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Mammal Distribution and Diversity in the Protected Forest of RPH Sumbermanjing Kulon KPH Malang

(Distribusi dan Keanekaragaman Mamalia di Hutan Lindung RPH Sumbermanjing Kulon KPH Malang)

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ABSTRACT

The Protected Forest of RPH (Forest Management Resort) Sumbermanjing Kulon is an area, which is susceptible to land conversion due to human activities, such as road construction and tourism. These conditions might harm the habitat of several animals and disturb their movements, specifically in the mammal group. Therefore, the purpose of this research is to determine the distribution and diversity of mammals as the basis for the proper management of the RPH. This research was conducted on a variety of forest habitats located on plot 97A, which covers an area of 331.5 Ha. Moreover, data were collected by creating line transects in this location and then analyzed by constructing a map of the mammals' distribution using the Shannon-Winer diversity index, evenness, and species richness. According to the results, 23 species of mammals were scattered in three types of habitats. The low category of mammal species diversity index was discovered in the mangrove forest (0.69), while the tropical rainforest (2.48) and coastal forest (2.18 were moderate). Furthermore, the mammal species evenness index in the lowland tropical rainforest, mangrove, and coastal forests indicated relatively even results while the highest mammal species richness index was detected in the lowland tropical rainforest. The mammal diversity results can be used by area managers for sustainable management.

1. Introduction

Indonesia is known for its vast biodiversity with several endangered wildlife, including mammals. This country is home to 720 mammal species and accounts for 13% of these animals globally. The geology and ecosystem of Indonesia are unique, resulting in 270 species of endemic mammals (Darajati et al., 2016). Furthermore, loss of biodiversity and deforestation can occur as a result of wildlife trade and forest area conversions into plantations, respectively. This process of deforestation impacts large mammals that depend on enormous specialized habitats for movement (Zemanova, Perotto-Baldivieso, Dickins, Gill, Leonard, & Wester, 2017). Although certain mammal species may survive with sufficient vegetation cover in the presence of human disturbance, their population tends to increase with decreasing human activity (Riggio, et al., 2018; Aryanti, Hartono, Ramadhan, & Pahrurrobi, 2018).

The diversity of mammals is crucial for the balance of forest ecosystems, where the loss of large carnivores impacts the food chain and results in the dominance of herbivorous animals.

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Therefore, the pressure on plant species consumed by herbivores is increased (Ripple et al., 2014). In forest ecosystems, fruit-eating mammals (frugivores) can serve as seed dispersal agents through feces, where seeds are attached to and lightly transported by carnivores over long distances to degraded areas, such as regions formerly damaged by fire (Corlett & Primack, 2011; Rost, Pons, & Bas, 2012). Also, mammals maintain the ecosystem services in human-modified landscapes (Peredo, Martines, Rodrigeuz-Perez, & Gracia, 2013) and preserve ecological processes that are beneficial to human welfare (Kartono, 2015).

Moreover, one of the habitats for various mammal species is the protected forest of the Forest Management Resort (RPH) Sumbermanjing Kulon, which is managed by the Forest Management Unit Department (BKPH) Sengguruh and Forest Management Unit (KPH) Malang located in Bantur Sub-district, Malang Regency, East Java Province. This region contains diverse vegetation and is relatively well maintained. Also, a total of 21 mammal species have been recorded, including the protected species of the Javan slow loris (*Nycticebus javanicus*), which are located far from settlements and roads (Aspinal Foundation, 2017; Aryanti, et al., 2018). However, due to the high amount of human activities as a result of its proximity to beach tourism, main roads, and fishermen's settlements, this forest area is currently under pressure. The commencement of the 2019 Java Island Southern Cross Road construction (Erwin, 2019) may have led to a reduction in the habitat and threatened the existence of animals. Therefore, this research aims to obtain data and information regarding the distribution and diversity of mammal species in the protected forest area of RPH Sumbermanjing Kulon KPH Malang. The results are expected to serve as basic information for the development of an appropriate and effective area management plan, ensuring the long-term viability of this region's biodiversity.

2. Method

2.1. Research Time and Location

This research was conducted between January-March 2019 on plot 97A of the Protected Forest RPH Sumbermanjing Kulon BKPH Sengguruh KPH Malang, with an area of 331.5 hectares. Also, this region contains three vegetation types, including lowland tropical rain forest (HDR), coastal (HP), and mangrove forests (HM). The roads leading to this location are in poor condition due to the presence of a combination of rock and soil, which becomes muddy during the rainy season. In addition, the long-tailed monkey (*Macaca fascicularis* Raffles) and the Javan langur (*Trachypithecus auratus* Geoffroy) include some of the mammal species often observed in this site.

