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Population and home range of the West Java Black Langur (*Trachypithecus mauritius*) in the forested area of Taman Safari Indonesia

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Abstract

The West Java black langur (Trachypithecus mauritius) is an Indonesian endemic primate found on the island of Java. Status and Conservation of the species is classified as Vulnerable based on the IUCN Red List and is listed in Appendix 2 of CITES. The West Javan langurs have been protected by Indonesian law since 1999. Under the decree of the Minister of Environment and Forestry Number. P.106/MENLHK/SETJEN/KUM.1/12/2018. The study aimed to examine population the population of the species and to determine its home range the forested area of Taman Safari Indonesia Bogor. This research was carried out from January to September 2021. Method The data collection used was a combination of methods concentrated Concentration Count using the observation method directly in the field. Analyze population distribution patterns using Nearest Neighbors, while the population distribution was analyzed using the area of the outermost point of encounter. The results showed that there were two groups of the West Java black langur existed in the area. The first group was around the location of the two houses, the panda palace, and the Jaksa waterfall 32 individuals and the second group was consisted of 15 individuals. Based on the survey, it was estimated that with an population density of T. mauritius in the area was 0.18 individuals/km^2 while the group density was 0.008 group/km^2. Group I was known to have a home range area of 17 ha while Group II had larger home range with 25 ha. The West Java black langur in this area were found to inhabit the upper parts of the forest at the altitude of 1000 to 1550 m above sea level. Population distribution patterns classified as clustered in all West Java black langur groups. The distribution of the West Java black langur population in TSI Bogor covers 58% of the total area.

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Introduction

Indonesia is one of three countries with the richest variety of primates in the world. On the Island of Java itself, there are four endemic primate species such as Javan gibbons (*Hylobates moloch*), surili Javan (*Presbytis comata*), West Java black langur (*Trachypithecus mauritius*), and Javan loris (*Nycticebus javanicus*). The West Java black langur (*Trachypithecus mauritius*) is categorized as Vulnerable based on the International Union for Conservation of Nature (IUCN) Red List Data 2021. Javan langurs have been protected by decree of the Ministry of Forestry and Plantations Number. 773/KptsII/1999 and strengthened by the Decree of the Minister of Environment and Forestry of the Republic of Indonesia No. P.106/MENLHK/SETJEN/KUM.1/12/2018. Here, all the species of Genus Trachypithecus were protected under the two decrees. The species is also listed in Appendix 2 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2016).

Javan langur (*Trachypithecus auratus*) is one species of Indonesian endemic animals. This species can only be found on the island of Java, Bali, Lombok, Sempu Island, and Nusa Barung (Brendon-Jones, 1995; Groves, 2001; Roos et al., 2008). Javanese langur or ebony leaf monkey too It is often called langur budeng or langur betung by Javanese people East (Wedana & Kurniawan,

2011). There are two subspecies of Javan langur (*T. auratus*), namely: *T. auratus* subspecies auratus and *T. auratus* subspecies mauritius. This species is widely spread in the forests situated in West Java Province, Banten Province, and Jakarta. So far, there are two subspecies of the black langur recognized, the eastern black langur (*Trachypithecus mauritius*), and *Trachypithecus auratus*. Spread in the eastern part of West Java Province to East Java Province, Sempu, Nusa Barung Islands, Bali Province, and Lombok. Meanwhile, the Western black langur, *Trachypithecus auratus mauritius* is distributed in Banten Province and the Western half of West Java Province such as in: Ujung Kulon, Jasinga, Bogor, Cisalak, Jakarta, Palabuhan Ratu, to the east on the South coast to Cikaso, or Ciwangi in the interior (Setiawan et al. 2021). According to Roos et al. (2008; 2014); and Mittermeier et al. (2013), the Western black langur race is considered as separate species, *Trachypithecus mauritius*. There are no specific measurements available, but the West Java langur is probably similar to the East Java langur (*Trachypithecus auratus*). Hair of the West Java langur is erect and forward-curled, facial skin is bluish or blackish, and ears have whitish or yellowish tufts. Females differ from males in having a pale, usually yellowish-white, pubic patch. Jaws and teeth are notably large. Palms and soles are slaty-black. The fur is glossy-black, with a very slight brownish tinge, especially on the belly, sideburns, and legs. The West Java langurs are generally similar to East Java langurs but lack the light-tipped hair.

