63	

Table 1. Continued

Population	Interorbital breadth		Interparietal length		Interparietal breadth		Braincase breadth		Mastoid width		Nasal length		Nasal breadth	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Gag Island														
N	20	10	20	10	20	10	20	10	20	10	20	10	20	10
Mean	6.90	6.90	6.20	5.90	11.30	11.50	16.90	16.80	16.00	16.00	15.60	15.00	5.40	5.20
SD	0.24	0.25	0.37	0.49	0.82	0.62	0.36	0.41	0.33	0.56	0.89	0.71	0.31	0.31
Minimum	5.98	6.59	5.17	5.59	9.81	10.76	15.71	16.22	14.26	15.35	12.11	14.14	4.50	4.90
Maximum	7.36	7.38	6.67	6.98	12.20	12.47	17.49	17.36	16.56	17.02	17.05	16.50	5.72	5.96
Mainland of Papua														
N	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Mean	6.6	6.6	6.9	7	12.9	11.9	18.2	17.3	18.2	16.8	16.5	16.5	5.5	5.3
SD	0.48	0.46	0.01	1.17	0.12	0.64	1.21	0.46	0.07	0.83	2.08	1.39	0.95	0.55
Minimum	6.78	6.32	6.57	6.17	11.64	11.47	18.74	17.04	18.17	16.17	17.00	16.59	5.91	5.24
Maximum	8.33	7.67	8.34	7.82	14.86	12.52	20.25	17.84	20.55	17.75	21.69	19.98	7.52	6.84
Gebe Island														
N	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mean	6.7	6.68	6.7	7.19	12.5	12.17	17.5	17.23	16.9	16.97	17.8	17.07	5.9	5.11
SD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Salawati Island														
N	1	NA	1	NA	1	NA	1	NA	1	NA	1	NA	1	NA
Mean	7.33	NA	7.6	NA	12.72	NA	19.24	NA	18.72	NA	19.19	NA	7.03	NA
SD														
New Guinea (Taylor *et al., 1982*)														
N	30		30		30		30		30		30		30	
Mean	6.2		5.5		10.9		16.5		14.6		16.2		4.9	
SD	0.33		0.42		0.78		0.57		0.76		1.21		0.51	

Table 1. Continued

Population	Palatal length		Incisive foramen length		Incisive foramen width		Inside M1- M1 breadth		Outside M1- M1 width		Bullae length		M1-3 length (crown)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Gag Island														
N	20	10	20	10	20	10	20	10	20	10	20	10	20	10
Mean	23.70	23.10	7.50	7.20	2.90	3.30	4.80	4.80	8.80	8.80	6.00	5.80	6.40	6.60
SD	1.01	1.12	0.35	0.32	0.21	1.49	0.33	0.42	0.28	0.37	0.24	0.23	0.39	0.28
Minimum	18.60	20.69	6.32	6.83	2.52	2.69	3.58	4.36	7.54	8.23	5.37	5.36	5.19	6.17
Maximum	24.78	24.68	8.15	7.65	3.17	7.53	5.54	5.60	9.33	9.50	6.35	5.98	6.91	7.03
Mainland of Papua														
N	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Mean	25.5	25	7.9	8	3.2	3	5.3	5.3	9.6	9.6	6.5	6.4	6.7	6.5
SD	3.36	1.66	0.96	0.53	0.53	0.09	0.86	0.54	1.23	0.44	0.85	0.21	0.49	0.15
Minimum	26.73	25.57	7.85	8.24	3.28	3.03	5.42	5.43	10.08	9.74	5.85	5.82	6.78	6.34
Maximum	29.99	28.50	10.11	9.32	4.40	3.47	6.62	5.90	11.92	10.37	7.64	6.59	8.42	8.12
Gebe Island														
N	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mean	25.9	24.27	8.8	7.09	3.5	NA	5.9	5.2	9.5	9.42	6.3	6.6	7.6	7.08
SD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Salawati Island														
N	1	NA	1	NA	1	NA	1	NA	1	NA	1	NA	1	NA
Mean	27.46	NA	7.45	NA	NA	NA	5.79	NA	9.5	NA	6.07	NA	7.11	NA
SD														
New Guinea (Taylor *et al., 1982*)														
N	30		30		30		30		30		30		30	
Mean	23.5		7.8		2.9		4.1		9.1		6.2		6.7	
SD	1.53		0.6		0.43		0.53		0.62		0.45		0.31	