2.2. Materials and Tools

GPS (Global Positioning System), binoculars, meters, digital cameras, flashlights, field guide books, and stationery were utilized in the field research. Furthermore, tally sheet instruments were used to record the data on vegetation and mammals.

2.3. Research Methods

Implementation Stages / Research Design

The stratified random sampling method was used to collect data on mammals from the three different habitat types (Bismark, 2011). This process was performed by creating and placing line transects of at least 1 km, based on the population information, preliminary surveys, and accessibility of each habitat type. Also, the paths were spaced at a minimum distance of 500 m apart to avoid double-counting while the observation radius between the left and

right lane was approximately 20 m in width. Figure 1 shows that there are 10 paths in this research, which were obtained by the following calculation method (Anggrita, Nasihin, & Nendrayan, 2017):

$$P = \frac{IS \times N \times 10.000}{L} \quad (1)$$

Description (Remarks):
P = path length
N = total area
IS = sampling intensity 0.6%
L = path width in the field

A vegetation analysis method on animal paths was used to obtain information on the composition of each vegetation type. Moreover, the nested sampling plot method involved creating an animal observation path with a distance of 20 m between the plots. The species, number of individuals, diameter, and height of each plant growth, such as trees, poles, saplings, and seedlings were recorded. Meanwhile, the measuring plots used for the lowland and coastal forests included plant trees, poles, and saplings with a diameter of > 20 cm (20x20m), 10-20 cm (10x10m), and < 10 cm (5x5m), respectively, as well as saplings and seedlings with a height of > 1.5 m and <1.5 m (2x2m). Based on the preliminary survey, the mangrove forest in Plot 97A of the RPH Sumbermanjing Kulon was observed to be quite small in size. Therefore, the square plot was placed in a location, with the potential presence of animals and included plant trees and saplings with a diameter of > 10 cm (10 x 10 m) and < 10 cm (5x5m), as well as saplings and seedlings with a height of > 1.5 m and <1.5 m (2x2m), respectively (Wiyanto & Faiqoh, 2015; Ghufrona, Kusmana, & Rusdiana, 2015). Mangrove trees with a trunk diameter greater than 20 cm are usually only observed in Papua's natural forests. Hence, these trees were generally 10-20 cm in length, with the largest measuring plot of 10x10 m (Poedjirahajoe, 2019). Also, literature research and interviews were used to identify the vegetation.

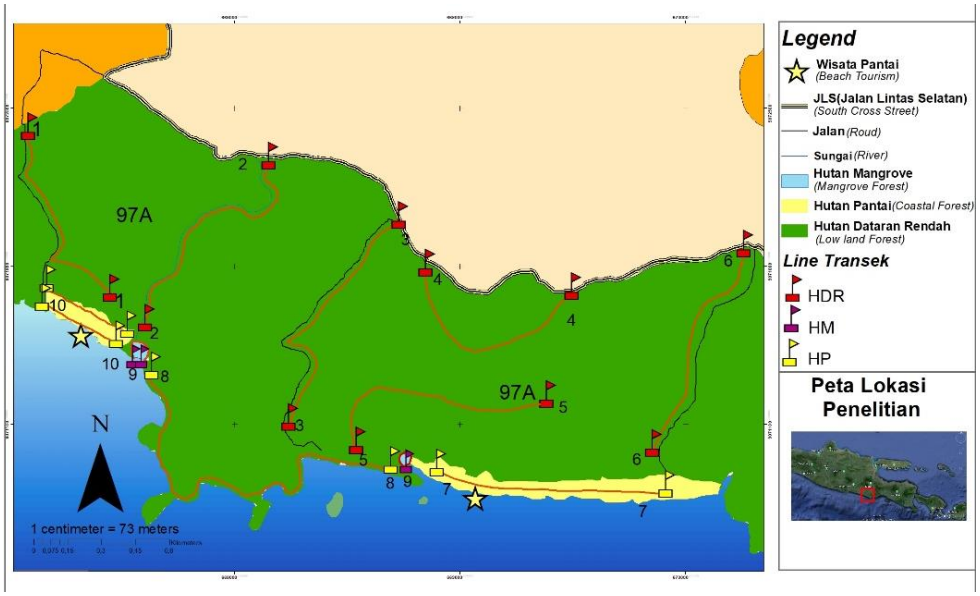


Figure 1. The research location map of the protected forest area plot 97A RPH Sumbermanjing Kulon BKPH Sengguruh KPH Malang

