

Group size of cynomolgus macaque (*Macaca fascicularis* Raffles, 1821) in Banyumas Regency, Central Java, Indonesia

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Abstract

The cynomolgus macaque (*Macaca fascicularis*) is a primate species that socially lives in many adult males and females. The number of individuals in each troop (group size) is different. Long-tailed macaque habitats were found in several locations in Banyumas Regency, reported to be in Mount Slamet, Cikakak-Wangon, Kalisalak-Kebasen, and the Dieng Mountains. This review article will explain the group size of long-tailed macaques whose habitat is in several Banyumas Regencies, Central Java, Indonesia. The results are in a group size of long-tailed macaque in Banyumas Regency varied and consisted of several troops. Further research is needed to determine the cause of the distribution of long-tailed macaques found in several areas in Banyumas Regency, Central Java, Indonesia.

Keywords: Cikakak-Wangon; Dieng Mountains; Kalisalak-Kebasen; Long-tailed macaque; Mount Slamet.

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1. Introduction

Each general system of animal behavior has at least a tendency to gather friends, except for aggressive behavior (attacking), which has the effect of maintaining 'distance' between animals or avoiding them, seeking shelter, gathering animals as they find refuge between themselves or others. Because they seek the same protection, such as in cages or shelter under trees, eating and checking behavior can make it easier for them to look for them and check their surroundings. On the other hand, joint examinations of the same food resources or breastfeeding can bring animals together in groups (Sukarsono, 2012).

Hunting behavior is a constant and powerful unifying force in animals that form troops or herds. They form closely organized groups by following and imitating one another. Also, nurturing and approachable behavior are great forces for attracting each other. Sexual behavior causes a strong withdrawal, especially during the time and season of mating. So, most animals will form social groups freely in their habitat (Sukarsono, 2012).

The long-tailed macaque (*Macaca fascicularis*) is a primate species that socially lives in many adult males and females. The number of individuals in each troop (group size) is different (Al Hakim, 2021; Pramudya et al., 2015; Supriatna & Wahyono, 2000). The relationship between individuals with one another in the troop causes the balance and integrity of the troop to be maintained, and this plays a role in protecting the troop from external threats and processes of social behavior (Al Hakim & Nasution, 2021). Animals living in troops will go through various daily activities with troop members and influence one individual with other individuals in the troop (Tinbergen, 1983).

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The group size of the long-tailed macaque (*Macaca fascicularis*) varies in each habitat, depending on habitat conditions, food sources, the threat level of predators, and interactions with other species outside the troop. The habitat of the long-tailed macaque was found in several locations in Banyumas Regency, Central Java Province, Indonesia. A previous study by Maryanto et al. (2012) mentions a troop of long-tailed macaques around the slopes of Mount Slamet. Nasution & Rukayah (2018) mentions that there are several troops of long-tailed macaques in Cikakak, Wangon, Banyumas Regency, as well as research Al Hakim (2021); Al Hakim & Nasution (2021) mentions that there is a troop of long-tailed macaques in Kalisalak, Kebasen, Banyumas Regency. Based on this information, we attempted to review the group size of long-tailed macaques whose habitat is in several areas within Banyumas Regency, Central Java, Indonesia.

2. Habitat and Group Size Found

2.1. Several Studies

We tried to collect more research publications based on scientific articles and other relevant sources such as books using keywords "Group Size, Mount Slamet, *Macaca fascicularis* Central Java, Banyumas Long Tailed Macaque, Group Size".

Based on the search results for keywords, eleven (11) scientific publications were found in journal articles, proceedings, and books discussing the existence of long-tailed macaques in the areas of Mount Slamet, Cikakak-Wangon, Kalisalak-Kebasen, and the Dieng Mountains. The result mentions that the group size was found in some areas, like Mount Slamet (Maryanto et al., 2012), Cikakak-Wangon (Hadi, 2005; Nasution & Rukayah, 2020, 2018), Kalisalak-Kebasen (Al Hakim, Nasution, Rizaldi, et al., 2021; Al Hakim, 2021; Al Hakim & Nasution, 2021; Nasution et al., 2021), and specifically in the Dieng Mountains, but unfortunately, we can't determine the group size data, only preliminary survey findings on the habitat of long-tailed macaques in there (Nijman & Van Balen, 1998; Setiawan et al., 2010; Setiawan & Nijman, 2001).

Long-tailed macaque habitat finding on Mount Slamet (Maryanto et al., 2012) mentioning the group size as a whole did not mention the differences in sex or age of the individual long-tailed macaques that were found. Other studies related to the condition of long-tailed macaques on Mount Slamet have not been found, the findings of our search only found studies of plant and animal diversity other than long-tailed macaques.

