



Long-Tailed macaque (*Macaca fascicularis*) population demographic and spatial use pattern in Telaga Warna, Bogor

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Article Info:

Received: 27 - 01 - 2023

Accepted: 27 - 03 - 2023

Keywords:

Home range, land use cover, population density

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Abstract. *Telaga Warna Nature Reserve and Nature Park is one of the animal and plants conservation areas in West Java, with an area of 496,49 ha. The long-tailed macaque is one of the protected animals at Telaga Warna. Based on the IUCN Redlist, long-tailed macaque are currently included in the endangered species. The largest decline in the long-tailed macaque population is due to illegal hunting. Given the declining condition of the long-tailed macaque population, this study was conducted to analyze the demographics of the population and analyze the home ranges of long-tailed macaques in Telaga Warna. The research was conducted in March-May 2021 at Telaga Warna. The data collected includes population demographics, home ranges, and habitat use. Analysis of population demographic data used concentration calculations based on sex and age structure, home ranges using a minimum convex polygon and habitat use was analyzed. The results of the research showed that there two groups of long-tailed macaque with a total of 64 individuals. The long-tailed macaque population will decrease because it has a regressive population with sufficient space and a low total population density of 0.13 ind/ha. The home range area of group A is 13.8 ha and group B is 6.26 ha. The home range area of group B is influenced by the size and age structure of the group. The long-tailed monkey group both use forest land cover, plantations and water bodies, and are found at an altitude of 1,400–1,600 masl with gentle to very steep slopes (> 8%).*

How to cite (CSE Style 8th Edition):

Hartati BR, Santoso N, Arief H. 2023. Long-Tailed macaque (*Macaca fascicularis*) population demographic and spatial use pattern in Telaga Warna, Bogor. *JPSL* 13(3): 472–480. <http://dx.doi.org/10.29244/jpsl.13.3.472-480>.

INTRODUCTION

The Telaga Warna Nature Reserve and Nature Tourism Park were conservation and protection areas for animals and plants in West Java. The Telaga Warna Nature Reserve was made into a conservation area based on the Decree of the Government Besluit (GB) No. 26 July 7 1927, and GB No. 14, and the appointment of TWA Telaga Warna based on the Decree of the Minister of Forestry Number 195/Kpts-II/2003 concerning the designation of forest areas in West Java Province, with an area of 496.49 ha. One protected animal in the Telaga Warna area is the long-tailed macaque (*Macaca fascicularis*). Long-tailed macaques are a type of primate that is widespread worldwide, one of which is in Indonesia. The distribution of long-tailed macaque occupies habitats such as primary rain forests, lowland forests, secondary forests, mangrove forests, riparian

forests, mountain forests, swamp forests, coastal forests, mangrove forests, agricultural areas, plantations, and habitats that are quite close to the main road and residential areas (Ain-Najwa et al. 2020; Al Hakim and Nasution 2021). The wide distribution shows that long-tailed monkeys have a high level of adaptation.

Despite having a wide distribution and high adaptability, long-tailed macaques are currently included as Endangered species based on the IUCN Redlist (IUCN 2022). This means there was an increase in status from vulnerable in 2020 (Eudey et al. 2020). The increase in status occurs due to a decrease in the global population caused by reduced natural habitat for long-tailed monkeys (IUCN 2022). The largest decline in the long-tailed monkey population in Indonesia was due to illegal hunting (IUCN 2022). Given the declining condition of the long-tailed macaque population, this study aimed to 1) analyze the population demographics and 2) analyze the home range of long-tailed macaques in Telaga Warna.

METHOD

Research Location and Time

The research was conducted in the conservation area of Telaga Warna Nature Reserve, Telaga Warna Nature Tourism Park and Jember nature reserve area. These three areas are on the border between Bogor district and Cianjur district. This observation was carried out for three months from March to May 2021.

Tools and Subjects

The tools used in this study include the Global Positioning System (GPS), Tally sheets, cameras, compasses, Arc GIS 10.4, and binoculars. The subjects of this study were long-tailed macaques at Telaga Warna.