2.4. Data Analysis

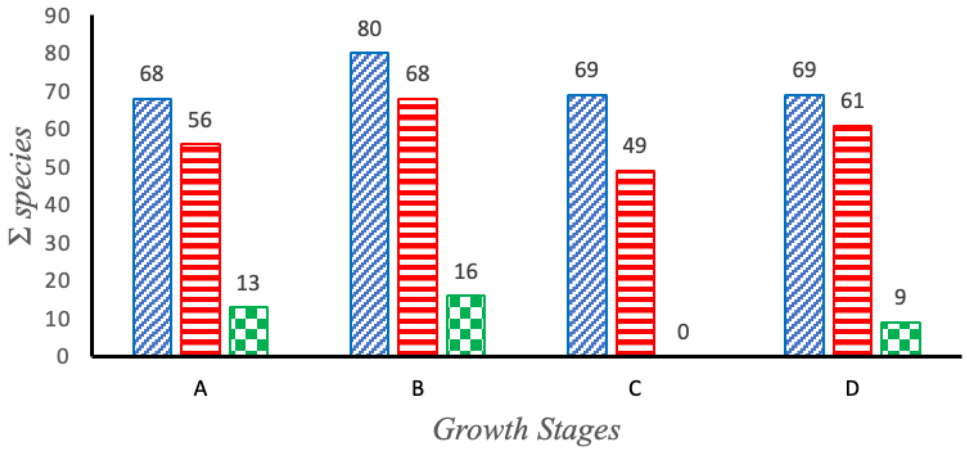
Moreover, the vegetation data was processed to determine the diversity index (H') while, the information concerning the mammals were analyzed for species frequency (F), Shannon-Winer diversity index (H'), evenness index (E), and Margalef species richness index (Dmg) (Magurran & McGill, 2010). The Kruskal Wallis test with the SPSS 21 application was used to determine the difference in plant species between the three vegetation types (Santoso, 2016).

3. Results and Discussion

3.1. Vegetation Composition

The lowland forest on plot 97A Protection Forest RPH Sumbermanjing Kulon contains more plant species, including tree and seedlings than the coastal and mangrove forests. In the lowland forest area, the tree and seedling were dominated by *bendo* (*Artocarpus elasticus* Reinw), *langkap* (*Arenga obtusifolia* Mart), *tutup angina* (*Malllotus floribundus* Blume), and *penjalin* (*Celtis philippensis* Blanco). Meanwhile, *nyirih* (*Xylocarpus granatum* J. Koenig) and *tinjang* (*Rhizophora apiculata* Bl) occupied the mangrove forest. The coastal forest was dominated by *ara jejawi* (*Ficus retusa* L), *langkap* (*A. obtusifolia* Mart), *butun* (*Baringtonia asiatica* L), *waru laut* (*Thespesia populnea* L).

Figure 3 illustrates that in the protected mangrove forest of RPH Sumbermanjing, the diversity of vegetation species was moderate (2 < H' < 3) for saplings and low (H' < 2) for seedlings and trees. This differs from the lowland and coastal forests, which are classified as high at all vegetation levels (H' > 3) (Nurudin, Kariada, & Irsandi, 2013). The low species diversity in the mangroves compared to lowland and coastal forests may be due to the limited organisms that may survive there (Kartika, Istomo, & Amanah, 2018).

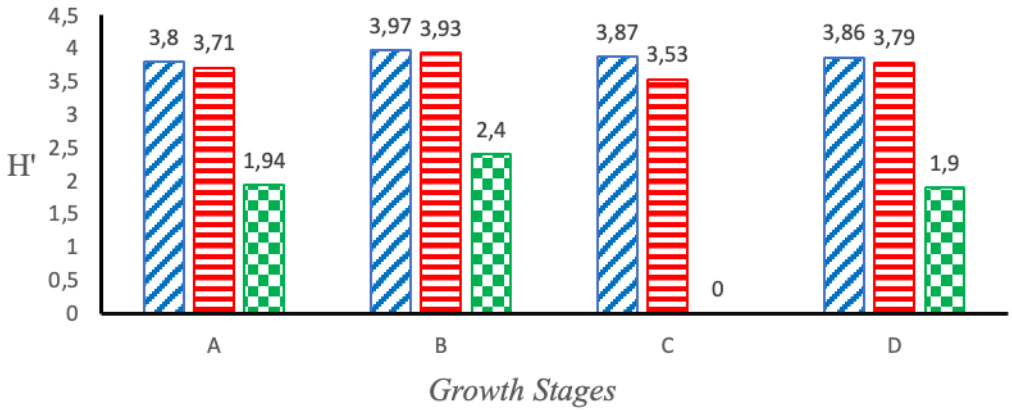


Remarks:

