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Mammals Diversity in Ranggawulung Urban Forest, Subang, West Java

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Abstract: Ranggawulung urban forest is one of the remaining vegetated sites in Subang. That place needs to be managed sustainably because of its potential to be a strategic location for biodiversity. Biodiversity studies in Rangawulung urban forest need to be conducted periodically to assess and control the impact of urban development. This study was undertaken to evaluate biodiversity in Subang City, especially Ranggawulung Urban Forest as an indicator of biological management in urban areas. There were ten species of mammals found in the Ranggawulung City Forest area from six families. One of the species found, the Javanese slow loris (*Nycticebus javanicus*), is a protected animal in Minister of Environment and Forestry regulations (PermenLHK Number P.106/2018). The animal is categorized as CITES Appendix I and Critical according to the IUCN red list. Diversity (H'), richness (Dmg), and evenness (E') indices of the area species were 2.03, 2.06, and 0.92, respectively. Ranggawulung Urban Forest is considered important as an animal habitat in Subang City and needs to be managed properly and sustainably.

Keywords: Biodiversity; Mammals; Urban forests; Ranggawulung

Introduction

Urban forests have a development goal for urban ecosystems' sustainability, harmony, and balance. Meanwhile, based on their function, urban forests in Indonesia are expected to improve and maintain the microclimate, aesthetic value for community tourism activities, water catchment areas, create balance and harmony in the physical environment of the city and support the preservation of biodiversity (Government Regulation Number 63/2002).

Indonesia is a mega biodiversity country, ranging from the scale of the ecosystem to its genetics (Suhartini, 2009). It is essential for us as citizens to pay attention to the biodiversity that exists in Indonesia.

Ranggawulung urban forest (HKR) as one of the remaining vegetated locations in the city of Subang, has the potential to be a strategic location for biodiversity sustainably. Biodiversity studies in the Rangawulung urban forest need to be conducted periodically to assess and control development impacts. Biodiversity is recognized worldwide as one of the determinants of ecosystem sustainability (Laurilla-Pant *et al.*, 2015). Furthermore, according to Bishop (2003), the current state of biodiversity needs to be known sustainably to be used as an indicator of the sustainability of using natural resources. The study of biodiversity in urban forests becomes increasingly essential when physical development is considered to harm the existence of biodiversity. This study was conducted to calculate the value of biodiversity in Subang City, especially HKR as an indicator of biological management in urban areas.

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Method

Data Collection

Mammal diversity data was collected using *line* transect method. Four line transects total, consisting of two line transects in each area of HKR (HKR) and Campground (Fig. 1). Transects 1 and 2 (southwest) are HKR areas, while transects 3 and 4 (northeast) are Campgrounds. Data collection was carried out for two days (5-12 August 2020) on each transect with three repetitions per day, namely morning (06.00-08.00 WIB), afternoon (16.00-18.00 WIB), and evening (19.00-21.00 WIB).

In addition to using line transects, data collection was also carried out using the Kasmin model mousetrap and a 36 mm-mesh *mistnet* with a length of 9 m with four folds of storage bags (*shelves*). Mouse traps (20 pieces) and mist nets (3 pieces) were installed around the observation area at 18.00-05.45 WIB.

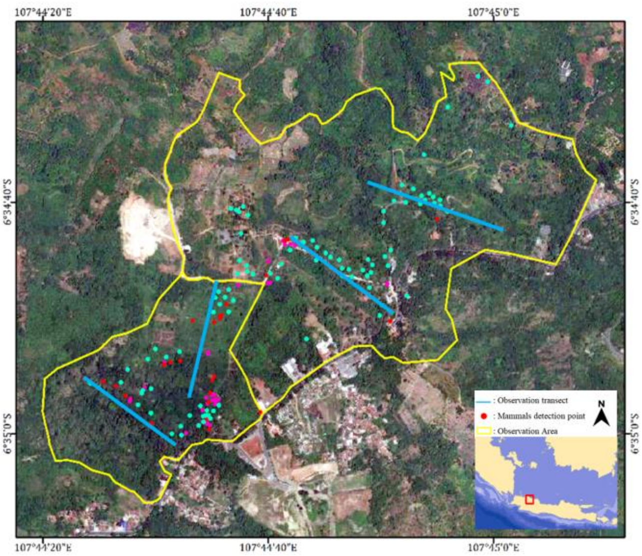

Figure 1. Observation Sites

Data Analysis

Species diversity indices (H')