Javan langurs are arboreal and diurnal, spending the majority of their time in trees and active during the day (Suwelo, 1982). They live in groups of about 7 members with 1 to 2 males and 5 to 6 females. However, groups can have up to 21 members, still with only 1 to 2 males. Group sizes vary depending on climatic conditions (Bristol Zoo Gardens, 2009; Nijman, 2000; Primate Info Net, 2007). Females make up the majority of the group due to male competition and the polygamous mating system. Home range is estimated to be 20 to 30 ha. This home range may be larger in Java than on other Indonesian islands. *Trachypithecus auratus* has a population density of 23 individuals/km in the Dieng Mountains of Java. (Nijman and Supriatna, 2008). The langur home range from 15 to 23 hectares with daily movements of around 500 to 1300 meters (Supriatna & Wahyono. 2000). The home range of the langur group will be wider according to the increase in size groups, number of tree species and tree density. The purpose of this study was to obtain data on the population and home range of the *Trachypithecus mauritius* in the TSI Bogor forest area. Search results of various research reports related to *Trachypithecus mauritius* in nature are still very limited so the information available is limited, especially the population and home range of West Java black langur in the Bogor TSI forest area. Considering the importance of data and information about the population size and home range of West Java black langur in TSI Bogor, it is necessary to do this research on the population and home range of West Java black langur in the region.

Materials and Methods

Study site

This research was carried out from January to September 2021 which is located in the TSI Bogor forest area. West Java. Indonesia. Administratively, TSI Bogor is located in Village: Cibeureum, Subdistrict: Cisarua. Bogor Regency. West Java Province. Geographically, TSI is located at 06°42'10"-06°43'25"- South Latitude (S) and 106°56'40"106°57'40" East Longitude (E), at an altitude of 1000 to 1550 meters above sea level (asl). The northern (downstream) boundary is a settlement and mixed garden, while the southern boundary is the Mountain Gede Pangrango National Park (MGPNP) area so the location of TSI Bogor is classified as an MGPNP buffer zone. The TSI Bogor area which has an area of 2.650.000 m^2 (265 ha) is a former tea plantation and mixed garden owned by the Cisarua Selatan tea plantation company which is no longer productive. In the General Spatial Plan (RUTR) for the Puncak Area (Keppres 79/85), the TSI area is included in the non-agricultural cultivation area which is designated as a Tourism Area, namely the Puncak Indah tourism area (covering 3 sub-districts including Ciawi, Megamendung, and Cisarua). The total forest area in (Figure 1) of parks and afforestation is 2.495.737 m^2 (249 ha). In general, the TSI Bogor forest is an area with a wet climate with an average rainfall of 3.000 to 4.000 mm/year. The rainy season lasts from October to May, and from December to March the rainfall can be more than 400 mm/month. The average temperature at the TSI Bogor is 18°C with relatively high humidity throughout the year, which is around 60-95%.

Data collection and analysis

The data collected in this study includes primary and secondary data. Primary data was obtained through direct observation in the field.