A = seedling
B = sapling
C = pole
D = tree

= Σ species of HDR (Lowland Forest)
= Σ species of HP (Coastal Forest)
= Σ species of HM (Mangrove Forest)

Figure 2. Number of plant species in protected forest plot 97A RPH Sumbermanjing Kulon



Remarks:

A = seedling
B = sapling
C = pole
D = tree

= Σ species of HDR (Lowland Forest)
= Σ species of HP (Coastal Forest)
= Σ species of HM (Mangrove Forest)

Figure 3. Diversity (H') of vegetation species in protected forest plot 97A RPH Sumbermanjing Kulon

Table 1. Observation of Plants Consumed by Mammals in the Protected Forest Plot 97A RPH Sumbermanjing Kulon KPH Malang

No.	Local name	Scientific name	Edible parts	Mammal Species
1	*Bendo*	*A. elasticus*	Fruit, sap	*N. javanicus* Geoffroy and *Muntiacus muntjak* Zimmermann,
2	*Bringin*	*F. benjamina*	Leaf, fruit	*M. muntjak* Zimmermann,*Tragulus javanicus* Osbeck, *Hystrix javanica* F.Cuvier, *Ratufa affinis* Raffles, and *T. auratus* Geoffroy
4	*Luwingan*	*F. hispida*	Leaf, fruit, sap	*M. muntjak* Zimmermann,*T. javanicus* Osbeck, and *T. auratus* Geoffroy
5	*Lau*	*F. variegata*	Leaf, fruit, sap	*N. javanicus* Geoffroy, *M. muntjak* Zimmermann, and *T. javanicus* Osbeck
6	*Langan Jangkan*	*Dillenia suffruticosa*	Fruit	*M. muntjak Zimmermann*
7	*Nelung*	*Trema orientalis*	Leaf, stem	*M. muntjak* Zimmermann, *T. javanicus Osbeck*, and *N. javanicus* Geoffroy
8	*Mangga*	*Mangifera indica*	Fruit	*N. javanicus* Geoffroy and *M. fascicularis* Raffles
9	*Pelawi*	*Alstonia scholaris*	Fruit	*M. fascicularis* Raffles
10	*Langsat kr*	*Aglaia lawii*	Leaf	*N. javanicus* Geoffroy
11	*Jamblang*	*Syzygium cumini*	Fruit	*Ratufa affinis* Raffles and *M. fascicularis* Raffles
12	*Ketapang*	*Terminalia catappa*	Fruit, leaf	*R. affinis* Raffles and *T. auratus* Geoffroy
13	*Kelapa*	*Cocos nucifera*	Fruit	*Callosciurus notatus* Boddaert
14	*Buni*	*Antidesma bunius*	Fruit	*C. notatus* Boddaert and *R. affinis* Raffles
15	*Kayu api*	*Melanolepis multiglandulosa*	Leaf, fruit	*T. auratus* Geoffroy

No.	Local name	Scientific name	Edible parts	Mammal Species
16	*Rao*	*Dracontamelon dao*	Leaf	*T. auratus* Geoffroy
17	*Bayur*	*Pteruspermum diversitolium*	Leaf	*T. auratus* Geoffroy
18	*Pokok Agutut*	*Cordia subcordata*	Leaf	*T. auratus* Geoffroy
19	*Gerok ayam*	*Buchanania arborescens*	Leaf	*T. auratus* Geoffroy
20	*Jembirit*	*Tabernaemontana sphaerocarpa*	Leaf	*T. auratus* Geoffroy
21	*Majegau*	*Dysoxylum spp*	Leaf, fruit	*T. auratus* Geoffroy
22	*Tutup*	*M. floribundus*	Leaf	*T. auratus* Geoffroy
23	*Waru*	*Hibiscus tiliaceus*	Leaf	*T. auratus* Geoffroy