Table 1. Continued

Population	M1-3 length (alveoli)		M1-2 length (crown)		Palate length post. M3		Mesopt. Fossa breadth		Zyg. Plate breadth		Weight	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Gag Island												
N	20	10	20	10	20	10	20	10	20	10	20	10
Mean	7.00	7.00	4.90	5.00	1.20	1.00	2.50	2.60	4.30	4.30	140.20	128.30
SD	0.24	0.25	0.26	0.21	0.26	0.22	0.26	0.23	0.24	0.37	19.70	19.90
Minimum	6.53	6.62	4.39	4.58	0.84	0.70	2.25	2.11	3.18	3.72	120.00	113.00
Maximum	7.36	7.26	6.79	5.39	1.48	1.32	2.82	3.03	4.77	5.04	151.00	175.00
Mainland of Papua												
N	3	3	3	3	3	3	3	3	3	3	3	3
Mean	7.7	7.7	5.1	5.4	1.6	1.6	3.2	3	4.5	4.8	NA	NA
SD	0.54	0.38	0.3	0.21	0.4	0.48	0.62	0.16	0.49	1.1	NA	NA
Minimum	7.52	6.20	5.19	5.23	1.86	1.57	3.34	2.68	4.53	4.77	NA	NA
Maximum	8.90	7.89	6.69	6.19	3.00	2.00	3.84	3.15	6.51	5.97	NA	NA
Gebe Island												
N	1	1	1	1	1	1	1	1	1	1	1	1
Mean	7.6	7.25	5.8	5.42	2.7	1.9	3	3.05	4.1	4.64	240	319
SD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Salawati Island												
N	1	NA	1	NA	1	NA	1	NA	1	NA	1	NA
Mean	8.01	NA	5.46	NA	2.45	NA	3.52	NA	5.25	NA	340	NA
SD												
New Guinea (Taylor *et al., 1982*)												
N	30		30		30		30		30		30	
Mean	7.4		5.5		NA		NA		NA		NA	
SD	0.32		0.28		NA		NA		NA		NA	

Table 2. Multiple regressions of *Rattus praetor* from Gag, Papua, Gebe and Salawati Islands by sex and location classes for skull characters. F. values are presented for main effects and their interactions. Significance level as follows: *) 0.05>P>0.01, **) 0.01>P>0.001 and *** P < 0.001

Measurement	**Sex**	**Location**	**Interaction (Sex, Location)**
Snout- vent length	0.599	24.020***	NA
Tail length	0.387	2.570	NA
Hind foot length	3.195	37.750***	NA
Skull occipitonasal l.	0.799	33.396***	0.788
Condylobasal length	1.863	32.004***	1.863
Basal length	0.733	40.420***	1.744
Zygomatic width	0.016	9.786***	0.183
Interorbital breadth	0.689	3.130	0.733
Interparietal length	2.078	8.654***	3.039
Interparietal breadth	0.468	5.060**	1.130
Braincase breadth	0.885	10.236***	2.300
Mastoid width	0.266	23.455***	5.996
Nasal length	0.001	9.886***	0.476
Nasal breadth	0.600	1.880	0.552
Palatal length	0.308	7.350**	0.046
Incisive foramen length	8.759*	8.812***	5.502
Incisive foramen width	0.104	0.143	0.613
Inside M1- M1 breadth	0.97	5.956**	0.105
Outside M1- M1 width	0.057	11.656***	0.064
Bullae length	0.443	9.886***	0.490
M1-3 length (crown)	0.003	3.989*	0.622
M1-3 length (alveoli)	0.24	17.486***	0.149
M1-2 length (crown	0.353	9.534***	0.907
Palate length post. M3	0.001	20.389***	0.833
Mesopt. Fossa breadth	0.017	15.032***	0.905
Zyg. Plate breadth	3.863	2.080	1.596
Weight	2.393	35.259***	

Table 3. Canonical variate function 1 coefficients of skull of *Rattus praetor* from Gag and Papua Islands. Standardized values followed by unstandardized values in brackets

