

Small Mammals Diversity in Kawah Ratu Resort, Mount Salak, West Jawa, Indonesia

Maharadatunkamsi

Zoological Division, Reserch Center for Biology-LIPI. Jl. Raya Jakarta Bogor Km. 46
Cibinong, Bogor 16911. **Email:** datun_mzb@yahoo.com

ABSTRAK

Keanekaragaman Mamalia Kecil di Resor Kawah Ratu, Gunung Salak, Jawa Barat, Indonesia.

Dalam rangka inventarisasi sumber daya hayati, telah dilakukan penelitian keanekaragaman mamalia kecil di kawasan Resor Kawah Ratu, Gunung Salak, Jawa Barat. Tujuan dari penelitian ini adalah untuk mengungkapkan jenis-jenis hewan mamalia kecil yang dapat dipakai sebagai masukan dalam rangka pengelolaan kawasan konservasi ini. Penelitian ini dilakukan dengan cara penangkapan menggunakan perangkap dan jaring kabut, serta observasi langsung pada tiga habitat utama yaitu hutan primer, hutan sekunder dan kawasan yang terganggu. Pengamatan pada masing-masing habitat dilakukan selama 4 hari. Sebanyak 60 perangkap kawat dan 20 ember jebakan sumuran digunakan untuk menginventarisasi hewan mamalia kecil darat. Empat buah jaring kabut digunakan untuk mengamati mamalia yang bergerak melalui udara. Dalam survei ini berhasil didokumentasikan sebanyak 179 ekor mamalia kecil yang terdiri dari 14 jenis. Hasil penelitian ini menunjukkan bahwa hutan primer mempunyai komponen penyusun komunitas mamalia kecil yang berbeda dari kawasan terganggu dan hutan sekunder. Sedangkan habitat dengan tingkat keanekaragaman tinggi dijumpai pada kawasan terganggu dan hutan sekunder. Hal ini diduga karena kedua habitat ini menyediakan variasi pakan yang lebih beragam dibanding hutan primer.

Kata kunci: keanekaragaman, mamalia kecil, hutan, kawasan terganggu

INTRODUCTION

Gunung Halimun Salak National Park, which is one of the biggest conservation area in Jawa was established to protect the watershed of several rivers and to conserve montane forest which is habitats for a diverse community of flora and fauna (Rais *et al.* 2007). Its natural resources and biodiversity are important ecological value. This national park is suitable area

for habitat of many protected and important species of mammals. It can be as watershed for human settlement and agricultural areas in Bogor and Sukabumi. It is also very important to prevent soil erosion of the area. Formerly it was declared as Gunung Halimun National Park consist of an area *ca.* 40,000 Ha. As a concern of the urgency of conservation in this area, in 2003 this national park was extended by annexing additional area of Mount Salak and its surrounding area. The name of Gunung

Halimun National Park was then changed into Gunung Halimun Salak National Park covering an area of about 113.357 Ha (Rais *et al.* 2007).

Gunung Halimun Salak National Park has been the subject of some studies on small mammals (Suyanto *et al.* 1997; Suyanto & Sinaga 1998; Maharadatunkamsi 2001). These studies were chiefly concerned with the small mammals diversity in the area of Gunung Halimun and its surrounding areas. For example, Suyanto (2002) based on his studies and his colleagues in Gunung Halimun National Park between 1997 and 1998, and based on collection at Zoological Division-LIPI noted that 37 species of small mammals was recorded from this area. On the other hand, only few published information is available on the small mammals of Mount Salak. However some kind of important mammals, such as Javan leopard (*Panthera pardus melas*), Javan gibbon (*Hylobates moloch*), Grizzled leaf monkey (*Presbytis comata*) and Sunda pangolin (*Manis javanica*) were found in Mount Salak (Suprijatna 2006; Dewi *et al.* 2007).

Based on lack information of small mammals from the area of Mount Salak, we conducted this study. The need of information of small mammals from Gunung Salak is clearly important in order to assist managing the Gunung Halimun National Park for conservation effort of this protected area. The objective of this study is to inventory of small mammals at Kawah Ratu Resort, Mount Salak and to compare small mammals community in primary forest, secondary forest and

disturbed area. These preliminary data have several worthwhile implications for the development of conservation strategy for this area. It is expected that this information will be valuable for management in order to maximize conservation efforts.