The value of mammal species diversity was obtained using the *Shannon-Wiener diversity indices* (Magurran, 2004), with the Formula 1

$$H' = -\Sigma\, Pi.\, Ln\, (Pi) = -\Sigma\, (ni/N).\, Ln\, (ni/N) \quad (1)$$

Notes: H' = Indices of diversity, *Ni* = Number of individuals of species I, N = Number of individuals of all species

The significance test of the H' value between communities was carried out using the t-test according to the Hutcheson (1970) method with Formula 2, 3, and 4:

$$t_h = \frac{H_1' - H_2'}{\sqrt{Var.(H_1') + Var.(H_2')}} \quad (2)$$

$$var(H') = \frac{\sum p_i.[\ln(p_i)]^2 - [\sum p_i.\ln(p_i)]^2}{N} + \frac{s-1}{2.N^2} \quad (3)$$

$$df = \frac{[Var.(H_1') + Var.(H_2')]^2}{\left(\frac{Var.(H_1')}{N_1}\right) + \left(\frac{Var.(H_2')}{N_2}\right)} \quad (4)$$

Notes: th= t-count value, Var (H1')= Shannon variance index of the first sample, Var(H2')= variance of the second sample's diversity index, H1'=the first sample's diversity index, H2'=the second sample's diversity index, N1 and N2 = the total number of individuals in the first and second samples, df = degrees of freedom.

The null hypothesis being tested is that there is no significant difference between the diversity index of the first path and the second path. The test criteria used are if t-count $t_{-count} \le t_{\alpha/2;\, df}$ it is concluded that the null hypothesis is accepted, that is, there is no significant difference between the Shannon diversity index in the first and second paths.

Evenness indices (E)

The evenness indices were analyzed using the Formula 5 (Magurran 2004):

$$E = \frac{H'}{\ln S} \quad (5)$$

Notes: E= Evenness indices, S= Number of species, H'= Indices of species diversity.

Specific Richness Indices (Dmg)

The value of species richness found uses the Formula 6 (Magurran, 2004):

$$D_{mg} = \frac{S-1}{\ln N} \quad (6)$$

Note: $D_{mg=}$ Margalef diversity indices, N= number of individuals, S= number of species observed, ln= natural logarithm.

The commonality of the community

The community similarity indices used is the Morisita index modified by Horn using the Formula 7:

$$M_{jk} = \frac{2\sum_{i=1}^{s} x_{ij}.x_{ik}}{\sum_{i=1}^{s} x_{ij}^2 + \sum_{i=1}^{s} x_{ik}^2} \quad (7)$$

Notes: Mjk= Morisita similarity index of the ith community with the kth community based on species, xij and xik=abundance of the ith species in the kth community and the kth community, s=total number of species.

Result and Discussion

Mammals Composition

The total number of mammal species observed in the four observation transect of the Rangawulung City Forest was ten species from six families. The composition of mammal species based on family is one species (10%) Lorisidae, one species (10%) Muridae, one species (10%) Tupaiidae, one species (10%) Viverridae, two species (20%) Sciuridae, and four species (40%) Pteropodidae. All bats (family Pteropodidae) were caught using mist nets, while mice were caught in mouse traps. The most common mammal species found in the observation area was the *Tupaia javanica*. The composition of mammals in the HKR area is shown in Table 1.

Table 1. Composition of mammal species

No	Species	Family	Transect			
			1	2	3	4
1	*Tupaia javanica*	Tupaiidae	3	1	0	0
2	*Cynopterus brachyotis*	Pteropodidae	3	2	1	1
3	*Cynopterus horfieldii*	Pteropodidae	0	2	0	1
4	*Cynopterus minutus*	Pteropodidae	1	2	0	0
5	*Eonycteris spelaea*	Pteropodidae	0	3	0	0
6	*Nycticebus javanicus*	Lorisidae	3	1	5	0
7	*Paradoxurus hermaphrodites*	Viverridae	1	0	2	0
8	*Callosciurus notatus*	Sciuridae	7	5	3	2
9	*Hylopetes Lepidus*	Sciuridae	0	1	0	0
10	*Rattus exulans*	Muridae	3	0	0	0
	Total Individual		51			

Squirrels were the most common species found in HKR; almost all transect of observation (except transect 3) showed that squirrels were the most commonly observed species. This is inseparable from the excellent adaptability of the squirrel and has a variety of feed niches (Andalisa, Rizaldi, & Nurdin, 2018). Squirrels in HKR were observed using various types of plants in the research area, including pine, silk tree, banana, mahogany, teak, and others. The most observed pine is in transect 1 (HKR area).