	Function 1	
	standardized	**unstandardized**
Greatest skull length	1.67655	0.733951
Mesopterigoid fossa breadth	0.94207	3.52999
Mastoidth breadth	-0.86752	-1.04029
Nasal breadth	-0.44653	-0.93467
Palatal length post upper molar 3	0.28058	0.785006
(Constant)		-20.5593

Consequently results based on the reduced set characters are presented. However, only three characters, these are palate length post to upper molar 3, mesopterygoid fossa breadth, and interorbital breadth were coefficients most heavily loaded on function 1 (>0.5), these canonical variate function coefficients values presumed to be the most important discriminant between two main groups.

The dendrogram plot between frequency and number of discriminant function showed that the five skull, dental and dentary selected characters can explain separation between mainland Papua and Gag Island populations (Figure 2). Results based on skull characters indicated 100% individuals were correctly classified in two populations. Furthermore, based on cranial, dental and dentary characters, the Gebe and Salawati specimens seem to be closely related to the mainland Papua population (Figure 2). These groupings also supported by univariate plot between mesopterygoid fossa breadth and interorbital breadth (Figure 3).

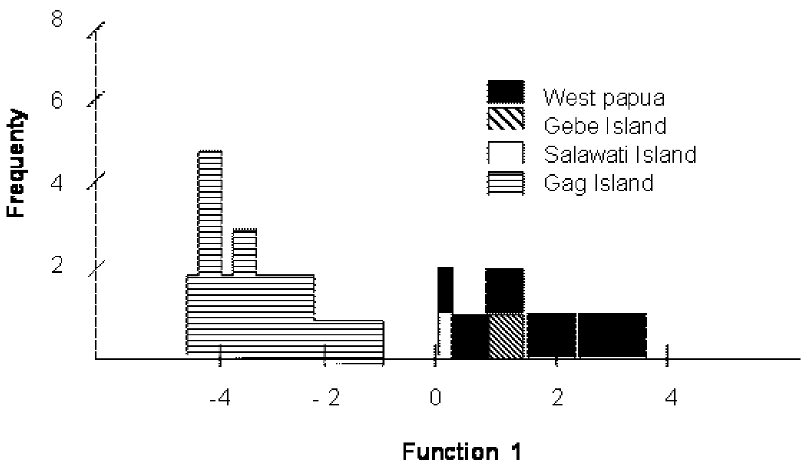

Figure 2. The dendrogram of the function 1 from canonical discriminant function of adult *Rattus praetor* based on five skull characters (see Table 3)

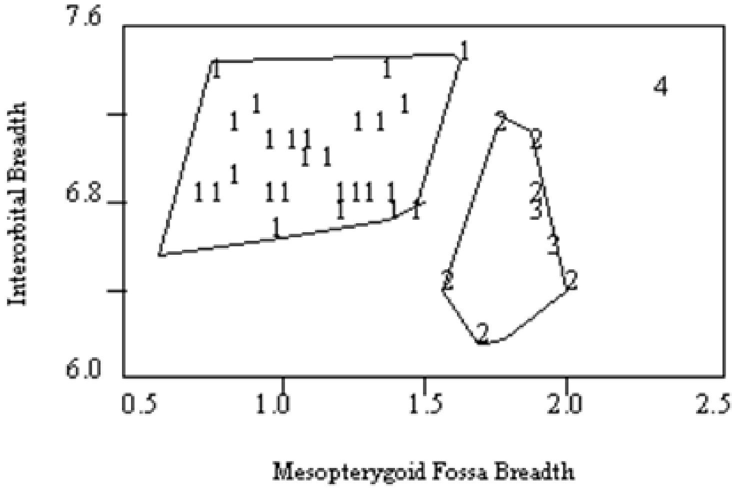

Figure 3. Plot of Interorbital breadth and mesopterigoid fossa breadth of *Rattus praetor* from Gag. I. (1), Papua (2), Gebe I.(3) and Salawati I. (4)

Taxonomy

Rattus nikenii sp. nov. (Figure 4, 5, and Table 1)

Holotype: Museum Zoologicum Bogoriense (MZB), Bogor Indonesia. No. 17921; adult male, skull separated, carcass fixed in formalin 10% and preserved in 75% ethanol; weight 140 gr; collected by I. Maryanto and MH Sinaga in August 2008.