Data Collection

Population Demographics

Demographic data were collected by direct observation of the size of the long-tailed macaque population using the concentration count method based on the initial survey and information from Telaga Warna conservations officers. Observations were made on two groups of long-tailed macaques by counting the number of individuals based on the sex and age class of each group. The calculation was carried out with three repetitions (Sangkauw et al. 2019; Sari et al. 2020). Repetitions were performed to reduce bias from the observer (Sabaruddin et al. 2017) and reduce research error (Wulandari et al. 2022). The data recorded during the observation were the number of individuals in each group and individuals by sex and age class. The number of individuals recorded was individuals found/seen directly in observation.

Home Range

Home range data was collected by taking the coordinates of long-tailed monkey movements using GPS. Data collection was carried out by following the movements of the Long-tailed macaques from leaving their nest in the morning (06.00 am) until returning to the nest in the afternoon (06.00 pm) (Martin and Bateson 1993; Yanuar 2017; Zeksen et al. 2021; Laynurak 2022). The data collection for the coordinates of the long-tailed macaque groups was carried out when they were active in the tree and when they moved to the next tree. The data was then overlaid with the Nature Reserve and Nature Tourism Park Telaga Warna maps.

Land Use Cover

The spatial use data used was based on the physical aspects of the home range of the long-tailed macaques. The long-tailed macaque home range data was overlaid with a map of the land cover, slope, and elevation of the Telaga Warna area. The land cover map was obtained from the classification of the Nature

Reserve and Nature Tourism Park Telaga Warna land cover maps using the Landsat 8 OLI Imagery satellite. Slope and elevation maps were obtained from SRTM maps. The analysis flow of land cover, slope, and elevation maps can be seen in Figure 1.

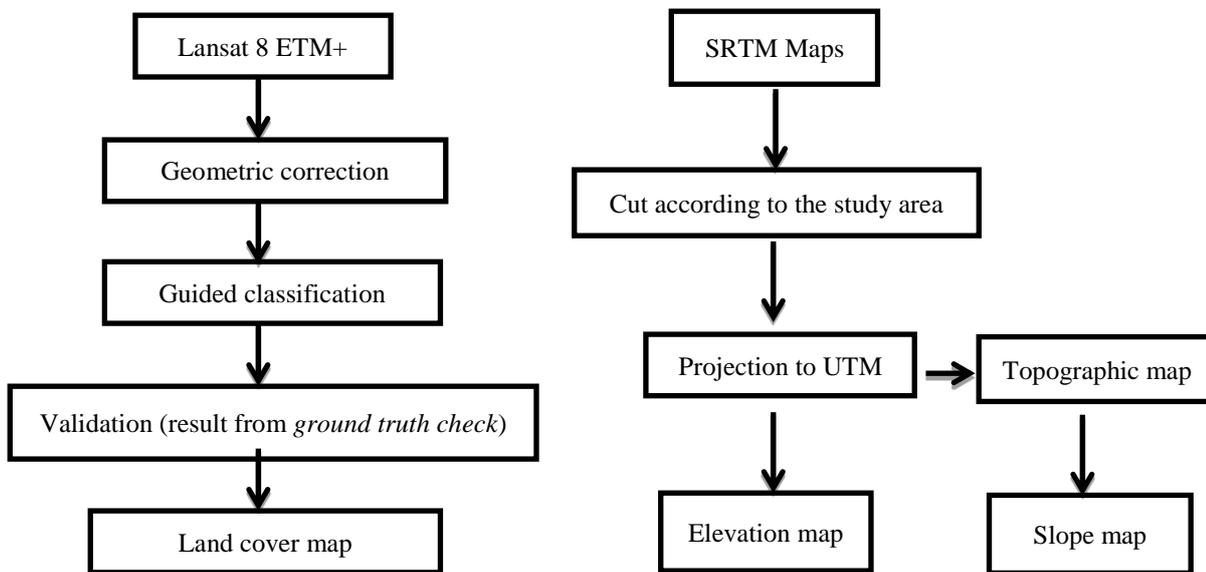


Figure 1 Flow chart for making a spatial use pattern map

Analysis Data

Population Demographics

The population size was obtained from the census results of the highest number of individuals from all observations. The population density was obtained by calculating the number of individuals per study area using the formula (Southwood and Henderson 2000).