A significance value of 0.006 or less than 0.05 was obtained using the Kruskal Wallis difference test for the number of vegetation species in each habitat type. Therefore, the amount of these species in mangrove, coastal, and lowland forests varied significantly. The condition of these diverse plant species has resulted in a variance of the mammals encountered due to their differences in selecting suitable habitats for their sustainability (Chabwela, Chomba, Kaweche, & Mwenya, 2017). Furthermore, the large number of plant species influenced the discovery of several mammals, which is related to the availability of abundant feed (Sulistyadi, 2016). The majority of mammals also use forests with several stands as a source of food and shelter (Arini & Prasetyo, 2013). Table 1 shows the results of the observations on several plant species consumed by mammals in plot 97A of RPH Sumbermanjing Kulon KPH Malang. Also, *M. muntjak* Zimmermann, *T. javanicus* Osbeck, *T. auratus* Geoffroy, *R. affinis* Raffles, and *M. fascicularis* Raffles include the various mammal species that consume plant parts in coastal and lowland forests.

3.2. Mammal Distribution

In the lowland tropical rainforest, 18 species of mammals with 72 individuals were discovered while 11 species with 43 individuals were observed in the coastal forest. Meanwhile, only 2 species with 2 individuals were seen in the mangrove forests. Figure 4 illustrates the distribution of mammal encounters in the protected forest plot 97 A RPH Sumbermanjing Kulon KPH Malang.

C. notatus was directly discovered in the mangrove forest, while *Paradoxurus hermaphroditus* was found indirectly in the form of footprints in the middle of a receding mangrove. The mammal species observed in the mangrove forest are assumed to be in search of food, such as earthworms because *P. hermaphrodites,* which is an omnivore preys on various insects, mollusks, earthworms, lizards, and small creatures, including mice (Suatha, 2019). Furthermore, *P. hermaphroditus* Pallas and *C. notatus* Boddaert exist in the mangrove ecosystem (Malla, Ray, Johnson, & Sivakumar, 2019; Zakaria & Rajpar, 2015), hence, these organisms can be seen in lowland and/or coastal forests.

Figures 2 and 3 show that the large number of mammals and individuals observed in lowland and coastal forests may be attributed to a greater number and species of vegetation than in the mangrove forest. These conditions support the demand for more readily available food sources for several mammal species. Conversely, only a few of these animals are seen in the mangrove forest, hence, they have low diversity (Kusmana, et al., 2017).

According to the frequency analysis results in Table 2, Sus scrofa Linnaeus is usually seen in the lowland forest. This is an adaptable mammal located in all

habitats of tropical rain forests, grasslands, sub-tropical, and bamboo forests as well as on agricultural lands in search of food (Sulistiyadi, 2016). In the coastal forest, the most common species are *M. fascicularis* and *C. notatus. M. fascicularis* survives in several habitats, including human areas (Hambali et al. 2014) while *C. notatus* can be seen in small islands, beachside coconut groves, around the coast of mangrove forests, and behind the outer part of a forest (Rugayah, Rahayu, Mulyadi, & Rahajoe, 2019).

The survival of mammals and other wild animals is essential for the protection and sustainability of their species, hence, conservation efforts through regulations that protect and preserve these organisms are required. According to CITES, 2 species of mammals in the protected forest plot 97A RPH Sumbermanjing Kulon are listed in Appendix I, and 7 in Appendix II (Figure 5). The animals in Appendix I include *N. javanicus* and *A. binturon*g, while *H. javanicus, M. fascicularis, T. auratus, R. affinis, P. hermaphroditus, A. cinerea,* and *P. bangalenis* were in Appendix II.

According to the IUCN Red Data List 2016, in reference to the protected mammal group, 3 mammal species, including *A. binturong, T. auratus,* and *A. cinerea* were classified as vulnerable in the plot 97A RPH Sumbermanjing Kulon. Meanwhile, *S. scrofa, T. javanicus, R. affinis,* and *N. javanicus* were endangered, data deficient, threatened, and had Redlist statuses, respectively. According to the 2008 Ministry of Environment and Forestry Regulation No. P.106, 9 mammal species, including *M. muntjak, T. javanicus, A. binturong, H. javanica, T. auratus, N. javanicus,* and *P. bangalenis* are protected.