Type locality: Gag Island, West Papua, Indonesia.

Paratype: Listed in specimens examined section.

Etymology: The new species is named after the first name of Niken Tunjung Murti Pratiwi, who is the wife of the first author to recognizing her understanding during this study and expedition.

Diagnosis: Compared directly with Taylor *et. al.* (1982), *Rattus nikenii* sp. nov is distinct from *R.p. praetor* and *R.p. coenorum* by having generally shorter snout vent length and hind foot than *R.p. praetor* and *R.p. coenorum*, while the tail length moderately clustered between *R. p. praetor* and *R. p. coenorum* (Figure 4). Skull occipitonasal length, zygomatic width are short, moreover the interorbital width and nasal width wider than *R. praetor* (Figure 5). The distinct dental characters of *R. nikenii* sp. nov are medium size and rounded, upper molar row are not parallel, medium size between species examined. Cusp of t^1 on M^1 and M^2 not very clear. Cusp t^1 seems separated from t^2 and t^7 in M^2, and not exist in M^3. Cusp t^8 on M^2 seems stocky and large which fusion between t^8 and t^9. Those characters showed different from *R. praetor* that characterized by the size of large and tough molars. Each cusp clearly defined in all molars. Cusp t^7 on M^1 and M^2 larger than M^3. The posterior cingulum not exist on all molars (Figure 6).

The majority (99%) mammary formula of *Rattus nikenii* sp. nov is 2 + 2 = 8 which distinct from *R. steini* with majority mammary formula 1 + 2 = 6. The measurements of skull and external characters indicated a close relationship to *R. steini*. It can be distinguished by relatively soft furred on ventral surface and sharp demarcation along the flank between ventral and dorsal pelage. The colour of *R. steini* is gray hue, which may be interrupted by white ventral markings; the lateral body pelage blends into this ventral gray, without any sharp demarcation and majority distributed at mid mountain (Flannery 1995).

Furthermore, the tail scales are 8-9 per cm which distinct from *R. s. steini* (10 per cm). The hind foot of this new species moderately long and mostly similar to other cranial measurements except for: braincase breadth; incisive foramen length and breadth; and bulla length and lengths of M^{1-3} and M^{1-2}, which relatively smaller than the measurements of the skull length (Figure 5b).

R. nikenii sp. nov. can be distinguished from *R. leucopus* by a non white tail tip or conspicuous mottling along the tail. It is also distinguished by the mammary formula of this new species (2 + 2 = 8 with 1 + 2 = 6 in *R. leucopus*). It differsent from *R. novaeguineae* by large, long tail and long foot. It is different from *R. mordax* that is only known from eastern Papua by small interparietal width and length (Taylor *et al.,* 1982).

Figure 4. Dorsal views of external characters from *Rattus nikenii* sp. nov (MZB 17921); *Rattus praetor coenorrum* (MZB 414 and MZB 421)

