
Short Communication

Notes on Field Survey and New Distributional Record of Small Mammals in Mount Murud, Sarawak, Malaysia**Sigit WIANTORO^{1,2}, Eileen LIT¹, Mohd Fizl SIDQ¹, Nor SALMIZAR¹, Isa SAIT¹ and M.T. ABDULLAH¹**¹*Department of Zoology, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia*²*Museum Zoologicum Bogoriense, Research Center for Biology, Indonesian Institute of Sciences, Widyasatwaloka Building, Jl. Raya Jakarta-Bogor Km. 46, Cibinong, Indonesia 16911*

ABSTRACT. Mount Murud is the highest mountain in Sarawak. It has high diversity and endemism of flora and fauna. Small mammal survey in Mount Murud was conducted in October 2008 using mist nets and live traps. A total of 17 individuals of small mammal comprising five species of Chiroptera, one species of Insectivora and one species of Scandentia were recorded. *Pipistrellus javanicus* (Chiroptera: Vespertilionidae) and *Hylomys suillus* (Insectivora: Erinaceidae) are new records for Mount Murud.

INTRODUCTION

Mount Murud is the highest mountain in Sarawak with the elevation of about 2,650 m asl. It is located close to the Indonesian border in northern Sarawak. A small area from Mount Murud is part of Pulong Tau National Park based on the initial proclamation Notification No. 2174, 1998 by the National Park and Wildlife Office Sarawak (Anon., 1998).

Cultivated land, secondary forest, upper mixed dipterocarp forest, Oak-Laural forest, Mossy

Elfin forest and summit heath are the types of vegetation that can be found from Ba' Kelalan (last village on the foothill of Mount Murud) on the way to the summit of Mount Murud (Anon., 1998). Mountain environment is ecologically specialised habitat that lead to endemism of species adapted to the area. Previous studies have shown that Mount Murud has high diversity and endemism of flora and fauna. A pitcher plant, *Nepenthes murudensis*, is only found in Mount Murud (Anon., 1998). Fire-lipped kellback (snake), *Rhabdophis murudensis*, is montane species first described from Mount Murud by Smith in 1925 (Stuebing, 2002). According to Wilson & Reeder (2005) Mount Murud is the type locality of *Mydaus javanensis montanus* Moulton, 1921 (synonym of *M. j. lucifer*). Recently, Das (2005) described a new species of amphibian, *Polypedates chlorophthalmus* from Mount Murud. Thus, this mountain provides a potential site for more scientific discoveries.

Tuen *et al.* (2003) had recorded 14 species of small mammals from three sampling sites in Mount Murud at Raven's Court, Pa Rabata and Church Camp. Two years later, another small mammal survey was conducted by Faisal *et al.* (2005) at two sampling sites in Mount Murud

Keywords: small mammal, Mount Murud, distributional record

at Merarap Camp and Raven's Court. Ten species of small mammals were recorded and six of them are new records for this mountain. Thus, there is a possibility to have additional new records of small mammals in Mount Murud through follow up systematic survey.

There were only a few small mammal research or expeditions conducted in the rugged Mount Murud. In 1998, Malaysian Nature Society conducted an expedition covering the area between Batu Lawi and Mount Murud. Between 2003 - 2005 several smaller surveys were organized by the Institute of Biodiversity and Environmental Conservation of UNIMAS. However, many of the interesting sites in Mount Murud have never been studied, since some areas are inaccessible due to its rugged topography.

The present survey was conducted on 27th to 31st October 2008 at three sites in Mount Murud.

The objective of this survey was to collect samples of small mammal, especially bats and rodents. The data from this survey were compared with those of previous surveys to determine the latest condition of the diversity of small mammal and their habitat in Mount Murud.

