Distribution and population estimate of grizzled leaf monkeys in Mount Slamet, Central Java, Indonesia

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Abstract. Grizzled leaf monkey (Presbytis comata) or javan surili is an endemic primate species to Java. This species is categorized as Endangered on the International Union for Conservation of Nature (IUCN) Red List. Data on population and distribution is still limited, especially in Central Java. Research on the population distribution of grizzled leaf monkey was carried out at the southern slope of Mount Slamet in Central Java. This research was aiming to explore the distribution and population estimate of grizzled leaf monkeys in the research area. Data were collected by using line transects (9 transects, 2 km length, 50 m wide, 6 repetitions) at 600-1200 m asl). The grizzled leaf monkeys were found in 9 transects. There were 72 individuals, consisted of 19 groups, with a population density of approximately 1.96 individuals/km² for the estimated population. Habitat types used by the monkeys were secondary forest (53%), primary forest (40%), or crop farm (7%), on elevation range between 900-1000 m asl.

1. Introduction

Grizzled leaf monkey (Presbytis comata Desmarest 1822) or Javan surili is categorized as an endangered species (threatened with extinction) by the IUCN Red List [1]. The Grizzled leaf monkey is one of the famous endemic species of western Java, with a geographic range from Banten to Central Java. The population of grizzled leaf monkeys in the wild remains 4,000 to 6,000 individuals and most of the population in conservation areas or protected areas. The main habitat of grizzled leaf monkeys was originally lowland forest ecosystems, but at this time there is a shift in habitat space to mountainous areas [2]. The population of the species is threatened due to habitat destruction due to climate change, which reaches about 96%, from the original area of 43,274 km² to 1,608 km² [3].

Climate change is caused by increasing air temperatures due to global warming, which causes wildlife to adapt to unpredictable weather conditions, such as a long dry season which causes a lack of food availability in the wild. Threats to the habitat and population of grizzled leaf monkeys in nature are not only due to climate change, but also activities such as logging and illegal hunting are still widely carried out by irresponsible individuals. The Grizzled leaf monkey’s habitat is originally lowland forest (tropical rainforest). However, lowland forests are increasingly dominated by humans who convert forests into plantations or settlements, causing them to move to hilly forests. If conservation efforts are not carried out sustainably, Indonesia as a country rich in biodiversity will be seriously disadvantaged. The primate populations tend to be less and less in Java. The reduction in population on the island of Java is thought to be related to the reduction in their natural habitat.
The purpose of this study is to examine data and information about the grizzled leaf monkey distribution, population, and to study population problems that affect the existence of these monkeys in Southern Slope Mt. Slamet. Several previous studies on population, Setiawan [4] the last population in Southern Slope Mt. Slamet (36 km²) are 219 individuals, and population density approximately 5.96/km². The population of the Javan surili in all slopes of Mt. Slamet was estimated at approximately 1,172-1,621 individuals, with a range density of 5.9-8.16/km² [5]. As a non-conservation area, this area must receive protection to maintain the existing grizzled leaf monkey population.

2. Methods
Data collection was carried out on the southern slopes of Mt. Slamet on 9 transects, which includes Telaga Pucung, Curug Cipendok, Karanggondang, Baron Forest, Curug Gomblang, East Curug Gomblang, Kalipagug, Baturraden, and Limpakuwus. The study was conducted for 2 months from July to August 2020 (the effective time of the study was 45 days observation, 6 repetitions on 3 days). This study was using line transect sampling. Length averages 2 km, and wide 50 m. Observation time starts from 07.00 - 12.00 WIB (morning) and 13.00 - 18.00 WIB (afternoon), the times of primates foraging (search foods). The observation parameters to the primate species identified used are the point of encounter, size of the group, number of individuals, elevation, type of vegetation, temperature, humidity, weather, and habitat type. Population estimate analysis was carried out using data obtained from population density, where the data was obtained from counting the number of identified individuals and dividing it by the area of the study area [6]. Meanwhile, the distribution of groups was carried out by mapping the coordinates of the encounters of each group.

3. Result and discussion
3.1 Distribution of grizzled leaf monkey
The site’s elevation in the study areas, ranging from 600 m asl. to 1200 m asl. and is included in the category of high hills and mountains [7]. There are two types of forest in the research location, namely secondary and primary forests. Production plantations are dominated by Damar (Agathis dammara) and Pinus (Pinus merkusii). In natural forests, there are vegetation types Ara or Benying (Ficus fistulosa), Bengkinang (Elaeocarpus glaber), Liana (Rubus moluccanus others) and others. The primates diversity of fauna was founded at the research location such as long-tailed macaque (Macaca fascicularis), Javan gibbon (Hylobates moloch), and Javan langur (Trachypithecus auratus).