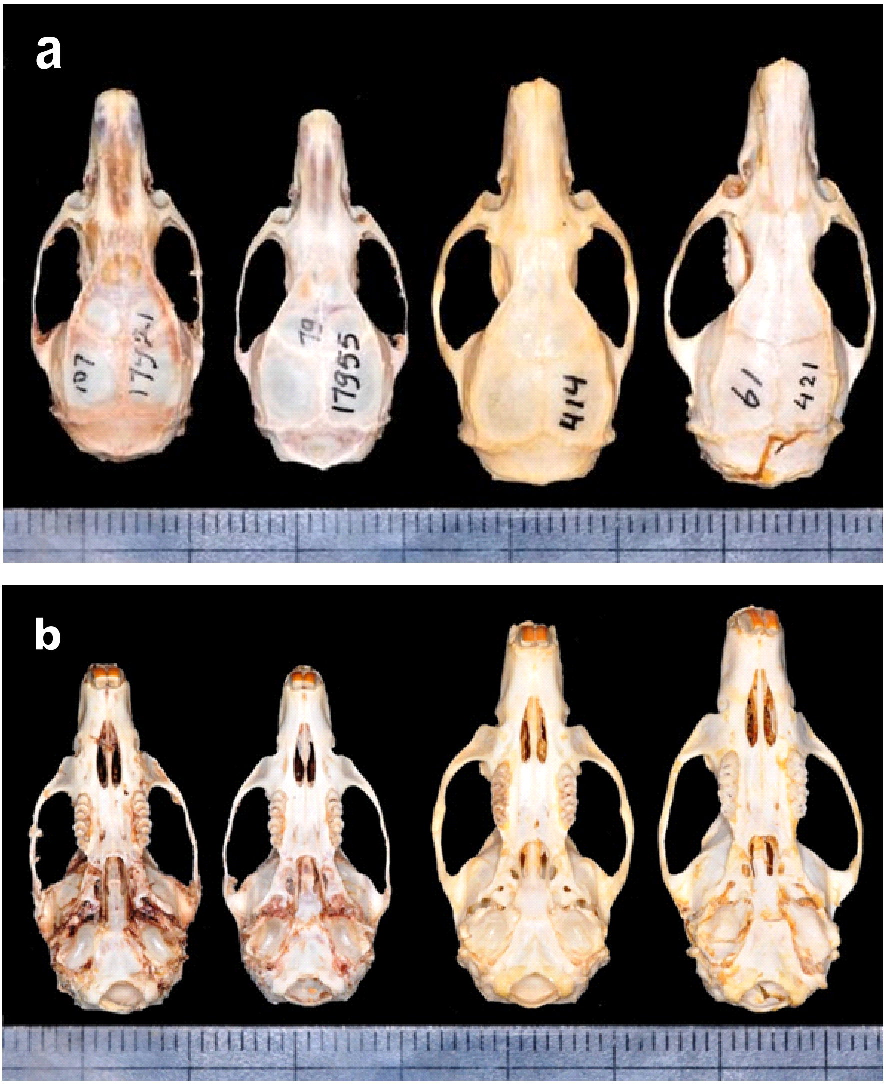

Figure 5. Dorsal (a) and ventral (b) views of skull specimens of *R. nikenii* sp. nov (MZB 17921, Holotype and MZB 17955, Paratype); and *R. praetor coenorrum* (MZB 414 and MZB 421)

Figure 6. Ventral view of upper molar specimens of *R. nikenii* sp. nov (MZB 17921, Holotype and MZB 17955, Paratype); and *R. praetor coenorrum* (MZB 414 and MZB 421)

Description: The morphology of this new species is consistent in most aspect with *R. praetor* as described by Thomas (1888). Dorsal profile of cranium oval, post orbital and temporal ridges interorbital breadth slightly broader, rostrum short, zygomatic moderately width, interparietal short and broad anteroposteriorly. Interorbital region wide, parietal ridge more curved than *R. praetor*, infraorbital fissue slightly narrow. Zygomatic plate wider compared with *R. praetor*. Incisive foramina moderately long, broader posteriorly and anteriorly to moderately sharp open, posteriorly project to point join in front a line joining the M^1-M^1 anterior face; mesopterygoid fossae broadening confidently, bullae uninflated; posterior palatum narrow extend beyond M^3, distance between the edge of posterior palatum and M^3 narrow, cranium moderately inflated in pterygoid region gently sloping to rostrum, which slopes slightly more actually in the anterior front; zygomatic plate moderately wide, supra occipitales somewhat square in the dorsal in lateral pants, incisors slightly opisthodont, molar row short, molar robust and broad. Palate broad between molar rows, molar rows diverging slightly posteriorly, mandible robust, ascending angular process slender and low, distance between point of coronoid process and condyloid process narrow. Incisor narrow and of orange coloured enamel

Pelage Coloration:

The Gag island rat has the following pelage coloration on the ventral surface recorded in the field before immersion in formalin: chin-white to base; throat-rufous merging to tawny; chest-brown to patchy light brown; abdomen-cream; and scrotal area- pale brown mixed with cream. These ventral colors sharply contrast along the flank with the light brown and ashy gray dorsum.

Distribution: Gag island, West Papua, Indonesia

Rattus praetor praetor (Thomas, 1988)

Mus praetor Thomas 1888: 158

Epimys praetor Thomas 1910: 605

Rattus praetor Thomas 1916: 240

Rattus rattus praetor Taylor *et al* 1982: 489

Type locality: Type locality fixed as Aola, Guadalcanal, Solomon Islands 150 m above sea level by C.M. Woodford, collected at unknown date.

