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TIKUS PURBAKALA: A GUIDE FOR ZOOARCHAEOLOGISTS ON THE IDENTIFICATION OF RATS FROM BORNEO CAVE EXCAVATIONS BY DENTAL CHARACTERS

Earl of Cranbrook and Philip J. Piper

INTRODUCTION

The existing mammal fauna of Borneo includes 26 named species of the rodent family Muridae, subfamily Murinae (Emmons 1993; Payne & Francis, 2005; Maryanto & Sinaga, 2008; Achmadi *et al.*, 2012). Of these, 19 middle-sized to large species belong to genera formerly grouped within the single genus *Rattus* by regional systematists including Chasen (1940), and Ellerman & Morrison-Scott (1951). Now divided among six genera, *Lenothrix*, *Leopoldamys*, *Sundamys*, *Maxomys*, *Rattus* and *Niviventer* (Wilson & Reeder, 2005), these species (Table 1) are collectively regarded as 'rats' for present purposes: tikus in Bahasa Malaysia.

Huge numbers of whole and fragmentary animal bones and teeth have been recovered in archaeological investigations of Borneo caves by the Sarawak Museum, notably the famous excavations at Niah (Harrisson, 1958, 1959; Barker *et al.*, 2007; Piper & Rabbet, 2013). These assemblages of animal remains are mainly the result of two non-exclusive processes of accumulation: (1) the natural deposition of carcasses of bats, rats, swiftlets and other cave roosting species that emerge to find resources to support their existence (termed 'trogloxenes'), or the remains of visiting individuals of species that inhabit the surroundings but also enter caves to exploit the resources of this environment ('troglophiles'); and (2) human activity, depositing in the cave mouth whole or parts of animal remains originally brought there as food, for tool manufacture and use, or other purposes. The second process produces material of prime interest to anthropologists and prehistorians but, for the biologist and palaeoecologist, the occurrence of troglaphiles among animal remains provides valuable information on the contemporary environment outside the cave.

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The present work has been developed in preparation for the authors' study of the rat remains from excavations by the Sarawak Museum at the Niah caves, which have yielded over 40 jaws with teeth. At other sites investigated by the Sarawak Museum, such as Sireh cave, the presence of broken incisors in the excavated area provided confirmation of the occurrence of rats throughout the archaeological deposit, although no identifiable items were found (Cranbrook, 2012). Among the animal remains from caves at Jambusan, Sarawak, excavated by A.H. Everett in 1878-79, Cranbrook (2013) found teeth of rats, so far unidentified. Re-excavating Gua Tupak, one of the caves investigated by Everett, Gani *et al.* (2013) noted rats among mammalian

remains that were not identified. The frequent occurrence of rat remains has therefore confirmed that these rodents are among habitual troglaphiles, to be expected in archaeological deposits in cave sites in Borneo.

These rats comprise an ecologically diverse group of small mammals, shown by their present ecology to be sensitive to environmental factors such as the nature and extent of forest cover, and to other ambient features reflecting altitude. If confidently identified, the species of rats in archaeological contexts therefore become potentially valuable members of the troglaphile community to provide palaeo-ecological information. The identification of post-cranial bones of Bornean rats in archaeology is challenging and at present has not been attempted. However, as shown below, dental remains can provide undisputed confirmation of identity at genus level and, in some cases, strong evidence at species level.

Although molecular phylogenetics have become a tool in the systematics of regional Murinae (Md Tamrin & Abdullah, 2011), traditional taxonomists have defined the genera of Borneo rats mainly on morphological characteristics such as body size, pelage and integument coloration and, especially, on anatomical features of the skull with the teeth of the upper molar row borne on the maxillary bone. Unfortunately, whole skulls of rats are rarely recovered undamaged in archaeological contexts. At the best, partial skull fragments of the maxillary region have been found, some bearing teeth of the upper molar row. More frequent are detached lower jaws (mandibles), often fragmentary but retaining some or all teeth in place. For practical purposes, therefore, while dependable features for identification of archaeological specimens can be found in diagnostic characters of the molars of the upper (maxillary) toothrow, it is the less-studied lower (mandibular) molar rows that must often be relied upon by the zooarchaeologist.

It is therefore the aim of this *Guide* to provide the means to identify the remains of rats from archaeological excavations in Borneo by the molar teeth only, with special emphasis on those of the lower jaw. In addition to the instances cited above, it can be predicted that there will be further discoveries of the remains of rats from Borneo archaeological cave sites. As modern procedures for excavation and recovery are applied, there will be opportunities for extended work on identification, and new interpretations to be made.

ACKNOWLEDGEMENTS

The Natural History Museum, London, (BMNH) provided comparative material used in this study from recent populations of rats inhabiting Borneo. We gratefully thank all staff of the Mammal Section for access to the collections in their charge. BMNH retains copyright of all photographs of specimens in the collections. Many thanks also to Dr. Larry Heaney of the Field Museum of Natural History, Chicago for providing modern comparative measurements of rat taxa from Borneo. Research by P.J.P. was funded by ARC Discovery grant DP14103650. All figures were prepared by P.J.P. from original scale photographic images of identified rat maxillary or mandibular dentition using Adobe Illustrator CS5. The tooth outline was first traced and then the pattern of the occlusal surfaces of each molar was illustrated. Where the enamel surface of the specimen had worn through, the exposed dentine was shaded black. Thus the stage of tooth wear in the figure corresponds to the wear observed in the original specimen (Figure 1).