The highest number of mammal species was found in transect 1 and transect 2 (HKR area), this is thought to be closely related to the more diverse types of vegetation. Vegetation in HKR tends to be denser than in the buffer location. Path 1 found various types of vegetation, including mahogany (*Swietenia mahagoni*), African wood (*Maesopsis eminii*), pine (*Pinus merkusii*), teak (*Tectona grandis*), silk tree (*Falcataria moluccana*), guava (*Syzygium sp.*), bamboo, putri malu. (*Mimosa pudica*), manga (*Mangifera indica*), jackfruit (*Artocarpus heterophyllus*), and flamboyant (*Delonix regia*). While transect 3 and transect 4 tend to be dominated by plantation plants and ponds as well as agricultural plants with a lower amount of vegetation. Araujo *et al.* (2004) stated that plants have a high correlation value with the presence of mammals 0.80. Fithria (2003) added that the diversity of vegetation structures (habitats) affects the number of wildlife species found.

Mammals found in HKR have an ecological and economic role in people's lives, either directly or indirectly. One mammal species in the HKR area is the Lalai flower nectar-eating bat (*Eonycteris spelaea*). According to Bawa (1990), nectarivores (nectar eaters) play an essential role in maintaining forest structures, especially in tropical forests. According to research by Bumrungsri (2013), in Thailand, E. spelae mostly eats nectar from *Parkia* spp. (Petai-petai) (34%), *Musa* spp. (Bananas) (28%), *Eugenia* spp. (Guava) (9, 4%), Oroxylum indicum (bungli flower) (6, 4%), *Durio zibethinus* (Durian) (6.2%), *Ceiba pentandra* (Kapuk) (5.5%), Sonneratia spp. (5.2%), *Cocos nucifera* (Coconut), and several other unidentified plants (2.5%). All of these types are commonly found in Indonesia.

Pineapple, banana, and durian is the largest fruit commodity in Subang Regency. Based on BPS (2020), the production of pineapple, banana, and durian in Subang Regency in 2019 was 187448.2 tons, 134102, 4 tons, and 26414.3 tons. Meanwhile, coconut is the largest commodity in the plantation sector, with a total production of 2510.6 tons. These four types are commonly traded species and have high economic value. According to Bumrungsri (2009), *E. spelaea* is the species that most frequently visits Durian flowers. The discovery of several types of bats, especially *E. spelaea,* in the HKR area, indicates the importance of the value of the area to the economy of residents and Subang Regency in general. Aside from being a place to fulfill food, the HKR area filled with trees, bamboo, bananas, and other plant species is suitable for bats to use as a resting place. According to several studies, the habitat of bats is generally in the form of trees, caves, leaves (Struebig *et al.* 20 10 0), cracks in the ground, rock crevices, cracks in tree bark, cavities in trees, tree stumps (Manning & Jones, 1989) leaf rolls bananas, and bamboo slits (Suyanto, 2001). HKR areas containing various types of fruit can also reduce the adverse impact of fruit-eating bats on the plantations of surrounding communities.

Mammals Diversity

The value of species diversity (H') of mammals found in the HKR area is 1.97, with a value of richness (Dmg) and evenness (E') of species of 2.29 and 0.71, respectively. If viewed based on the observation path, the highest to lowest species diversity values in each path in sequence are transect 2, 1, 3, & 4 (Fig. 2).

The Shannon t-test results showed a significant difference (α=0.05) in the Shannon diversity indices value (H′) between several observation transect. A significant difference was observed in transects 1 and 3, 2 and 3, and 2 and 4. The highest species richness was observed in transect two, while the highest evenness of species was observed in transect 4.

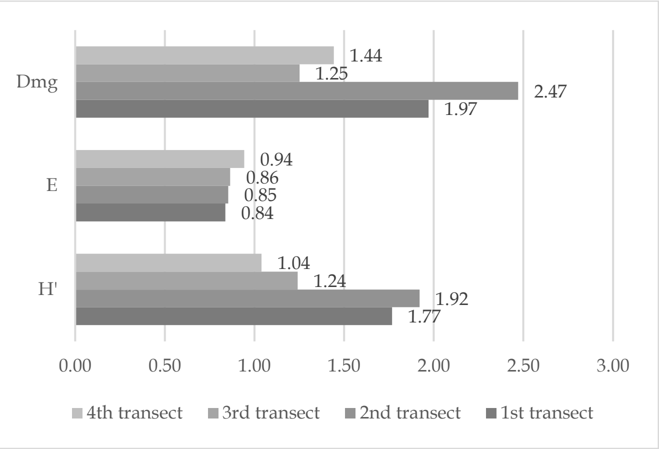

Figure 1 Diversity, richness, and even distribution of mammal species in HKR

In general, the types of mammals in HKR are relatively uneven. Coconut squirrels are the most common species found in HKR, followed by the Javan slow loris and codot krawar as the three most dominant species in the HKR area (Fig. 3).