Type: Skin in alcohol and intact skull, adult female, BM 88.1.5.39.

Diagnosis: *Rattus praetor praetor* differs from *R. nikenii* as described in the earlier diagnosis of this new species.

Description: The original description of *R. praetor* by Thomas (1888,1889), palatine foramina long, rather longer than the molar series, ending behind just on a level with the front M^1. Bullae low and small comparatively rough and opaque, teeth as usual molars rather broad and rounded. Incisive foramina bowed and rostral area relatively heavy. Supraorbital edges of skull finely ridges, the ridges prolonged backwards to the outers corners of the interparietal, short fur, mixed and with numerous spines and with a few much longer piles on the posterior back. Mammary formula is 2 + 2 = 8.

Color: The original color described by Thomas (1889) General color coarsely grizzled gray, the longer piles and the spines black tipped, the ordinary fur with yellow tips; the bases of all pale slatty gray. Underside dirty white, in old specimens yellow, the hairs all gray at base. Ears rounded, rather short, laid forward they just reach to the posterior canthus of the eye. Hands and feet grayish white, a darker patch on the terminal part of the metatarsus. Hind foot rather short in proportion to the size of the animal.

Rattus praetor coenorrum Thomas, 1922

Rattus coenorrum Thomas 1922:263

Stenomys leucopus coenorrum Rumler 1938: 188

Rattus praetor coenorrum Taylor *et. al.* 1982:220

Type locality: Type locality fixed as Pionier-bivak, Mamberamo river Papua Province, Indonesia.

Type: British Museum Natural History (BMNH) base on W.C. van Heurn, 18 December 1920; complete skin and skull, male sub adult, BM 22.2.2.19

Diagnosis: *Rattus praetor coenorum* differs from *R. nikenii* sp. nov as described in the earlier diagnosis of this new species.

Description: The complete descriptions are provided by Taylor (1982). The large skull has prominent supraorbital-temporal and supraoccipital ridging on large specimens that rises to 1.5 mm. The rostral region is heavy and the nasal bones flare terminally but do not overhang appreciably. The incisive foramina are well bowed. The palate terminates about 0.5-1.5 mm. posterior to the molar row. The bullae and the molars are small relative to skull size.

Color:

Overall dorsal color is dark brown with a grizzled tip of the spines hair is buff or cinnamon. The ears are medium brown with sparsely haired, The pelage of ventral coloration is yellowish ivory with gray background.

Specimens examined

Rattus nikenii sp nov.

Gag Island: Male, MZB 17902, 17906, 17909, 17910, 17911, 17913, 17917, 17918, 17919, 17920, 17921, 17944, 17947, 17948, 17955, 17999, 17962, 17963 , 31269, 31390, 31399 Female, MZB 17903, 17904, 17905, 17916, 17930, 17946, 17950, 17954, 17958, 17960, 31270, 31393, 31395, 31397

Rattus praetor

Papua, Male, MZB 414, 421, 424, 30171, 30176, 30178, 30183, 30186,. Female MZB 415, 425, 5807, 29947, 30181.

Gebe Island: Male, MZB 15277, Female, Australian Museum M 26353

Salawati Island: Female, Australian Museum M 29374

DISCUSSION

The Gag Island rat of *Rattus nikenii* sp. nov is different in cranial, dental and external traits from *Rattus praetor coenorrum* collected from Gebe Island and Papua, and is also different in coloration and teat formula number from *R.s. steini* collected from West Papua.

Taylor *et al* (1982) reported that *Rattus praetor* in New Guinea and Papua were sympatric with *Rattus tanezumi* and *Rattus exulans*. We caught this species using life trap from the coastal area to the top of hill (± 150 m a.s.l) in Gag island. At the coastal area this species was sympatric with *Rattus tanezumi,* and also in the central basin or molengraaff basin. Consequently, this species could also be an introduced species because of human mining activity. However, in the bush and forest it was sympatric with *Rattus exulans* especially at the coconut plantation area. Recently the adult male of Gag island rat collected has a body weight larger than 100 gr, which is above the normal weight range for adult size. Maryanto and Kitchener (1999) noted that below 80 gr of weight was considered as juvenile, in between 80-100 gr of weight range followed by scrotal testes was adult. This confirms that the body weight larger than 100 gr with scrotal testes was adult male. For female, a body weight above 96 gr was adult and below 55 gr was juvenile.