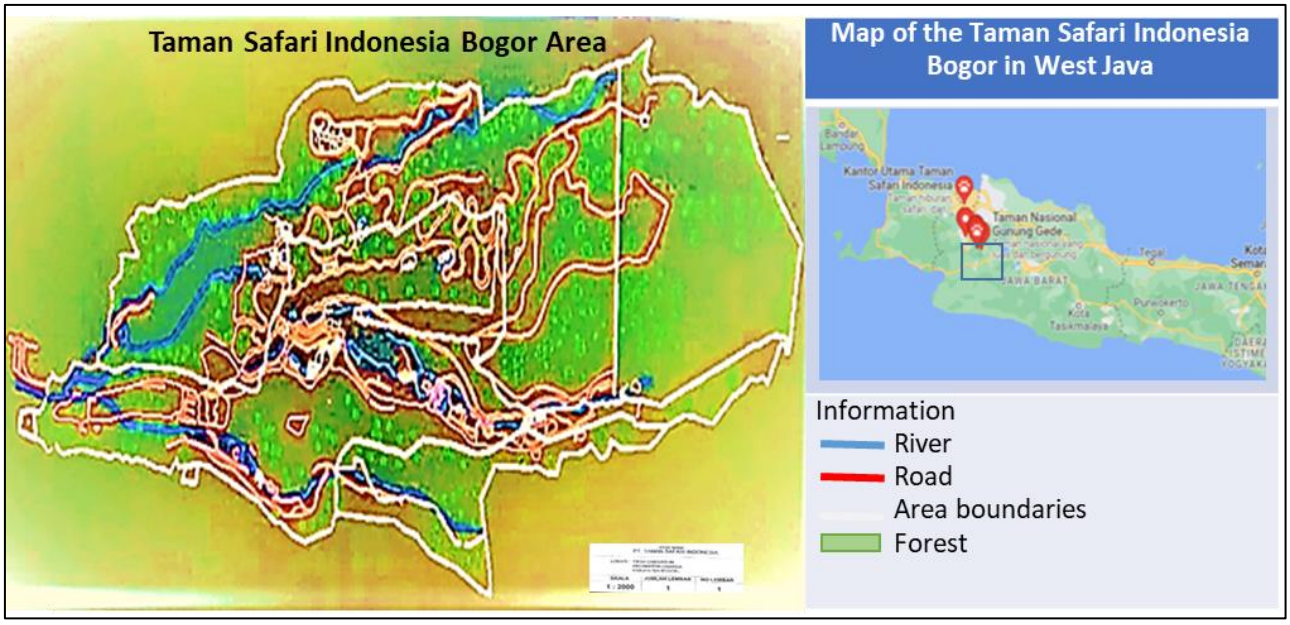

Figure 1. Map of the forest area in Taman Safari Indonesia. Bogor. West Java and Map of the Java Island.

Initial observations in the field were carried out to identify places where West Java black langur congregate. Secondary data was obtained through literature studies and information from previous studies.

1. Population

The population data sought is data number of individuals, group composition including sex ratio and age structure. A count of the number of individuals was carried out at 07.00 - 12.00 WIT and 13.00 - 17.00 WIT. Each group was repeated 20 times. The method used is method concentrated, namely in sleeping locations and searching locations the feed. The location is then marked with GPS. Retrieving data when something is detected individuals or groups of West Java black langur, the researcher stopped and recorded the coordinates of the encounter, number of individuals, and group composition.

Population data for each group is recorded in a tally sheet containing the column number of groups, and the number of individuals (adult males, adult females, young males, juvenile, and infant). To identify physical characteristics and age, standards created by Lim and Sasekumar (1979) and Napier and Napier (1967) were used.

2. Home range

Data retrieval of the West Java black langur range is carried out by tracking, namely following and identifying position points based on the activities of the West Java black langur group and mapping their roaming routes using the GPS. The method used to connect the outermost coordinate points where the West Java black langur active is the direct encounter method by following the movements of the West Java black langur.

Data Analysis

1. Population

Population density is the size of the population (individuals) divided by the area of the study (ha):

$$D = \frac{P}{A}$$

Description:
D = Population density (individual/km^2)
P = Total individuals detected during observation
A = Total area of observation (ha)

Calculation of the estimated population of West Java black langur answer can be calculated with the following equation:

$$P = D \times A$$

Description:
P = Estimate population (individual)
D = Population density (individual/km^2)
A = Representative habitat area

Table 1. The number of individuals in the TSI Bogor forest area.

Groups	Adult		Juvenile	Infant	Total (individual)
	Male	Female			
1	6	8	10	8	32
2	3	5	5	2	15
Total Groups = 2	**9**	**13**	**15**	**10**	**47**

Figure 2. The Group of West Javan black langurs, in the Taman Safari Indonesia Bogor forest area.