3.3. Diversity, Richness, and Evenness of Mammal Species

In theory, the diversity of mammal species increases with the variety of their diet, such as plants, insects, and rodents (Feng, Yun & Yang, 2018). Figure 6 shows the diversity index of these organisms and the number of vegetation species in each forest condition. The species diversity (H') of mammals in lowland and coastal forests was moderate ($2 < H' < 3$) but low ($H' < 2$) in the mangrove forest. Also, the most common mammals in the lowland and coastal forests were *S. scrofa* and *M. fascicularis*, respectively. The limited species and populations observed in the small sample area of mangrove forests may contribute to its low species diversity.

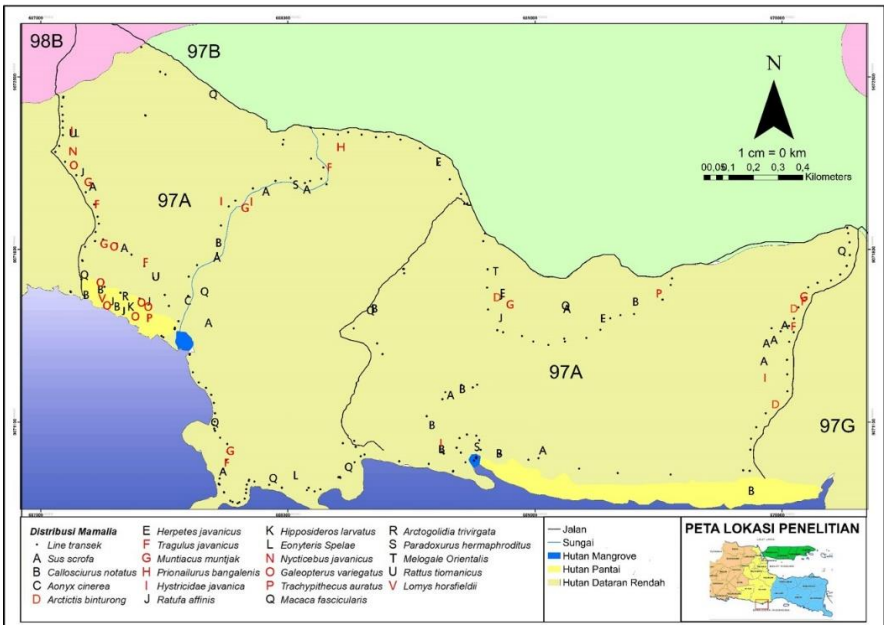
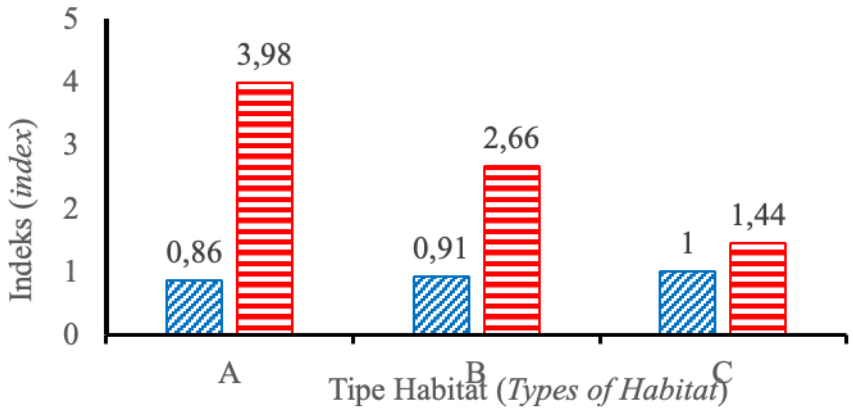


Figure 4. Map of mammal distribution in protected forest plot 97A RPH Sumbermanjing Kulon KPH Malang

Table 2. Encounter and Frequency of Mammals in Protected Forest Plot 97A RPH Sumbermanjing Kulon KPH Malang