MATERIALS AND METHODS

The vegetations of Kawah Ratu Resort consist of primary forest, secondary forest and disturbed area (Rinaldi *et al.* 2008). Based on vegetation types, three alliances of vegetation were classified in Kawah Ratu Resort: (1) *Euodia latifolia-Schima wallichii*, (2) *Schima wallichii-Maesopsis eminii* and (3) *Pinus merkusii/Agathis damara-Dysoxylum arborescens/ D. dichotoma* (Wiharto *et al.* 2008; Rinaldi *et al.* 2008).

Three sites were selected for this study representing major habitat for small mammals in Kawah Ratu Resort as follows (Figure 1).

1. Primary forest (Cibogo Track)

This site is covered by primary forest, which is still natural and has high vegetation species diversity with low level of vegetation in ground covering. Some of trees are covered with moss and lichens indicating this area is typical primary sub-montane forest. Sampling was conducted between 06°44'25.8"S, 106°42'18.4"E - 06°44'29.7"S, 106°42'22.1"E; and 06°44'34.5"S, 106°42'34.2"E - 06°44'26.4"S, 106°42'16.0"E at an altitude between 1,400 and 1,500 m asl.

2. Secondary forest (Pondok Bajari).

The vegetation of this site consisted of old secondary forest. The forest has been subjected to some disturbances of human activities. Sampling was conducted between 06°44'51.5"S, 106°42'46.4"E - 06°44'49.4"S, 106°42'39.4"E; and 06°44'55.0"S, 106°42'50.0"E - 06°44'59.4"S, 106°42'52.8"E at an altitude between 1,050 and 1,400 m asl.

3. Disturbed Area (Legok Cicadas)

This site was chosen as a discrete habitat represent disturbed area. Most of the habitat surrounding is cleared for plantations dominated by damar (*Agathis damara*) and mangos. Sampling was conducted between 06°44'51.5"S, 106°42'46.4"E - 06°44'49.4"S, 106°42'39.4"E; and 06°44'55.0"S, 106°42'50.0"E - 06°44'59.4"S, 106°42'52.8"E at an altitude between 1,000 and 1,150 m asl.

This survey was conducted using methods described as follows:

Live traps were used to catch small mammals species such as rats, squirrels and treeshrew. Sixty collapsible cage traps of dimension 25 x 10 x 10 cm made from wire were deployed for each site.

The traps were placed on along the line transect about 10 meters apart. Single type of bait made from a mixture of shrimp paste and peanut butter was deployed to attract animals. The traps were checked at 08.00 every morning. Bait was replenished normally every three days. Pit fall traps were also deployed for each site. Twenty pots with a diameter of 20 cm and 20 cm depth were buried in the ground with its rim at surface ground level. Traps were applied for 4 days at each site of study area.

Mist nets were used for trapping volant mammals, mainly bats. Four of 12 m x 2.7 m nets with 30 mm fine mesh and 4 pockets were deployed. The mist nets were placed across flight paths such as streambeds, river valleys or forest trail. Mist nets were checked every day in the morning at 08.00 and night at 21.00 hours. Mist nets were set up on each site for 4 nights.

To complete the information that can not be obtained in any other way, direct observation was conducted during day and night time using binoculars and spotlight.

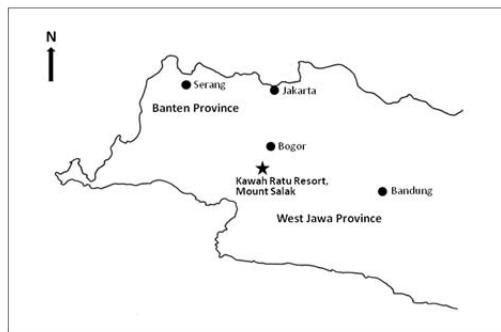


Figure 1. Map of Kawah Ratu Resort, Mount Salak indicating the locality surveyed in this current study.

Simpson's Index Diversity ($1-D$) was calculated for each habitat (Simpson 1949). Bray Curtis index of similarity was used to compare the small mammals community between habitats observed (Krebs 1989).

RESULTS

During this current survey, a total of 179 individuals from 14 species of small mammals were recorded from the study areas. These comprised of 8 species of bats, 4 species of rats, 1 species of treeshrew and 1 species of shrew. One of these species (*Maxomys bartelsii*) is endemic to Jawa and one species (*Tupaia javanica*) is listed in CITES Appendix 2. Systematic arrangements and English name used in this paper generally followed Wilson & Reeder (2005) and Suyanto *et al.* (2002). Detail of records of small mammals according to site is presented in Table 1.