Figure 1. Photograph of the occlusal aspect of an archaeological specimen, identified as a worn lower molar row of Müller's rat *Sundamys muelleri*, with the corresponding scale figure prepared by P.J. Piper. Areas of exposed dentine are coloured black and enamel is white.

Table 1. Named species of Borneo 'rats', as defined in the text: Head and body lengths (H&B), weights, length of upper molar row, and distribution within Borneo and Habits/Habitats from Payne *et al.* (2005), or alternative sources as noted.

<i>Genus</i>	<i>Species</i>	<i>H&B length (mm)</i>	<i>Weight (g)</i>	<i>Upper molar row (mm)</i>
<i>Lenothrix</i>	<i>canus</i>	165-220	80-220	8.2-8.6
<i>Leopoldamys</i>	<i>sabanus</i>	215-273	250-532	9.1-10.0
	<i>diwangkarai</i>	197-255	189-190	8.5-9.3
<i>Maxomys</i>	<i>alticola</i>	139-176	n/a	5.4-6.1
	<i>baeodon</i>	126-140	n/a	4.1-5.0
	<i>ochraceiventer</i>	140-171	n/a	5.4-6.0
	<i>rajah</i>	139-218	95-218	6.9-8.1
	<i>surifer</i>	160-202	n/a	5.8-6.8
	<i>whiteheadi</i>	91-111	30-83	5.1-6.2
	<i>tajuddinii</i>	95-122	50-70	5.2-6.4
<i>Niviventer</i>	<i>cremoriventer</i>	106-160	53-100	5.6-6.6
	<i>rapit</i>	122-163	n/a	5.8-6.1
<i>Rattus</i>	<i>argentiventer</i>	140-210	85-180	6.8-7.5
	<i>baluensis</i>	150-188	80-135	6.5-7.0
	<i>exulans</i>	101-138	45-65	4.7-5.6
	<i>norvegicus</i>	163-265	50-400	7.0-7.4
	<i>tanezumi</i>	122-219	100-200	6.2-7.0
	<i>tiomanicus</i>	140-188	78-125	6.0-6.8
<i>Sundamys</i>	<i>infraluteus</i>	226-295	237-600	10.6-11.6
	<i>muelleri</i>	179-244	160-305	8.2-10.0

Notes

1. Measurements of all species from Payne *et al.* (2005) or other sources, as indicated.
2. Distribution and habitats from Wilson and Reeder (2005).
3. Measurements of *Leopoldamys diwangkarai* from Maryanto & Sinaga (2008). The species was described from three specimens, two from Borneo: the type from Pemantang Murawai, Central Kalimantan, and a paratype from Bukit Baka, West Kalimantan.

<i>Distribution</i>	<i>Habits/Habitat</i>	<i>Notes</i>
Sarawak, Sabah, Kalbar	Arboreal. Lowland forests, to 550 m on Kinabalu	1, 2
Throughout	Scansorial. Lowland and montane forest, up to 3100 m on Kinabalu.	
Two specimens, West & Central Kalimantan	Lowland forest	3
Kinabalu and Trus Madi, Sabah	Montane forest; 1070 - 3360 m on Kinabalu	4
Rare; in Sarawak and Sabah	Lowland forests; to 1400 m on Kinabalu	4
Sabah	Lowland & submontane forests, to 1700 m on Kinabalu	4
Throughout	Strictly terrestrial Lowland forests, including second growth.	4
Throughout, including many islands	Terrestrial. Lowland and submontane forests, to 1680 m on Kinabalu	4
Throughout, including larger islands	Terrestrial. Lowland forest, to 2100 m on Kinabalu	5
Uncertain	Peatswamp forest	5
Throughout, and north Borneo islands	Scansorial. Lowland and submontane forest, up to 1530 m on Kinabalu	
Uplands of Borneo	Montane forests, Taken at 940 – 3360 m on Kinabalu	
Scattered localities, perhaps under-collected	Ricefields, grassland and and plantations; lowlands, to 1646 m on Kinabalu	6
Kinabalu only	Kinabalu only, above 1524 m to summit	
Throughout	Semi-commensal, entering rural houses, and in ricefields, plantations and secondary forest, up to 1650 m on Kinabalu.	
Some Borneo ports and adjoining land	Towns, plus records from ricefields in western Sabah	
Poorly recorded, but probably throughout	Commensal with people. Houses, gardens, crops and rice-field to the edge of secondary forests.	7
Throughout	Secondary forests and disturbed habitats	
Uplands of northwest Borneo	Disturbed and primary forests, uplands from 700 m, to 2930 m on Kinabalu	8
Throughout	Lowland forests, up to 1650 m on Kinabalu	

4. Distribution from Achmadi (2010).
5. Measurements from Achmadi *et al.* (2012).
6. Upper molar measurements from Maryanto (2003), n = 17 specimens from Kalimantan.
7. n = 42 Synonym of *Rattus rattus diardii* in Payne *et al.* (1885). Habitat from Pagès *et al.* (2010).
8. For new distribution records, extending the range reported by Payne *et al.* (1985), see Cranbrook *et al.* (2014).