The statistical analysis was carried out in order to avoid over fitting the data, the problem inherent in analyzing large sets of characters in DFA, by reducing the large data sets into subsets of five characters. These are greatest skull length, mesopterigoid fossa breadth, mastoidth breadth, nasal breadth, palatal length post upper molar 3 were selected to minimize the value of Wilks' lambda (Table 2). The results showed that these skull characters provided similar clusters for all of *Rattus nikenii* sp. nov and *Rattus praetor*. All five characters are important in the discriminant function with coefficient values loaded heavily (> 0.5) on Function 1, and follow in function 1 which separated between *Rattus nikenii* sp. nov and *R. praetor* based on loading factors of more than 0.5 namely greatest skull length, mesopterigoid fossa breadth, mastoidth breadth.

The Discriminant Function Analysis or DFA was carried out to distinguish the morphology of *Rattus praetor* and *Rattus nikenii* sp. nov. Univariate statistics also support the distinction between *Rattus praetor* and *Rattus nikenii* sp. nov based on characters of mesopterigoid fossa breadth and interorbital breadth (Figure 2) and indicated *Rattus nikenii* sp. nov is relatively smaller than *Rattus praetor*. *Rattus nikenii* sp. nov is more restricted to ultrabasic area.

The species of *R. praetor* distributes in mainland New Guinea, Waigeo, Salawati of Raja Ampat Islands, Gebe and Halmahera Islands. Geologically, those area have wide spread ultrabasic areas. On the ultrabasic substrates, the valley forests were clearly the most important areas for the community of specific rat. So far, this new species was only recorded from ultrabasic area in Gag island. This island was part of ultrabasic areas that spread out from Waigeo, Gag, Gebe and Halmahera. So, it is possible that new species also occur on these islands.

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We are indebted to Toni Gultom, Dansesa Rinding, The environment coordinator of Gag BHPBilliton. We also gratefully acknowledge the support survey to BITA URS for facility field contract survey in 2008. Thanks are extended to our assistant Harun from MZB-LIPI Bogor and Naim, Paul, and Pauli for preparing traps of rats. Finally, we are indebted to Dr. D.J. Kitchener from USAID Medan and Dr. Christopher Helgen from Smitsonian Museum for their constructive comments on ealier version of this paper.

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OBITUARY

Dr. Sampurno Kadarsan

Late Dr. Sampurno Kadarsan passed away in Bandung on 17 September 2010 at the age of 81 years old. He was survived by his wife and four married daughters. He was born in Surabaya on 11 August 1929. However, he lived in Bogor for much of his time.

Education

He entered Diploma in biology in 1955 under the Ministry of Agriculture. Then, he joined the University of California, Berkeley – USA and achieved BSc. degree in Entomology & Parasitology in 1959. Upon returning to Indonesia, he undertook further study at Bandung Institute of Technology (ITB) and achieved his first degree in biology in 1964. Then, he got an opportunity to enter the University of Maryland, College Park, USA for postgraduate study and achieved his PhD degree in 1971.

Working Career

He started working in the division of Marine Fishery (*Djawatan Perikanan Laut*) in Jakarta. Then, he moved to the division of Nature Research (*Djawatan Penyelidikan Alam*) in Bogor as an assistant in biology. In 1960 he became the director of Museum Zoologicum Bogoriense, under the Centre for Nature Research Institute (*Lembaga Pusat Penyelidikan Alam*). In 1977 he became a senior professor at the Fakulti Perubatan, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia. He became a senior scientist at the National Biological Institute-Indonesian Institute of Sciences (LIPI) in 1981. In 1986 he was the Director of the Research & Development Centre for Biology and Head of the Indonesian Botanic Gardens, LIPI. He achieved Principle Scientist in 1990. Since 1993 he obtained professorship in parasitology at the Faculty of Veteriner – Bogor Agriculture University. He was the editor of journal of Treubia from 1992 to 1997, and remained as a proof reader until 2007.

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