MATERIALS AND METHODS

Study area

The sampling site consists of Ba' Kelalan, Lapo Bunga Camp and Church Camp (Figure 1). Ba' Kelalan (N 03° 58.338' E 115° 36.779') has the elevation of about 945 m asl. Sampling was conducted in an orchard that was dominated by apple trees. The second site was Lapo Bunga Camp (N 03° 56.572' E 115° 32.496') at 1,731 m asl. This site is part of the protected forest in Mount Murud which is covered by mixed dipterocarp forest. The Church Camp was the



Figure 1. Map showing the study area (modified from www.googlemap.com and ITTO project).

targeted site for this survey with the elevation of 2,113 masl and located in N 03° 55.645' E 115° 30.676'. Mossy Elfin forest can be found in this site. This forest is shorter in stature (<10 m) and appears much less diverse with mainly *Eugenia* (Euphorbiaceae) and *Rhododendron* (Ericaceae). The ground, as well as many branches and trunks, were completely covered in mosses, liverworts and lichens (Anon., 1998).

Sampling methods

Three standard mist nets (two ply polyester 75d) with 31 mm mesh size (9 m in length; 2.7 m high) with three shelves were deployed in Ba' Kelalan and Lapo Bunga for one night. On the other hand, 20 mist nets were deployed at Church Camp for three nights. Mist nets were set along the forest trail, transition area between forest and open area and across stream. All nets were opened from 1730 hours until 0600 hours in the next morning.

Fifty live traps consisting of Sherman trap and Lim collapsible cage trap were deployed at Church Camp for three days to trap non-volant small mammals. Banana and pineapple were used as bait. All traps were checked on 0600 hours and 1700 hours daily.

Captured small mammals were measured (weight, head and body length, tail length, forearm length for bats, ear length, tibia length, hind foot length), their sex determined and identified to species level using descriptions by Payne *et al.* (1985) and Corbet & Hill (1992). Identified specimens were then killed using chloroform. Muscle and liver tissue samples were collected and preserved in ethanol 95% and lysis buffer. Blood samples were also collected using filter paper. Voucher specimens were preserved in ethanol 95% and then deposited in the Zoological Museum, Department of Zoology, Faculty of Resource Science and Technology, UNIMAS.

RESULTS AND DISCUSSION

A total of 17 individuals of small mammal were recorded in this survey (Table 1). Twelve bats, comprising of five species were caught during 66 net-night trapping at Ba' Kelalan, Lapo Bunga and Church Camp. Four individuals of Mountain Treeshrew (*Tupaia montana*) and a Lesser Gymnure (*Hylomys suillus*) were trapped during three nights sampling at Church Camp. Javan pipistrelle bat (*Pipistrellus javanicus*) and *H. suillus* were not recorded by two previous studies in Mount Murud.

Twenty species comprising of seven families were recorded from previous surveys by Tuen *et al.* (2003) and Faisal *et al.* (2005). Tuen *et al.* (2003) conducted surveys at Raven's Court, Pa Rabata and Church Camp and recorded 79 individuals comprising of six families and 14 species of small mammals. Ten species of bats from three families were recorded from Merarap Camp (700 m asl) and Raven's Court (1335 m asl) by Faisal *et al.* (2005). Six species were new records for Mount Murud. In addition to previous studies, there are currently 22 species in eight families of small mammals (Soricidae, Erinaceidae, Tupaidea, Pteropodidae, Rhinolophidae, Hipposideridae, Vespertilionidae and Muridae) in Mount Murud (Table 2).

Seventeen individuals of small mammals belonging to seven species that were trapped from 66 net-nights for bat and 150 trap-nights for non-volant mammals is a low capture rate. The capture rate for bats is 18.18% and non-volant mammals is 3.33%. In 1996 a study of small mammals was undertaken in the immediate vicinity of Bario (about 1,100 m asl). However, the capture rate was low for rodents (non-volant mammal), only 0.5% and, apart from five bat species, only two common terrestrial were recorded (Rahman *et al.*, 1998). Cold weather and minimum food sources such as fruit could be factors that lead to low diversity on mountain habitats (Zubaid, 1994; Shukor, 1997).