Bats documentations were represented by 6 species of Megachiroptera/Pteropodidae (*Aethalops alecto*, *Chironax melanocephalus*, *Cynopterus brachyotis*, *Cynopterus horsfieldi*, *Cynopterus sphinx* and *Macroglossus sobrinus*) and 2 species of Microchiroptera/Vespertilionidae (*Miniopterus magnater* and *Myotis muricola*). The rodents documentation comprised of 4 species of rats/Muridae (*Maxomys bartelsii*, *Rattus exulans*, *Rattus tanezumi* and *Rattus tiomanicus*). Only one species of treeshrew/Tupaiaidae, *ie. Tupaia javanica* was documented during this

survey, with all 3 individuals were recorded from secondary forest. Four individuals of shrew/Soricidae (*Crocidura monticola*) was also recorded from secondary forest.

Our captures data showed that less number of small mammals species utilized primary forest. Moderate number of small mammals were found in the secondary forest. This study indicated that depend on each species, wide range of habitats were utilized by rats and bats. Overall, the secondary forest and disturbed area were the most productive habitat for small mammals, where 14 number of species were recorded. Many species of fruit bats (Table 1) confined to disturbed area feed on fruit plantation and/or nectar. Also several species of rodents take advantage of plantations and crops in the disturbed area.

DISCUSSION

This study showed that high small mammals richness occurred in the disturbed area and the secondary forest indicating these habitats were the most productive for small mammals community. Eleven species of small mammals consisted of 82 individuals were recorded from disturbed area; compare to the secondary forest (11 species, 44 individuals) and primary forest (5 species, 53 individuals). This phenomenon was understandable since during this current study, forest trees have not flowered yet and there was very little fruiting in the forests. This situation presumably insisted forest small mammals to forage to the disturbed area

Table 1. List number of individuals and species in each of the sites surveyed

Species	Primary Forest	Secondary Forest	Disturbed Area	Status
Megachiroptera/Pteropodidae				
<i>Aethalops alecto</i>	5	9	1	Lc
<i>Chironax melanocephalus</i>	32	7	18	Lc
<i>Cynopterus brachyotis</i>	1	5	36	Lc
<i>Cynopterus horsfieldi</i>	0	1	1	Lc
<i>Cynopterus sphinx</i>	0	3	3	Lc
<i>Macroglossus sobrinus</i>	10	2	17	Lc
	0	0	1	Lc
Microchiroptera/Vespertilionidae				
<i>Miniopterus magnater</i>				
<i>Myotis muricola</i>	0	0	1	Lc
Rodentia/Muridae				
<i>Maxomys bartelsii</i>	5	3	0	E
<i>Rattus exulans</i>	0	0	1	Lc
<i>Rattus tanezumi</i>	0	1	2	Lc
<i>Rattus tiomanicus</i>	0	6	1	Lc
Scandentia/Tupaiaidae				
<i>Tupaia javanica</i>	0	3	0	CI 2, Lc
Insectivora (Eulipotyphla)/				
Soricidae	0	4	0	Lc
<i>Crocidura monticola</i>				
T o t a l	53	44	82	

Status: E= endemic Jawa, CI 2= CITES Appendix 2, Lc= IUCN Least Concern.

No species is protected by Indonesian regulation

and secondary forest for better feeding grounds. Our observation seemed to indicate that habitat utilisation by small mammals in Kawah Ratu Resort was related to food and foraging areas. Disturbed area and secondary forest may be abundant and consistent food sources, contributing to the maintenance for most small mammals (Sakai 2002). This trend was about consistent to some other studies that showed disturbed habitats had higher diversity of small mammals (Hall *et al.* 2004, Maharadatunkamsi 2006a). Although higher richness of small mammals in the forest have been observed in other studies (Santosa *et al.* 2008, Fukuda *et al.* 2009).

Data on the bats (Chiroptera) showed that the disturbed area were the highest in bat species and more abundance than those in the primary and secondary forest. Eight species of bats consisted of 78 individuals were recorded from disturbed area; compare to the secondary forest (6 species, 27 individuals) and primary forest (4 species, 48 individuals). It was observed that at the time survey, floristic of the forest had not yet fruited and flowered. Cultivated plants in disturbed area such as bananas, mangos, guavas and papayas may provide various kind of food, contributing to the maintenance of bats diversity. This phenomenon indicated that certain

species of bats in Kawah Ratu Resort might be capable of adapting to changes in their natural environments and likely to be tolerant to some degree of habitat modification. However, this must be treated with some caution since forest bat are easily affected by habitat loss, degradation and hunting pressure (Gorresen & Willig 2004, Maharadatunkamsi 2006b; Presley *et al* 2009).