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

Explanation:

D: Density

Q: Population

A: Area

Sex ratio was obtained by calculating the number of males and females (Binsasi et al. 2020) using the following formula:

$$S = \frac{Y}{X}$$

Explanation:

S: Sex ratio

Y: Number of male individuals

X: Number of female individuals

The age structure was obtained by comparing the number of individuals for each age class of a population by counting and grouping the number of adult males, adult females, adolescent males, adolescent females, and young and infants (Santosa and Sitorus 2008). Age classes are grouped as infants (0–1.5 years), young (1.5–4 years), adolescents (4–9 years), and adults (9–21 years) (Tokachil and Yahya 2019).

Space Usage

The coordinates obtained were then mapped and overlaid with the Telaga Warna Map. Home ranges were obtained by connecting the outermost coordinate points where long-tailed macaques were active using a minimum convex polygon. Home range results were then analyzed descriptively. The physical aspects of the long-tailed macaque's habitat were analyzed descriptively by comparing the conditions between the observed groups of long-tailed macaques.

RESULTS AND DISCUSSION

Long-tailed Macaque Population Demographics

Population Size

Observations of long-tailed macaques in the Telaga Warna area identified two groups, Group A and Group B, presented in Table 1. Group A consisted of 26 individuals, and Group B had a larger number of individuals than Group A, which was 38. The difference in the number of individual groups is thought to be due to differences in the habitat conditions where the groups live. Based on observations, group B has relatively more food sources than group A, so they can develop better. This result was in line with Sampurna (2014), which states that feed is one of the determining factors for the size of the long-tailed macaque group.

Table 1 Size and composition of long-tailed macaques in the Nature Reserve and Nature Tourism Park of Telaga Warna

Group	Group size	Number of individuals (ind)					
		Infants	Young	Adolescent		Adult	
				Male	Female	Male	Female
A	26	4	4	3	4	4	7
B	38	8	5	4	5	6	10
Total	64	11	9	7	9	10	17

The total number of individual long-tailed macaques for the two groups in Telaga Warna was not much different from the previous study, namely Nila et al. (2014), as many as 50 to 63 individuals and Nugraheni (2016) as many as 47–70 individuals. The population conditions that were not much different are thought to be related to habitat conditions that have reached the optimum point to support the long-tailed macaque population. This was in line with Hidayat (2012) and Jannah et al. (2019), who said that the number and size of long-tailed macaque groups in an area are very closely related to the carrying capacity of its habitat. In addition, according to Dhaja et al. (2019) the population size of a group can be affected by birth rates, death rates, immigration, and the ability to compete with other groups.

Population Density

The results of observations and calculations of the density of the two groups of long-tailed macaques, based on the total area (496.49 ha) in Telaga Warna, were 0.13 individuals/hectare. Based on the group's home range, the density in group B (6.1 ind/ha) was higher than in group A (1.9 ind/ha). According to Lesson et al. (2004), the population density of long-tailed macaque in natural habitats without additional feed has a maximum capacity of around 1,000 kg of biomass/km² or around 333 individuals/km² with an average weight of long-tailed monkeys of 3 kg or around 3–4 individuals/ha. This means that overall, the Telaga Warna area has a lower population density of long-tailed macaques (0.13 < 3–4 ind/ha) compared to Lesson et al. (2004).

Sex Ratio

The results of observations on the gender of long-tailed macaques in the adult and adolescent age classes showed that the sex ratio of the long-tailed macaque population in Telaga Warna as a whole was 1:1.53, which means that there were more females than males. According to Napier and Napier (1985), the normal ratio of males and females in one group is approximately 1:2, which means that the sex ratio of long-tailed macaque in Telaga Warna could still be considered normal. The sex ratio for each group can be seen in Table 2.