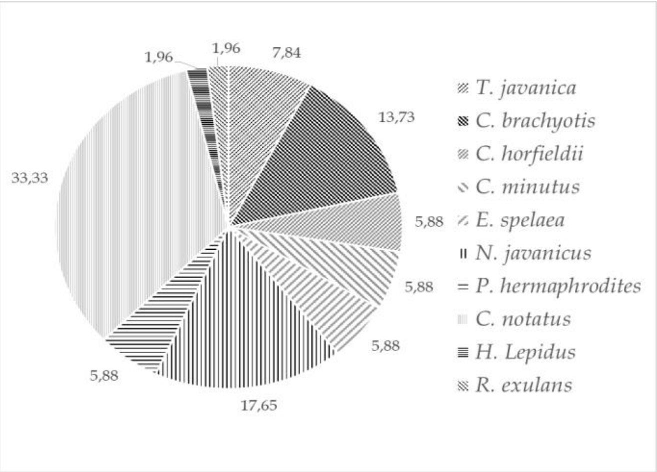

Figure 2dominance of mammal species in HKR.

Biodiversity or biological diversity (biodiversity) is the entire diversity of life forms on earth and their interactions (BAPPENAS 2003). Species diversity is related to community or environmental traits, spatial diversity, intertemporal factors, stability, primary production, productivity, competition, predation, niche structure, and evolution (Heip & Engels, 1974). Feldhamer et al. (1999) explained that biodiversity has two main components: species richness, which is the number of species from an area, and species evenness, which is the abundance of an individual in each species. Information on species diversity is an essential aspect of identifying the structure of species in a community (Menhinick, 1964) which can then be used as a basis for determining management priorities (Hellmann & Fowler, 1999).

Magurran (1988) states that the higher the species diversity in a habitat, the higher the quality of the habitat. The increase in these three parameters was possible because of the availability of feed used by mammals in the form of flowering or fruiting plants found in the observation locations.

Transect 2 and transect 1 (HKR area) have higher diversity and richness than the other two transect, as well as the species encountered observed at each location which is thought to be closely related to the more diverse vegetation types in the area.

Generally, the types of mammals in HKR are relatively even with evenness indices close to 1. Mammals in an area are more evenly distributed (no one dominates) if the evenness indices are closer to 1 (maximum evenness indices). According to Krebs (1999), the evenness value is more even if it is close to 1 and more uneven if it is close to 0. According to Drayer and Richter (2016), the existence of a dominant species causes the species evenness indices to be low.

Mammal Community Similarities

Generally, two clusters are formed based on the number of individuals and types of mammals in each transect. The first cluster with the highest similarity value was formed by transect 2 and transect 4 (75.6 percent similarity), then together they formed a cluster with transect 1 and transect 3 with values of 72.7% and 43.5% (Fig. 4).

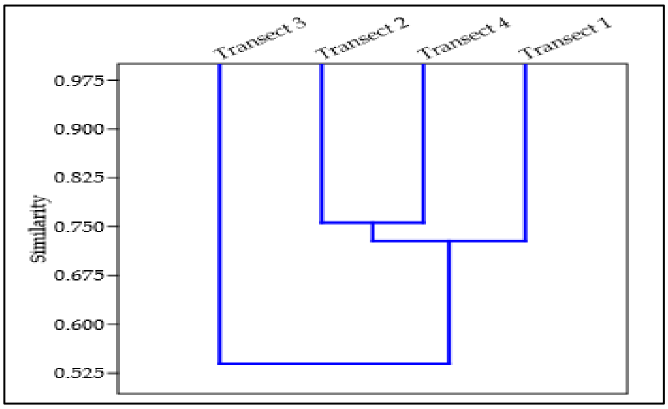

Figure 3 Diversity, richness, and even distribution of mammal species in HKR

Biodiversity studies expressed in the form of biodiversity measures, which include species richness, Shanon-Wiener species diversity indices, and species evenness indices, can lead to misinterpretation if a community similarity analysis is not carried out. This is because the three diversity measures can produce the same value, but the species composition is different. Therefore, it is necessary to analyze the similarity of the community.