The recorded rats (Rodentia) indicated different pattern from bats. Distribution of rats was greatest in the secondary forest. The total of rats in the secondary forest was 3 species (*Maxomys bartelsii* 3 individuals, *Rattus tanezumi* 1 individual and *Rattus tiomanicus* 6 individuals), compare to 3 species in the disturbed area (*Rattus exulans* 1 individual, *Rattus tanezumi* 2 individuals and *Rattus tiomanicus* 1 individual) and one species in the primary forest (*Maxomys bartelsii* 5 individuals). The secondary forest provided a wide variety of plant types which is a suitable habitat for rats. *Maxomys bartelsii* constituted the largest number of rats recorded in the primary forest. This species tends to live in the primary and secondary forest, and not reach disturbed area (Corbet & Hill 1992; Maharadatunkamsi 2001). While *Rattus tanezumi* was the most high recorded in the disturbed area taking advantage from agricultural plants for feed (Handayani & Ristiyo 2008; Pagès *et al* 2011).

The variability of diversity of small mammals community in Kawah Ratu Resort was calculated using the method of Simpson's Index Diversity ($1-D$). It is a measure that accounts for the

richness and the proportion of each species from a biodiversity sample within an area. The values of this index range from 0 (no diversity) to maximum 1 (Krebs 1989). Overall the index value for small mammals in Kawah Ratu Resort was 0.81. It means that the diversity of small mammals in Kawah Ratu Resort was high indicating that individuals of most species were evenly distributed between all sites. The value is about similar to study in Batang Toru, North Sumatra with the index of 0.79 (PT. Hatfindo Prima 2005), and Gunung Ciremai National Park, West Jawa was 0.89 (Maharadatunkamsi & Maryati 2007). The diversity of small mammals community in Kawah Ratu Resort is slightly higher from small mammals community in Gag Island with the value of index 0.66 (Maryanto & Kitchener 1999) and 0.74 in Bogani Nani National Park, Sulawesi (Maharadatunkamsi 2006a).

Trapping effort at each site for this current study was fairly similar and single kind of bait was applied. This approach allowed comparisons of diversity between habitats was undertaken. The highest Simpson's Index Diversity (0.90; 11 species) was in secondary forest, followed by disturbed area (0.72; 11 species). While primary forest had the lowest Simpson's Index Diversity (0.59; 5 species). Species diversity which is indicated by Simpson's index Diversity showed a trend of small mammals abundance between sites. Species diversity of small mammals increased from primary forest to disturbed area and secondary forest. The importance

of secondary forest and disturbed area are understandable due to the provision of an adequate vegetation to an alternative food sources for small mammals, especially bats; as Kinjo *et al* (2003) observed that agricultural area can be an important feeding forage for certain fruit bats. During this survey, there was limitation of fruits and flowers in the forest. As a result forest bat species such as *Aethalops alecto* and *Chironax melanocephalus* may be forced for forage to the disturbed habitat. Our data demonstrated that *Aethalops alecto* and *Chironax melanocephalus* are capable to fly between forest and disturbed area searching for food.

Further we investigated the similarity between habitats observed using Bray-Curtis index between pair of habitats (Krebs 1989). The range value of the Bray-Curtis similarity index was between 0.33 and 0.77. In other words, the result showed that the similarity measure only between 33% and 77%. According to this similarity indices, the lowest value of similarity was between the primary forest and disturbed habitat (0.33), indicated that the most distinct habitat was between the primary forest and the disturbed area. Higher degree of similarity was between primary forest and secondary forest (0.55). The secondary forest and disturbed area showed the closest degree of similarity with the value of 0.77.

Following the values of similarity between habitats, we examined the relative abundance of certain species in order to explain the differences between habitats. Small mammals at primary

forest of Kawah Ratu Resort was dominated by the Black capped fruit bat, *Chironax melanocephalus* with 32 individuals were recorded during this survey gave the value of relative abundance 0.60. On the other hand, the most abundant species at the disturbed habitat was the Common short nosed fruit bat, *Cynopterus brachyotis* (36 individuals) and the secondary forest was the Gray fruit bat *Aethalops alecto* (9 individuals), resulting the value of relative abundance of 0.44 and 0.21, respectively. This species abundance differences between habitats contributed to the low level of similarity between habitat observed.