Table 2 Sex ratio of long-tailed macaques in Telaga Warna

Group	Number of males	Number of females	Males:Females
A	7	11	1:1.57
B	10	15	1:1.5

In general, the sex ratio of long-tailed macaques was 1:2, with the difference between the two groups not too high. These results were almost the same as the research of Surya (2010) at the Batu Tegi Dam in Lampung, Hidayat (2012) in the Gunung Walat Educational Forest, and Sampurna (2014) on Peucang Island. The sex ratio is related to the reproductive behavior of the long-tailed macaque group and influences competition between males to mate with females so that fights can occur. In line with the opinion of Subiarsyah et al. (2014), who said that if the number of adult males is more than the number of adult females, it can cause high tension (fights) in fighting over females in heat.

Age Structure

The age structure for group A of long-tailed monkeys in Telaga Warna with a total of 26 individuals there were 4 infants, 4 young, 7 adolescents, and 11 adults. In group B, with 38 individuals, there were 8 infants, 5 young, 9 adolescents, and 16 adults. The age structure can be used to assess population conditions and prospects for population development so that the sustainability of the animal population in that location can be estimated. Based on Figure 2, it can be seen that the age structure of the long-tailed macaque in Telaga Warna describes the adult class more than the younger class, which means the population was regressive. Based on the age approach, according to Vrazila et al. (2022) a regressive population generally shows unstable growth, which indicates a declining population and extinction. These conditions, if there was no change in environmental conditions, may indicate population extinction after some time (Tarumingkeng 1994).

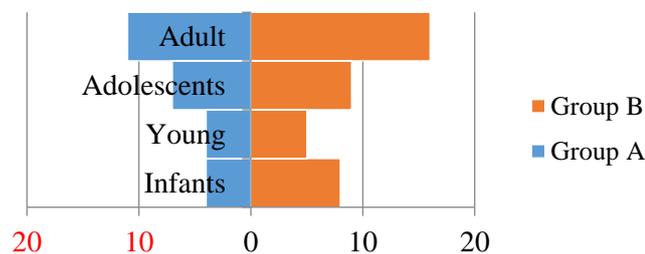


Figure 2 Age structure of long-tailed macaques in Telaga Warna

Spatial Use Pattern of Long-tailed Monkeys (*Macaca fascicularis*)

Home Range

Home range analysis results show that each group of long-tailed macaques has a different area and daily range. In Table 3, it can be seen that Group A has a wider home range than Group B. Home ranges vary according to the state of the environmental resources (Kusumadewi et al. 2014). Alikodra (2002) explained

that the size of the home range for a primate species was determined by two factors, namely the trips that can be taken every day by each member of the group and the dispersal of the group. The smaller home range of Group B was thought to be related to the larger population size and more age classes of infants in the group. This affects the movement ability of the group and shortens the daily distance traveled (Alikodra 2002). The home range area overlap between groups A and B was 1.93 ha. Group A and B, when they met, did not show aggression towards each other. Overlap occurs in forest and plantation areas where there are food sources.

Table 3 Home range area and long tail monkey range

Group	Cruising area (Ha)
A	13.80
B	6.26
Overlay of A dan B	1.93

Home Range Characteristics

Land cover

The results of the analysis of land cover in the Nature Reserve and Nature Tourism Park of Telaga Warna area and its surroundings show that there are five land covers; forests, water bodies (lakes), open land, settlements, and plantations. The two groups are distinguished by coloring the line of the group's home range, a blue line for Group A and a red line for Group B.