2. Home range analysis

Home ranges of each group of West Java black langurs in answer were analyzed quantitatively and descriptively. Quantitative analysis was carried out to determine the home range area and home range length. Calculation of the home range area was carried out using Minimum Convex Polygon (MCP) analysis. MCP is the most popular and widely used method for estimating home range areas. Descriptive analysis is a description and explanation of the home ranges of each group of West Java black langur studied in the form of pictures and tables based on direct field observations. The parameters measured included: the daily range carried out for nine months, namely the length of the langur group's roaming which is carried out during their active time every day from leaving the sleeping area to the next sleeping location. The maximum radius is the farthest distance from the daily cruising route.

Results

Population Estimate of *T. mauritius*

The results of data collection in the field obtained the number of individual West Java black langurs as many as 47 individuals which were divided into 2 groups, namely Group 1 as many as 32 individuals, and Group 2 as many as 15 individuals (Table 1), with an individual density of 0.18 individuals/km^2 and a group density of 0.008 individuals/km^2 (Figure 2).

Home range

Based on calculations carried out using the Minimum Convex Polygon method, it is known that the West Java black langur's home range is as follows: Group I is estimated to be 17 ha and Group II is 25 ha in the Bogor TSI forest area. If the West Java black langur moves to meet its needs, the West Java black langur group can move to another group's home range. The overlap is located in areas where conflicts often occur between groups I and II. The conflict between the two groups occurred at the border of the recreational highway and was detected when voices were heard from one of the groups or both groups. Equal distribution of food sources with high potential causes weak group defense of home ranges, resulting in overlapping home ranges. The home range of West Java black langurs often overlaps between group I and group II using the MCP method, namely 7.1 ha. Apart from being an indicator of the availability of food and shelter, the home range of the West Java black langur group can also be used to interact with other group members, thus opening up opportunities for the formation of new groups (Figure 3).