Table 1. Taxonomic checklist and measurements of adult small mammals collected in Mount Murud, Sarawak

Species	N	Head and Body length (mm)	Tail length (mm)	Forearm length (mm)	Ear length (mm)	Tragus length (mm)	Tibia length (mm)	Hindfoot length (mm)	Weight (g)
CHIROPTERA									
<i>Aethalops alecto</i>	2♂3♀	60.95 (55.62-64.78)	None	43.13 (41.96-44.9)	10.11 (8.61-10.84)	None	14.61 (11.43-15.93)	8.87 (6.23-10.26)	15 (13-20)
<i>Cynopterus brachyotis</i>	1♂1♀	84.15 (80.88-87.42)	11.16 (10.86-11.46)	63.19 (62.15-64.24)	13.88 (13.01-14.76)	None	22.92 (22.74-23.1)	12.9 (12.46-13.34)	32 (30-34)
<i>Macroglossus minimus</i>	2?	66.24 (65.24-67.24)	None	40.7 (39.44-41.96)	13.14 (12.12-14.17)	None	16.23 (15.88-16.58)	10.41 (10.37-10.46)	15 (13-17)
<i>Megaerops ecaudatus</i>	2♂	78.42 (77.6-79.24)	None	52.9 (51.7-54.1)	13.75 (13.42-14.08)	None	20.05 (19.04-21.06)	11.82 (11.74-11.9)	24.5 (24-25)
<i>Pipistrellus javanicus</i>	1♂	45.61	39.45	34.4	10.98	5.54	14.2	7.98	5
SCANDENTIA									
<i>Tupaia montana</i>	4♂	145 (134-171)	177.25 (170-187)	None	15.16 (14.8-16)	None	45.43 (38.78-49.88)	37.39 (36.08-38.33)	119.25 (110-130)
INSECTIVORA									
<i>Hylomys suillus</i>	1♀	129.62	23.16	None	16.06	None	34.62	25.84	50

* Values in parentheses indicate minimum and maximum values

Table 2. Taxonomic list on small mammals, individuals caught and comparison with previous data in Mount Murud.

Family Species	Present study	Faisal <i>et al.</i> (2007)	Tuen <i>et al.</i> (2003)
Soricidae			
<i>Crocidura monticola</i>	0	0	1
Erinaceidae			
<i>Hylomys suillus</i>	1	0	0
Tupaidae			
<i>Tupaia montana</i>	4	0	11
Pteropodidae			
<i>Cynopterus brachyotis</i>	2	43	14
<i>C. horsfieldii</i>	0	0	3
<i>Penthetor lucasi</i>	0	6	0
<i>Megaerops ecaudatus</i>	2	18	13
<i>Balionycteris maculata</i>	0	1	0
<i>Aethalops alecto</i>	5	19	13
<i>Eonycteris major</i>	0	5	0
<i>Macroglossus minimus</i>	2	11	7
Rhinolophidae			
<i>Rhinolophus boornensis</i>	0	0	1
<i>R. sedulus</i>	0	0	1
Hipposideridae			
<i>Hipposideros ater</i>	0	3	0
<i>H. cervinus</i>	0	0	9
Vespertilionidae			
<i>Murina rozendaali</i>	0	3	0
<i>Miniopterus schreibersii</i>	0	3	0
<i>Pipistrellus javanicus</i>	1	0	0
Muridae			
<i>Rattus rattus</i>	0	0	1
<i>Niviventer rapit</i>	0	0	1
<i>Maxomys whiteheadi</i>	0	0	1
<i>Leopoldamys sabanus</i>	0	0	1
Total individual	17	112	79
Total family	4	3	6
Total species	7	10	14

A Lesser Gymnure (*H. suillus*) was trapped at the trail to the summit of Mount Murud, about 200 m from Church Camp. This species has brownish upper part, paler under part, which looks like a large shrew and distributed in mountain habitats above 1,000 m asl (Yasuma *et al.*, 2003). We recorded a male *H. suillus* with 129.62 mm of head and body length, 23.16 mm of tail length, 16.06 mm of ear length, 34.62 mm of tibia length and 25.84 of hind foot length.

Pipistrellus javanicus, which is commonly found at elevation up to 1,600 m asl, have been recorded only from 1,200-1,600 m asl on Mount Kinabalu and the Crocker Range in Sabah (Payne *et al.*, 1985). The present study, however, recorded this species above 2,000 m asl. A male *P. javanicus* was caught at the trail near the helipad about 300 m from the Church Camp.