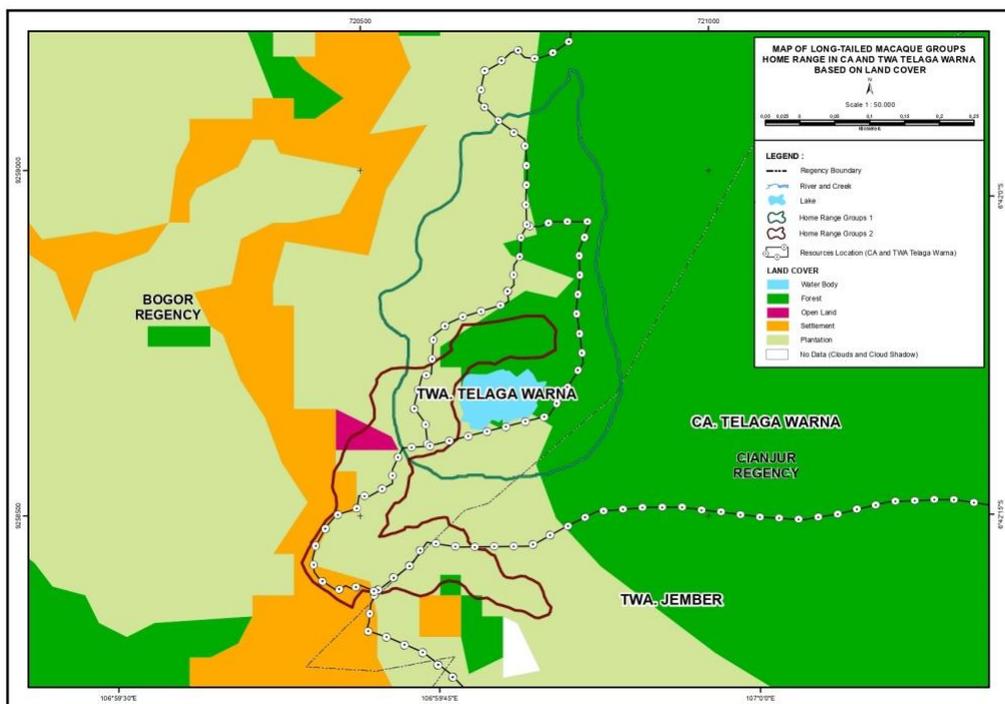
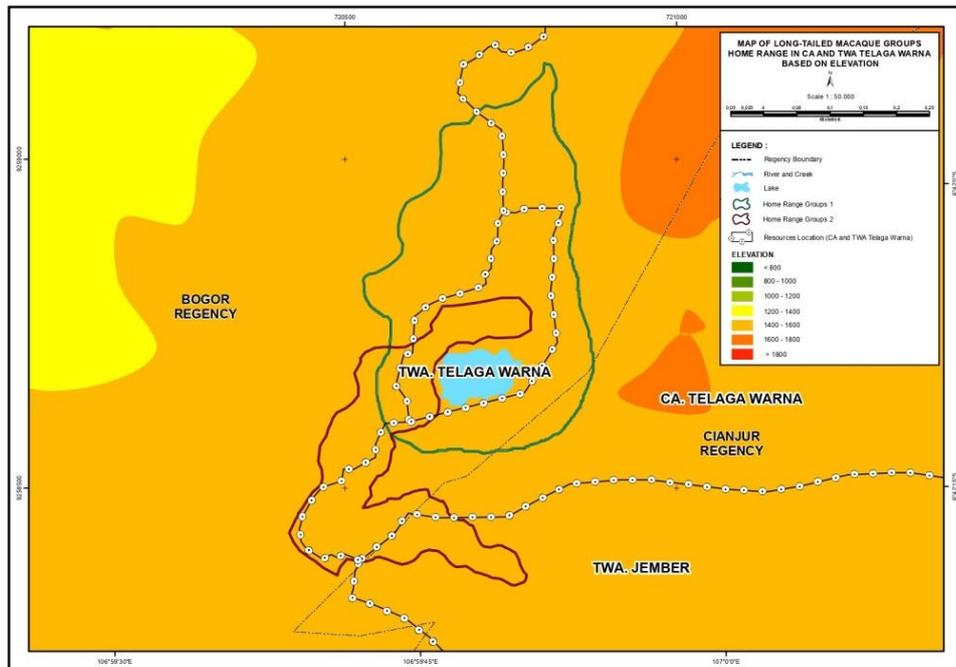