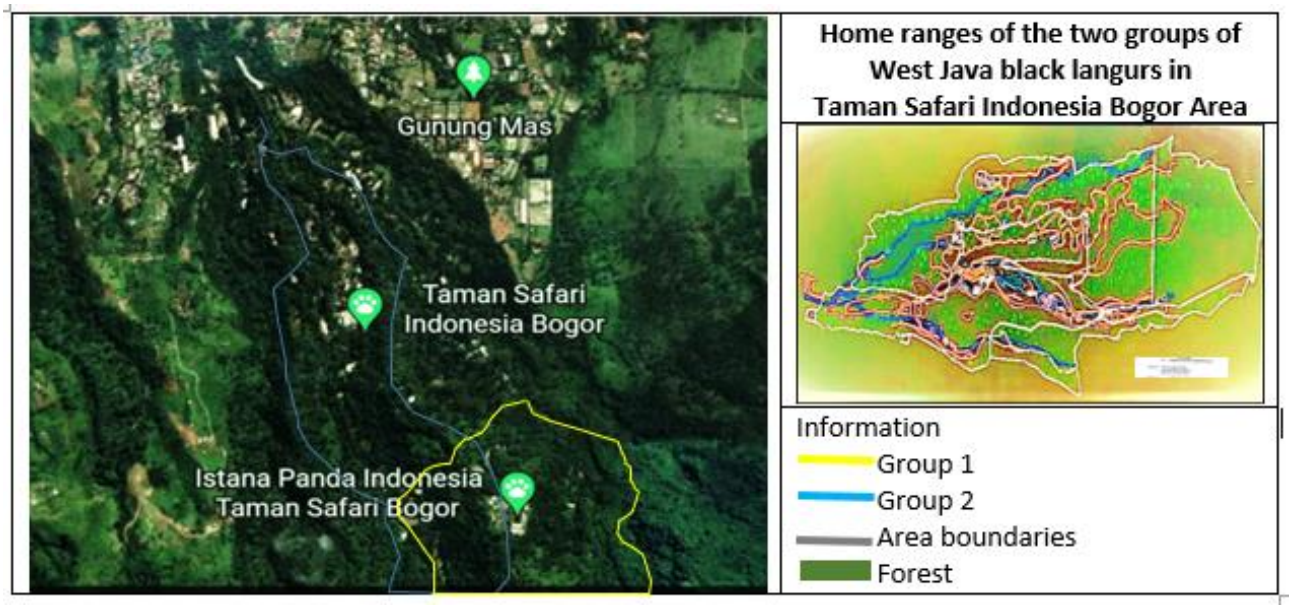

Figure 3. Description of the home ranges of the two groups of West Java black langur in West Java. Group 1 with the yellow line and Group 2 with the blue line.

Discussion

Population Estimate of *T. Mauritius*

In the two groups found in the TSI Bogor area. The dominant male langur always leads the group in daily activities. Langur adheres to a one-male system with many females. In Table 3 above, it can be seen that there is an increase in population and habitat conditions in TSI Bogor which are still good. In line with research by Sari et al. (2020) that the Javan langur is included in the uni-group which has one male and several females in the group. During the study, many female adults brought their infants in groups (infants were orange). Infant with yellow pelage spent more time being held and screamed, while babies with black pelage spend more time moving around and feed. The number of neighboring animals decreases when the baby pelase turns black, which implies that the group members are attracted to the baby's yellowness (Trisilo et al. 2021). The lower the level of disturbance to the area and the number of available feed sources, the more the population will increase. By the statement of Wedana et al. (2013) categorizes the entire APNP area as a good habitat for the Javan langur because it has a fairly low level of disturbance.

The number of animal populations is very necessary for effective and sustainable management of the area. Inventory of wildlife and their environment is an important initial step in wildlife management. Counting the number of individuals for each group was carried out when the group was in sleeping trees and resting trees, and when the black langurs in charge crossed between trees. After the number of groups and the number of individuals can be counted, the next step is to identify the age structure and sex ratio in each group, while the composition of the age structure and sex ratio was identified based on physical and morphological characteristics of the black langurs which could be accounted. According to Leca et al. (2013) the size of the Javan langur population is between 4 to 26 individuals.

Javan langurs live in groups with one adult male and several juvenile males, females and young (Bennerr and Davies 1994; Nijman 2000). One group numbers between 6 to more than 23 individuals (Supriatna and Ramadhan, 2016), 3-30 individuals (Nijman 2000). Primate population density at generally affected by availability or habitat quality (Chapman et al. 2017; Bernard et al. 2019). It is too stated by Dharma et al. (2020), if the carrying capacity of the habitat is not able keep pace with rapid growth population, then the population in the habitat is reduced drastically. The main threat to all primates globally is population pressure on habitat due to hunting and fragmentation (Estrada et al. 2017; Chetry and Bhattacharjee 2019). According to Mustari & Pasaribu (2019) the high adult composition illustrates the regeneration process of the Javan langur and the condition of its habitat is in good condition.

To determine the distribution of the West Java black langur population in the conservation area at TSI Bogor, we collected data from the results of a forest area survey. The survey results showed that the West Java black langur population based on data obtained from the survey contained two groups with a total of 47 individuals, whereas

based on the previous year's data no population data was found.

The West Java black langur population in TSI Bogor still survives in conservation areas. Even though there are locations where groups of West Java black langurs were not found during direct observations in the field, we still assume that is the case.

The West Java black langur group was not found at this location. Because, based on repeated surveys with several members, we have never encountered a group of West Java black langurs in other locations. Since no groups of West Java black langurs were found at this location during the survey, we assume this is the case. The population density in the area is very low so the chance of encountering it is small.

Home range

The langur is an animal that can inhabit various types of forests with vegetation different. West Java black langur at TSI Bogor is found at an altitude of 1000-1550 m above sea level. In the research of Astriani et al. (2016) at Balanan Resort, Baluran National Park, has the highest encounter with Langur from a height of 0-450 m above sea level. Not much different from the encounter of Langur in the Puncak Cemara forest area of KPH East Rinjani where the highest encounter ranges from an altitude of 450 – 1850 m above sea level. The three groups of langur can be differentiated based on different group sizes, as well as geographical conditions in the form of the height and thickness of the forest which is quite far away and where it meets.