No.	Local Name	Scientific Name	Frequency (%)		
			HDR	HP	HM
1	*Bajing Kelapa*	*C. notatus* Boddaert	11.11	16.28	50
2	*Babi Hutan*	*S. scrofa* Linnaeus	22.22	4.65	0
3	*Kijang*	*M. muntjak* Zimmermann	9.72	2.33	0
4	*Kancil*	*Tragulus javanicus* Osbeck	12.50	4.65	0
5	*Garangan Jawa*	*Herpestes javanicus* Geoffroy	4.17	0.00	0
6	*Binturong*	*Arctictis binturong* Raffles	4.17	0.00	0
7	*Teledu Jawa*	*Melogale Orientalis* Horsfield	1.39	0.00	0
8	*Landak jawa*	*H. javanica* F.Cuvier	4.17	0.00	0
9	*Monyet Ekor panjang*	*M. fascicularis* Raffles	11.11	23.26	0
10	*Lutung Jawa*	*T. auratus* Geoffroy	4.17	9.30	0
11	*Jelarang Bilalang*	*R. affinis* Raffles	2.78	6.98	0
12	*Musang luwak*	*P. hermaphroditus* Pallas	1.39	0.00	50
13	*Kukang jawa*	*N. javanicus* Geoffroy	1.39	0.00	0
14	*Berang-berang cakar kecil*	*Aonyx cinerea* Illiger	0.00	2.33	0
15	*Lemur sunda/kubung malaya/tando*	*Galeopterus variegatus* Audebert	4.17	11.63	0
16	*Kelelawar Fajar*	*Eonycteris Spelaea* Dobson	0.00	9.30	0
17	*Bajing terbang jawa*	*Iomys horsfieldii* Waterhouse	0.00	2.33	0
18	*Kucing Hutan/Kucing kuwuk*	*Prionailurus bengalenisis* Kerr	1.39	0.00	0
19	*Musang rase*	*Viverricula indica* Geoffroy	0.00	2.33	0
20	*Tikus hutan*	*Rattus tiomanicus* Miller	1.39	2.33	0
21	*Musang Akar*	*Arctogalidia trivirgata* Gray	0.00	2.33	0
22	*Barong Horsfield*	*Hipposideros larvatus* Horsfield	1.39	0.00	0
23	*Tomusu Asteng*	*Miniopterus medius* Thomas & Wroughton	1.39	0.00	0
		Total	100	100	100

Remarks: HDR = Lowland Forest, HP = Coastal Forest, HM = Mangrove Forest



Remarks:
A = HDR (Lowland Forest)
B = HP (Coastal Forest)
C = HM (Mangrove Forest)
= ∑ Species
= H' of Mammals

Figure 5. Species evenness index (E) and richness index (Dmg) of Mammals in Protected Forest Plot 97A RPH Sumbermanjing Kulon

These conditions indicate that lowland and coastal forests can serve as a source of food and shelter for mammal species that inhabit the protected forest in plot 97 A RPH Sumbermanjing Kulon KPH Malang. The Javan langur (*T. auratus*) is also known to move around using the canopy covers of vegetations (Aryanti & Azizah, 2019).

The overall diversity of mangrove ecosystems is relatively low compared to tropical habitats, such as coral reefs and tropical rainforests (Lee, Jones, Diele, Castellanos-Galindo, & Nordhaus, 2017). In theory, the habitat type and dense vegetation cover provide shelter for several mammal species. However, the movement of these animals may be inhibited due to the use of corridors through the canopy, which increases the chance of encountering predatory mammals (Gorini et al., 2011). These conditions are more favorable for omnivorous mammals in search of prey, such as *A. binturong* Raffles or *P. hermaphroditus* Pallas. Furthermore, sustained forest conditions with vegetation stands can provide food sources in the form of insects that depend on this vegetation and plant parts (leaves, fruit, flowers, nectar), which are consumed (Susilo & Putri, 2018). This condition is also beneficial for omnivorous mammals, such as civets or the Viverridae family, which consume fruits, insects, worms, snails, and small mammals (Septiyan, Kapsul, & Mahrudin, 2016).

Figure 5 demonstrates that the species richness index (Dmg) of mammals is moderate in the lowland forest but low in coastal and mangrove ecosystems. The Margalef species richness index (Dmg) can be categorized as low, moderate, and high, if the values are < 3.5, > 3.5 - < 5, and > 5, respectively (Arini & Wahyuni, 2016). Moreover, mangrove and coastal forest zones are habitats for a variety of other fauna species, such as birds, reptiles, fish, and invertebrates due to the availability of food sources and several species of vegetation, despite the low species richness of mammals (Rajpar & Zakaria, 2014; Zakaria & Rajpar, 2015). The presence of mammals in mangrove and coastal forests also indicates that these habitats support sources of food and shelter for mammals.