Figure 3 Land cover map

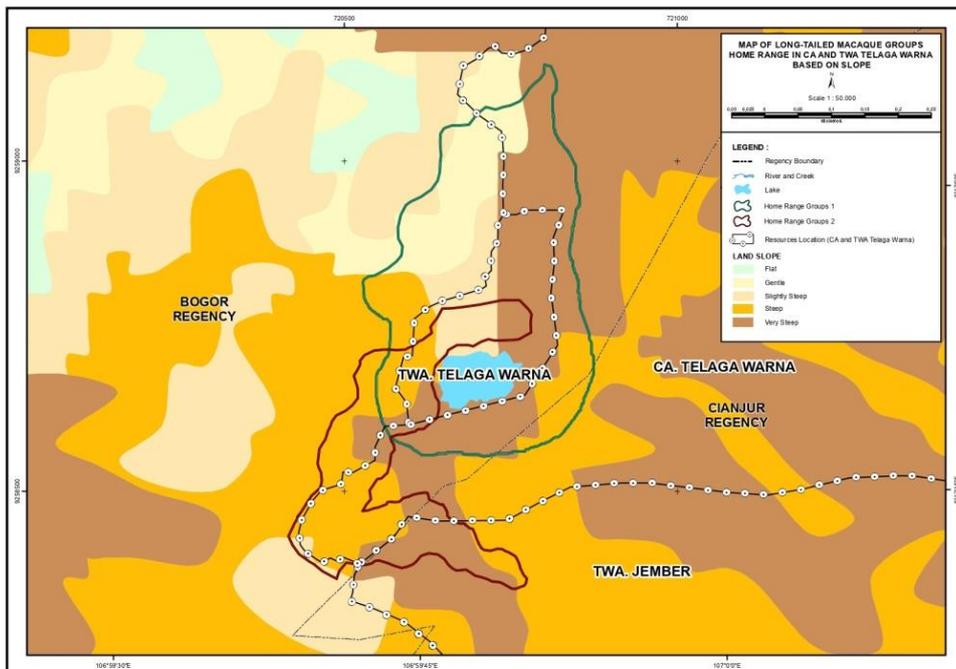
Figure 3 shows that Group A long-tailed macaque was found in forest land cover, plantations, and water bodies (lakes) in the Nature Tourism Park area and Nature Reserve of Telaga Warna. Group B was found in forest land cover, plantations, settlements, open land, and water bodies. It can be seen that there was an overlap in the spatial use of forest land cover areas, plantations, and bodies of water (lakes) in the Telaga Warna TWA area. The overlap in the use of space for long-tailed macaques occurs because it was influenced by several factors, such as the presence of several types of food-producing plants and the presence of feeding activities by visitors who travel around the Telaga Warna lakes. According to Sembiring et al. (2016), the availability of food sources was the main factor for gathering animals.

The elevation and slope of the land

Both groups of long-tailed macaques in Telaga Warna were found at altitudes of 1,400–1,600 meters above sea level and on gentle to very steep slopes (> 8%) (Figure 4). These results differ from the results of a study by Santosa et al. (2013) which stated that long-tailed macaques in Gunung Walat University Forest were found at an altitude of 410–772 masl on a slope of 0–78%. This difference was thought to be due to the geographical differences between the two places, namely Telaga Warna and Gunung Walat University Forest, Telaga Warna was located at a higher altitude than Gunung Walat University Forest. These results indicate that long-tailed macaques have a high level of flexibility and adaptation to the environment.



a)



b)

Figure 4 a) Elevation maps and, b) slope maps

CONCLUSION

The long-tailed macaque population in the Telaga Warna area consists of two groups with a total of 64 individuals. The long-tailed macaque population will decrease because it has a regressive population with sufficient space and a low total population density of 0.13 ind/ha. The home range area of group A was 13.8 ha, and that of group B was 6.26 ha. The long-tailed macaque group both use forest land cover, plantations, and water bodies and were found at an altitude of 1,400–1,600 meters above sea levels with gentle to very steep slopes (> 8%).

ACKNOWLEDGEMENTS

We would like to express our gratitude to all members of the West Java Natural Resources Conservation Center region I, the Head of the Telaga Warna resort, the Forestry Police, forest ecosystem controller, and the PT. Lintas Daya Kreasi (LDK) who have facilitated and granted permission to carry out this research in their area.

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