The grizzled leaf monkeys were identified in 9 transects. There were 72 individuals, consisted of 19 groups (table 1). Distributing was founded from 691 m asl. to 1,157 m asl. The encounter point in the lowest land at the Baturraden, and the highest land at the Telaga pucung, both are in the same types of habitat, that is primary forest. Every transects through the different type of habitat grizzled leaf monkey (figure 1), through the different types of land use and land cover. Which are primary forest, secondary forest, crop farm, and field. These monkeys were found in secondary forests (53%) (figure 2), mostly at the elevation of 900-1000 m asl, (33%) (figure 3). The lower the elevation, the fewer the monkeys have been identified cause in the lowlands there is a lot of human disturbance, in the lowland near human activities, settlement, and crop farm. Temperature and humidity averages (22.5 °C) and (92.8 RH%). Meanwhile, the weather at the time of observation was often cloudy. In this study, the monkeys were much found in the habitat of forest plantation or secondary forest (Agathis and Pinus). In the forest plantation where food resources were not higher than in the natural forest, where food resources such as Liana and Ara, were available among plantation tree.
Table 1. Population distribution of grizzled leaf monkeys in southern slope Mt. Slamet

| Transect | Location                  | Group/Individual |
|----------|---------------------------|------------------|
| 01       | Telaga Pucung             | 2 / 4            |
| 02       | Curug Cipendok            | 4 / 15           |
| 03       | Karanggondang             | 4 / 15           |
| 04       | Baron forest              | 1 / 1            |
| 05       | Curug Gomblang            | 2 / 8            |
| 06       | East Curug Gomblang       | 1 / 4            |
| 07       | Kalipagu                  | 2 / 9            |
| 08       | Baturraden                | 2 / 13           |
| 09       | Limpakuwus                | 1 / 3            |
| Total    |                           | 19 / 72          |

Figure 1. Map of distribution grizzled leaf monkeys in southern slope Mt. Slamet [8].

Figure 2. The distribution of habitat types of grizzled leaf monkeys in southern slope Mt. Slamet.

Figure 3. The distribution of differences elevation of grizzled leaf monkeys in southern slope Mt. Slamet.
Based on statement of Supriatna et al. [9] this monkey species more suitable in edge areas. In this study, monkeys mostly were found in secondary forests. The suspect, their distribution is influenced by the availability and distribution of feed. In TNGC (Taman Nasional Gunung Ciremai) the size of the group of monkeys tends to decrease with increasing distance from the forest edge and animals that can act as predators such as Macan Kumbang (*Panthera pardus*), the same case occurred in this research [2]. The habitat that is inhabited by grizzled leaf monkey on the southern slopes of Mount Slamet is at an altitude of 702-1,168 masl. The habitat of grizzled leaf monkey from primary, secondary, and mangrove forests, starting from an altitude of 250-2,500 m asl, and are found in forests bordering gardens [3]. According to Maryanto et al. [10] the habitat of this monkey is lowland rain forest to the mountains with an altitude of about 2,000 m asl. The altitude limit of natural habitat is around 1,250 m asl [11]. In the research on Mount Merbabu, surili is distributed at altitudes between 1,977-2,555 m asl [12].

### 3.2 Population density of grizzled leaf monkey

Setiawan in 2007 [4] the estimated population in Southern Slope Mt. Slamet (36 km²) was 219 individuals with a population density of approximately 5.96 individuals/km². In this study, the population estimated was 72 individuals of 19 groups with a population density of approximately 1.96 individuals/km². The population density has been decreased in 13 years. Even though there is a bias incident due to the use of the wrong method, this study was conducted by the same study location.

Habitat degradation has obviously happened at all slopes of Mt. Slamet [5]. The threats of the habitat of grizzled leaf monkey were anthropogenic disturbance (figure 4). Anthropogenic disturbance includes illegal logging, fuelwood collection, ornamental forest plants, and conflicts between monkeys and villagers. Moreover, human activity at the forest edge is estimated to be higher than inside the forest because the forest edge is generally adjacent to artificial ecosystems such as agricultural areas [13]. Human activities can affect the dynamics of life and the process of ecological disruption in the forest, which is the habitat for various wildlife. Human activities, especially logging and hunting can cause loud noises which result in a decrease in habitat quality and theoretically will have a negative impact on the behavior and condition of the wildlife population [14].

![Disturbance Map](image)

**Figure 4.** The disturbance map of: (a) distance from road, and (b) distance from settlement.

The monkey’s population in the Mount Slamet case study on the southern slopes, still occupies a lot of secondary forest areas, which means that they are outside the protected forest area, and this monkey population tends to have a higher density than other habitat types. These results indicate that it is possible to conserve the Grizzled leaf monkey population outside the conservation area. Conservation efforts outside the conservation area are urgently needed, by involving communities around the forest.

### 4. Conclusion

The population has been decreased by 13 years from approximately 219 individuals to 72 individuals, and population density approximately from 5.96 individuals/km² to 1.96 individuals/km². Overall, these
results indicate that lowland and hilly forests have the opportunity to conserve populations outside conservation areas without having to change the function of the area. Therefore protecting the Mt. Slamet is urgently needed to save these monkey populations and their habitat, since there is no conservation area in the range distribution of *Presbytis comata* subspecies in Central Java. Increasing forest protection status, law enforcement, conservation awareness programs, and community based empowerment should be enforced in Mt. Slamet.

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