The wide home range of the West Java black langur often results in overlapping or overlapping with other primates, such as the Javan gibbon, surili langur, long-tailed macaque, and Javan slow loris. Other groups that enter the home range or territory of another group are sometimes attacked by the dominant male. However, sometimes these two groups of West Java black langurs can coexist without fighting. Based on this research, it is known that the distribution pattern of West Java black langur in the TSI Bogor forest has a clustered pattern. The Javan Langur distribution has the lowest and highest altitude at 13 m asl and 120 m asl, respectively. However, the Javan Langurs can utilize habitats with varied altitudes until 3000 m asl (Nijman 2013). We assume the structure of vegetation and physical factors of the environment at different altitudes affect Javan Langur distribution. Lowlands have a more diverse vegetation structure compared to the highland (Monge-Gonzalez 2019). The West Java black langur habitat conditions in forest areas TSI Bogor have temperatures ranging from 16°-29°C with humidity between 60-95%.

Home ranges are areas that animals visit regularly because they can provide food, drink and has a function as a shelter and hiding, sleeping and mating places (Alikodra 2002).

In general, the home range is influenced by the availability of feed sources and the number of individuals in the group. The primate home range is also influenced by feed sources, sense of security, group competition, rainfall, human activity and group size (Winarno and Harianto 2018). These results are consistent with Dong et al. (2019) which revealed that altitude and settlement are key factors in determining habitat suitability.

A home range is an area where an animal lives that are not defended against the entry of other animals into the area. If the area has started to be defended, then the area becomes its territorial area. Home range is estimated to be 20 to 30 ha. This home range may be larger in Java than on other Indonesian islands. West Javan ebony langurs are diurnal (active during daylight hours) and arboreal (tree-dwelling), moving quadrupedally (on all fours) through the trees. Based on related species, their home range size is likely about 74 acres (30 ha) on average. Adults spend more than half of their day resting (61%, according to one study), longer than most frugivorous (fruit-eating) primates, and this is likely because their special digestive system requires more rest time to completely digest feed. Juvenile West Javan ebony langurs spend less time resting and feeding and more time moving than do adults (NPC 2021). Furthermore, defines the home range as an area visited by wildlife regularly because it can supply feed, drink, a place to sleep and mate, and function as a shelter. It was further stated that the size and stability of home ranges varied according to feed sources and types, topography, population density, predators, and group size.

Conclusions

In the TSI Bogor forest area, two groups of answerable West Java black langurs were found, namely Group 1 consisting of 32 individuals, and Group 2 consisting of 15 individuals, with an population density of 0.18 individuals/km^2 and a group density of 0.008 groups/km2. With an estimated population 47 ranging from 1 to 47 individuals.

Group I is estimated to be 17 ha and Group II is 25 ha in the TSI Bogor forest area. The West Java black langurs in this area is able to live in the highland forest with an altitude of 1000-1550 m asl, with varying numbers and sizes of groups, one

of which is in the TSI Bogor forest area. The average temperature at the TSI Bogor is 18°C with relatively high humidity throughout the year, which is around 60-95%.

TSI Bogor is a general conservation institution that has an important role in preserving the West Java black langur in charge. For this reason, TSI Bogor continues to maintain sustainability and maintain the population of the West Java black langur in the TSI Bogor forest area.

The Author's Contribution

Walberto Sinaga, Jansen Manansang, and Sri Supraptini Mansjoer created the research concept; Walberto Sinaga, Jansen Manansang, and Sri Supraptini Mansjoer designed the study; Walberto Sinaga obtained permission for research and data management collection; Walberto Sinaga, Walberto Sinaga data collection in the field; Walberto Sinaga analyzed data and write scripts; Jansen Manansang, Sri Supraptini Mansjoer, and Walberto Sinaga provided input and approve the final draft.

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Conflict of Interests

The authors declare that there are no conflicts of interest.

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