Cluster analysis based on the species distribution was summarized to describe the relationships between species at the three habitats surveyed using Bray-Curtis similarity index. Each similarity measure was used as the data for a cluster analysis (Sneath & Sokal 1973). The dendrogram showed the similarity pattern of certain species of small mammals observed in Kawah Ratu Resort (Figure 2). At the index about 0.68 *Aethalops alecto* was clustered together with *Maxomys bartelsii* indicating that this two species are forest dependant. These two species occurred in both primary forest and secondary forest. This pattern is about the same with *Crocidura monticola* and *Tupaia javanica*, although these two species were recorded from secondary forest. At the similarity index about 0.62 these two species clustered together with *Cynopterus sphinx* and *Rattus tiomanicus*. While *Rattus tanezumi* and

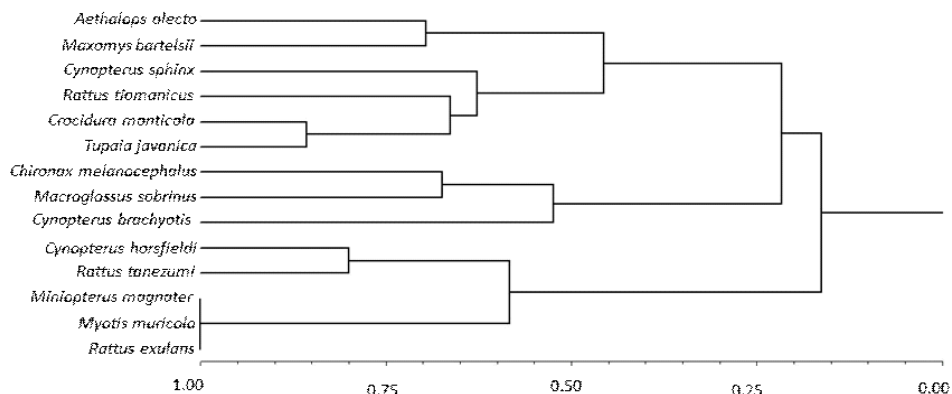


Figure 2. Dendrogram based on the Bray-Curtis index of similarity between species of small mammals observed in Kawah Ratu Resort, Mount Salak.

Cynopterus horsfieldi was clustered together at the value of index about 0.80 indicating these two species utilized secondary forest and disturbed area. On the other hand, *Miniapterus magnater*, *Myotis muricola* and *rattus exulans* were documented only at disturbed area, clustered together with the value of index about 1, and at the value of index about 0.6 they clustered with the disturbed area dweller that is *Cynopterus horsfieldi* and *Rattus tanezumi*. The cluster of *Chironax melanocephalus* and *Macroglossus sobrinus*; and then combined with *Cynopterus brachyotis* was an intriguing result as indicating an association of distribution species at primary forest and disturbed area. Although *Chironax melanocephalus* mainly detected at the forested area, but the moderately high number of this species in disturbed area indicated that this habitat can be an alternative for feeding locations.

In sum up, the high number of *Cynopterus brachyotis*, *Cynopterus sphinx* and *Macroglossus sobrinus* in

the disturbed area, but detected in low number in forest area indicated that they mostly feed on cultivated plantations. This results indicate that this three species of small mammals mostly use disturbed area for feeding and able to be tolerant with the degree of human disturbance. Conversely, disturbed area may be inadequate habitats for *Chironax melanocephalus*, *Aethalops alecto* and *Maxomys bartelsii*. The capture rate of these three species were higher in the forest area than in disturbed area. Being more restricted to forest area, *Chironax melanocephalus*, *Aethalops alecto* and *Maxomys bartelsii* are more susceptible to disturbance.

CONCLUSSION

This study suggests a changes in small mammals distribution, especially megachiroptera among natural vegetation and disturbed area in Kawah Ratu Resort.

Many species that recorded in the study area indicated that Kawah Ratu Resort is an important habitat for small mammals, including endemic species and species listed in CITES Appendix.

Some species of bats (*Chironax melanocephalus* and *Cynopterus brachyotis*) indicated wide distribution in Kawah Ratu Resort, while certain rats (*Maxomys bartelsii*) showed limitation in their distribution.

It is noteworthy to include such potential small mammals conservation program in management plan of this valuable national park in order to conserve its biodiversity rich in term of species, ecosystem and genetic.

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