Two montane species of small mammal were recorded. Grey fruit bat (*Aethalops alecto*) is apparently confined to montane forest above 1,000 m asl (Payne *et al.*, 1985). This species is the most abundance at Church Camp compared with other sites. Mountain Treeshrew (*Tupaia montana*) is one of the protected species in Sarawak, distributed at the mountain habitats. Four individuals were recorded at Church Camp. However, *T. montana baluensis* subspecies was recorded at 370 m asl in Mount Sidong, Sarawak (Payne *et al.*, 1985).

Highland bat diversity surveys are still lacking and the total chiropteran fauna known in Sarawak might be underrepresented (Faisal *et al.*, 2007). Previous bat studies at highlands or mountains have been carried out, but the capture rate was low (Table 3). There were 15 species of bats recorded at Mount Murud. Mount Penrissen has the highest bat species diversity as compared to the other areas which is 17 species (Jayaraj *et al.*, 2005). Thirteen species of bats were recorded at the Crocker Range (Payne *et al.*, 1985; Tuen *et al.*, 2002), while Tuen *et al.* (2007) recorded four species of bats in Mount Berumput.

The loss of natural habitats and change of the microhabitats may lead to the local extinction of some species (Faisal *et al.*, 2007). Loss of habitat and fragmentation of vegetation are two major contributors to population decline and further restrictions on distribution of bats (Nameer *et al.*, 2001). Therefore, bat population could be used as an environmental bioindicator (Korad *et al.*, 2007).

The phenogram of the relationship among various habitats base on the diversity of bats using SAHN Method of clustering showed two major groups (Figure 2). Mount Penrissen group is part of the Padawan karst area. Karst (limestone) area was characterized by cave formation that provides the best roosting sites for bats. More than half insectivorous bats in Indonesia have used caves as their roosting site (Suyanto, 2001). The second group consists of Mount Murud, Crocker Range and Mount Berumput. All of these sites had been previously disturbed by activities that cause the fragmentation of vegetation and loss of habitat for animal, especially bats.

The results of the present survey were comparable with survey in 2003 in terms of bat diversity. The lower capture rate of bat indicated that the habitats had been disturbed due to logging activities that cause the fragmentation of vegetation which contributed to population decline (Nameer *et al.*, 2001). The absence of food sources due to the habitat fragmentation forced the animals to migrate in search of food source such as fruit (Anon., 1998). Raven's Court, Ba' Kelalan, Pa Rabata, Lapo Bunga Camp and Church Camp are categorized as montane habitat which had been logged. On the other hand, the Murud 2005 survey showed a different result compared to another survey in the same area. Merarap Camp was one of the sites of this survey that was never been surveyed by previous researchers. Merarap Camp has the elevation of about 700 m asl (Faisal *et al.*, 2005) and dominated by mixed dipterocarp forest that provide many roosting sites and

Table 3. Comparative diversity of bats in montane areas base on the capture rate during survey period (ind/trap.night).