Figure 5 also shows that the number of mammal species in each habitat type is relatively even (E=1) in

the protected forest plot 97 A RPH Sumbermanjing Kulon KPH Malang. Furthermore, these ecosystems have a relatively even level of distribution, though the diversity index is moderate in the lowland and coastal forests and low in the mangrove ecosystem. This condition indicates that the mammal community in the mangrove forest is evenly distributed and home to a variety of species, despite its relatively small size. Several similar mammal species are present in all three habitat types with different vegetation constituents. Specifically, *C. notatus*, which is commonly observed in lowland and coastal forests, can also be found with easy access in the mangrove forest. Also, animals are spread based on dietary factors, hence, they are usually present in an area with easy access to food (Nento, Sahami, & Nursinar, 2013). This condition indicates that the protected forest of RPH Sumbermanjing KHP Malang is in a state of equilibrium with other communities (Nahlunnisa, Zuhud, & Santosa, 2016). The importance of the mangrove ecosystem, which is rich in food sources for several faunas, such as aves, mammals, reptiles, fish, and invertebrates is also seen from the above phenomenon (Zakaria & Rajpar, 2015). In addition, due to the combination of terrestrial, transitional, and aquatic environments, various existing fauna species utilize a variety of hard (soil or mangrove roots) to soft (mud) substrates (Kustanti, 2011).

3.4. Implications of the Distribution and Diversity of Mammal Species in the Protected Forest Area of RPH Sumbermanjing Kulon KPH Malang

The Protected Forest Area of RPH Sumbermanjing Kulon KPH Malang is located in the southern part of Greater Malang, which is fragmented and under significant pressure from human activities. However, because this area remains natural and provides a food source for several animal species, it is an option for the survival of wildlife. Therefore, a variety of partly protected mammals can still exist in this forest.

Ecologically, due to the poor growth of seeds under the canopy of the parent tree, the presence of mammals maintains the regeneration of forest stands by playing a role in the dispersal process of various seeds (Matthesius, Chapman, & Kelly, 2011). This occurrence is also seen in other areas, where the presence of several seed dispersal mammals is essential in the population dynamics of rattan species in the forests of Peninsular Malaysia. Also, this region is highly dependent on the presence of the primate species *Macaca namestrina* Linnaeus (Ruppert, Mansor, & Mohd Sah, 2014). The presence of large and small herbivorous mammal species also aids in the dispersal of different seeds. *T. auratus* Geoffroy, *T. javanicus* Osbeck, *M. muntjac* Zimmermann, and *M. fascicularis* have been recorded as fruit consumers in the protected forest of RPH Sumbermanjing Kulon KPH Malang. Hence, large mammals with considerable amounts of forage consumption and longer movements are effective seed dispersers over long distances (Sridhara, McConkey, Prasad, & Corlett, 2016).

Managers should consider the information on the distribution and diversity of mammal species provided in this research while developing conservation policies and sustainable management systems. The following measures should also be taken to maintain the habitat quality and avoid a reduction in the diversity of mammals in the protected forest plot 97 A RPH Sumbermanjing Kulon: a) provision of warning signs concerning the existence of protected animals, b) educating and socializing the community on the potential of mammals seen in the protected forest, and c) inviting the

community to participate in managing the forest area.

These actions are expected to increase public awareness concerning the importance of protecting the forest and using natural resources, such as special interest tourism. The community may also generate additional income from the forest without disturbing the animals and their habitats. Furthermore, mammal observation, bird watching, plant biosystematics, and forest roaming may be managed together with the community. These measures are quite possible, as the protected forest plot 97 A RPH Sumbermanjing Kulon KPH Malang can support 51 bird species in addition to the mammals (Ardiansyah, Matovani, Pertiwi, Salsabilla & Aryanti, 2020).

4. Conclusion and Suggestion

4.1. Conclusion

The mammals recorded in the protected forest area of plot 97 A Forest Management Resort (RPH) Sumbermanjing Kulon consisted of 23 species with 72 individuals spread across three habitat types. Furthermore, lowland and coastal forests had moderate mammal species diversity, while the mangroves had the lowest. The mammal species evenness index was relatively even for the three forests with different vegetation. This condition is further supported at the tree and seedling level by the significant diversity of vegetation species, which act as a food source in lowland and coastal forests.

4.2. Suggestion

Currently, land conversion in the form of road construction and massive tourism threatens the forest area, which is a habitat for various mammal species. Therefore, the research results on the protected forest of RPH Sumbermanjing Kulon KPH Malang can be used as a basis for determining the appropriate process of wildlife management. Communities around this region are promoted to participate in the area management process in order to build common goals and a sense of togetherness, cooperation, as well as responsibility.

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