Based on the community similarity indices, the three locations tend to have relatively high similarity (46%-76%). The lowest community similarity values were observed in transects 3 and 4. These values were influenced by the similarity in the number of species, and individuals found in both locations tended to be few. It was observed that only codot krawar and coconut squirrels used both areas simultaneously. The highest community similarity was observed in transect 2 and transect 4, where the species found in transect 4 could be observed in transect 2. This result implies that mammal species observed in transect 4 can use transect 2 as their habitat.

Conservation and Protection Status

One of the ten types of mammals found, the Javan slow loris is a protected animal in Minister of Environment and Forestry regulations (PermenLHK Number P.106/2018). This species is also critically endangered, according to the International Union for Conservation of Nature (IUCN) and Appendix I according to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

On the IUCN red list and CITES Appendix I due to its rarity in nature and the high threat of extinction for the species. According to the IUCN, the population of this species tends to decline. Since 2007 all slow lorises have been included in Appendix 1 of CITES (Nekaris & Jaffe, 2007). The entry of slow lorises into the list of animals categorized as Appendix 1 and critically endangered or critical, then the international trade in slow lorises from natural habitats must be strictly controlled and only allowed for particular non-commercial interests with special permits.

The decline in the population of slow lorises and other primates is influenced by various factors, most of which originate from humans, including habitat destruction and hunting for trade. The primate trade is based on various purposes, including pets, consumption, traditional medicine, biomedical research, and zoo animals. Although Indonesian and international law prohibits the illegal trade of slow lorises, these species are often traded illegally (Nekaris, Blackham, & Nijman, 2008).

The high level of hunting and trade poses a serious threat to the sustainability of slow lorises, especially the low birth rate, with a maximum of one cub every one and a half years (Puspita, 2017). Apart from hunting, habitat degradation is also a threat to the sustainability of the slow loris population.

Supriatna and Wahyono (2000) stated that slow lorises eat about 50% of fibrous fruits, various types of animals such as insects, mollusks, lizards, and occasionally eat bird eggs about 40%, and 10% of sap and seeds from seed pods. Leguminosae), including cocoa fruit or seeds. According to Nurcahyani (2015), the presence of gummy trees plays a vital role in the survival of slow lorises. This follows the findings of slow lorises at the observation site, which were generally observed in fruiting plants, had seeds, or had to sap, such as manganese, jackfruit, and flamboyant trees which could be found in transect 1, transect 2, and transect 3.

Slow loris was found in three of the four observation transect within the HKR and campground areas. The discovery point of the Javan slow loris is close to the local causeway. This condition is different from the research of Aryanti *et al.* (2018) which states that the farther the distance from residential areas, the higher the level of slow loris encounters will be. Added by Winarti (2011), the habitat of the Javan slow loris tends to be far from settlements. Loris encounters points close to the causeway used by the community are very vulnerable to hunting activities that will harm the population, especially in the HKR area. Javan slow lorises are hunted for trade. According to Nekaris & Jaffe (2007), illegal trade is still the biggest threat to slowing the loris population decline.

Efforts to protect slow lorises in the HKR area need to be carried out to ensure the sustainability of slow lorises in the area. The protection of slow lorises in HKR can be in the form of providing population monitoring programs and demographic parameters, assessing habitat suitability, and socializing HKR biodiversity with the community. Harmonis (2005) states that in saving endangered wildlife species, supervision must continue to be intensified, increase public awareness, and education on wildlife conservation from an early age, improve the community's economic level, and increase research in finding the right concept in wildlife management. Feldhamer et al. (1999) concluded that several factors that influence the extinction of a species are the increase in human population which results in increased forest conversion and destruction of animal habitats.

Conclusion

The total number of mammal species found in the Ranggawulung City Forest was ten. The coconut squirrel was the most common species in almost all observation transect. Generally, the HKR area (transects 1 and 2) had higher species diversity than the campsites (transects 3 and 4). The species found in transect four can be found in transect 2 with relatively similar numbers. This is one of the reasons why the two transects have the highest similarity of 76%, this result also indicates that the types of mammals in transect four can make transect 2 their habitat. One of 10 mammal species observed in the Ranggawulung City Forest (HKR and campground Area) is a protected species and classified as critical according to the Minister of Environment & Forestry Regulation (PermenLHK P.106/2018) and the IUCN *Redlist*, this species is the Javan slow loris (*Nycticebus javanicus*).

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