Species	Mt. Murud 2008	Mt. Murud 2005 (Faisal <i>et al.</i> 2007)	Mt. Murud 2003 (Tuen <i>et al.</i> 2003)	Mt. Berumput (Tuen <i>et al.</i> 2007)	Crocker Range (Tuen <i>et al.</i> 2002)	Mt. Penrisen (Jayaraj <i>et al.</i> 2006)
<i>Aethalops alecto</i>	0.075	0.112	0.055	0.012	0.012	0.105
<i>Balionycteris maculate</i>	0	0.005	0	0	0	0.052
<i>Cynopterus brachyotis</i>	0.03	0.252	0.059	0.012	0.083	1.894
<i>C. horsfieldii</i>	0	0	0.012	0	0.012	0
<i>Dyacopterus spadiceus</i>	0	0	0	0	0	0.052
<i>Eonycteris spelaea</i>	0	0	0	0	0	0.263
<i>E. major</i>	0	0.029	0	0	0	0
<i>Macroglossus minimus</i>	0.03	0.064	0.029	0	0.012	0.842
<i>Megaerops ecaudatus</i>	0.03	0.105	0.055	0	0.023	0
<i>Penthetor lucasi</i>	0	0.035	0	0	0	0.211
<i>Rhinolophus borneensis</i>	0	0	0.004	0	0	0.052
<i>R. sedulous</i>	0	0	0.004	0	0	0
<i>R. arcuatus</i>	0	0	0	0.037	0	0
<i>R. trifoliatas</i>	0	0	0	0	0.012	0
<i>R. affinis</i>	0	0	0	0	0	0.052
<i>Hipposideros ater</i>	0	0.017	0	0	0	0
<i>H. cervinus</i>	0	0	0.038	0	0	0.052
<i>Pipistrellus javanicus</i>	0.015	0	0	0	0	0
<i>Murina rozendaali</i>	0	0.017	0	0	0	0
<i>Miniopterus schreibersii</i>	0	0.017	0	0	0	0
<i>Myotis muricola</i>	0	0	0	0	0.035	0
<i>Kerivoula papillosa</i>	0	0	0	0.012	0	0
<i>K. intermedia</i>	0	0	0	0	0	0.052
<i>K. minuta</i>	0	0	0	0	0	0.052
Total of capture rate	0.18	0.653	0.256	0.073	0.189	3.679

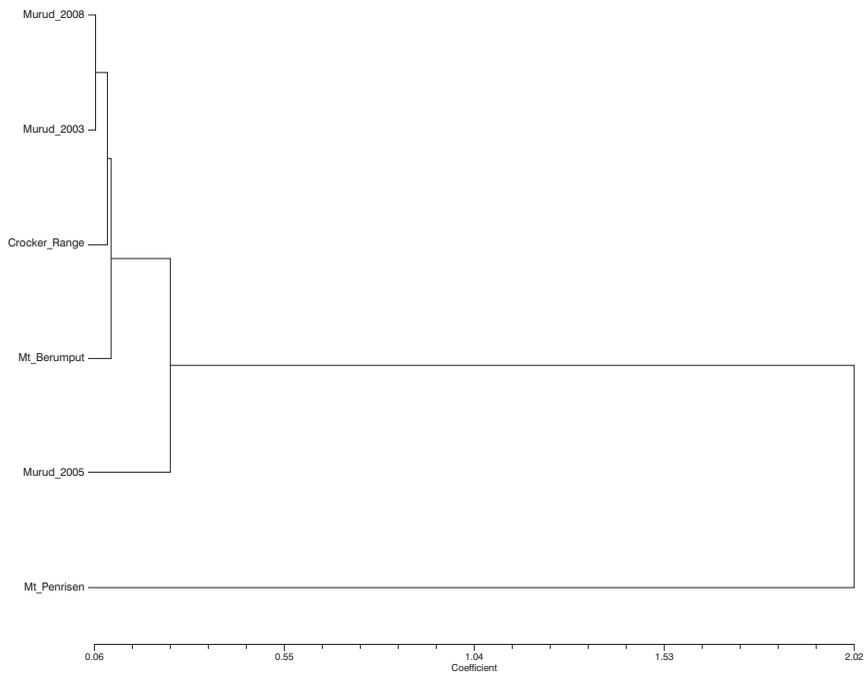


Figure 2. Phenogram of the dissimilarity between mountain habitats base on the bat diversity in each area when the surveys were conducted. Murud 2008 (present study); Murud 2003 (Tuen *et al.* 2003); Murud 2005 (Faisal *et al.* 2007); Crocker Range (Tuen *et al.* 2002); Mount Berumput (Tuen *et al.* 2007) and Mount Penrisen (Jayaraj *et al.* 2006).



Hylomys suillus



Pipistrellus javanicus

Figure 3. Javan pipistrelle bat (*P. javanicus*) and Lesser Gymnure (*H. suillus*) as new records for Mount Murud.

food sources for bats. This condition was different with montane habitats that are dominated by shrubs and has low temperature. This could be one of the contributing factors to the high diversity of bats at the Merarap Camp.

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