The group size of long-tailed macaques in other areas in Banyumas Regency is dominated by research results with the study location being in Cikakak-Wangon (Hadi, 2005; Nasution & Rukayah, 2020, 2018) and in Kalisalak-Kebasen (Al Hakim, Nasution, Rizaldi, et al., 2021; Al Hakim, 2021; Al Hakim & Nasution, 2021; Nasution et al., 2021). These studies are interesting because they have paid much attention to the long-tailed macaques in Cikakak-Wangon and Kalisalak-Kebasen. The review results can be seen in Table 1 for each location in Banyumas Regency, Central Java, Indonesia, with the number of observations made.

2.2. Habitat Description

The location where the long-tailed macaque habitat is found cannot be separated from the habitat conditions that support the survival rate. Long-tailed macaques can live around primary and secondary forests from the lowlands to the highlands ($\pm 1,000$ meters above sea level). In the highlands, long-tailed macaques can be found in secondary growth areas or areas around people's plantations. Long-tailed macaques are also often found in mangroves and forests near people's villages (Supriatna & Wahyono, 2000)–Are under the habitat conditions of the long-tailed macaques in Mount Slamet, Cikakak-Wangon, Kalisalak-Kebasen, and the Dieng Mountains.

Long-tailed macaques found on Mount Slamet are in primary forest (9 individuals), secondary forest (2 individuals), and HPT (*Hutan Produksi Terbatas*) or limited production forest (12 individuals) (Maryanto et al., 2012). The total number of individuals found on Mount Slamet was 23 regardless of age and gender. This small group size is not proportional to the area of primary forest, secondary forest, and HPT (Figure 1).

Table 1. The results of previous studies regarding the group size of *Macaca fascicularis* in several areas of Banyumas Regency.

Research sites	Number of individuals (with total survey)						
	AM	AF	SM	SF	JM	JF	I
Mount Slamet (Maryanto et al., 2012)–Original Troop			9 (overall data)				
			2 (overall data)				
			12 (overall data)				
Cikakak-Wangon (Hadi, 2005)–Original Troop	9	23	6	8	24		14
					(combined)		
Cikakak-Wangon (Hadi, 2005)–Troop 1	7	21	5	4	25		4
					(combined)		
Cikakak-Wangon (Hadi, 2005)–Troop 2	3	7	1	3	8		5
					(combined)		
Cikakak-Wangon (Nasution & Rukayah, 2018)–Troop 1	4	15	7	7	11	4	3
	4	14	11	5	12	5	2
	7	16	13	3	10	4	3
Cikakak-Wangon (Nasution & Rukayah, 2018)–Troop 2	2	6	6	5	5	2	2
	2	8	8	2	6	3	1
	4	9	10	2	5	3	0
Cikakak-Wangon (Nasution & Rukayah, 2018)–Troop 3	2	4	5	3	2	2	3
	2	3	6	5	2	2	1
	3	5	5	4	2	4	2
Cikakak-Wangon (Nasution & Rukayah, 2020)–Other troop	5	16	9	6	22	11	4
	5	18	10	5	22	12	5
	8	20	11	2	24	10	4
Kalisalak-Kebasen (Al Hakim, Nasution, Rizaldi, et al., 2021; Al Hakim, 2021; Al Hakim & Nasution, 2021)–Original Troop	12	14	8	9	10	14	6
Kalisalak-Kebasen (Nasution et al., 2021)–Original Troop	12	14	8	8	23	17	7
	12	17	14	15	11	14	8
	12	18	15	17	10	13	6
Dieng Mountains (Nijman & Van Balen, 1998; Setiawan et al., 2010; Setiawan & Nijman, 2001)–data deficient	Incomplete data (initial survey only)						

Notes: AM=adult male, AF=adult female, SM=sub-adult male, SF=sub-adult female, JM=juvenile male, JF=juvenile female, I=infants.

Based on Figure 1, the land area of primary forest from the mainland cover form, the primary forest has the widest cover of 20,242 ha with 74.2%, while the secondary forest is found mostly on the southern and eastern slopes. The secondary forest has a better carrying capacity for large mammals, including primates, to forage, sleep, shelter, and reproduce. Meanwhile, 8,235 ha consists of dense forest (protection forest) and limited production forest (HPT; *Hutan Produksi Terbatas*) such as *Agathis dammara* resin and *Pinus merkusii* pine (Maryanto et al., 2012). Suppose this number is compared with the area of primary forest, secondary forest, and HPT on Mount Slamet. In this case, the group size on Mount Slamet is a migratory species, with the wide area of habitat inhabited by long-tailed macaques, that can impact suitable habitat to get food resources and rest area over a wide area (such as primary forest, secondary forest, and HPT, but if this area not to be managed effectively, it will impact the long-tailed macaque habitat) so, they are very vulnerable to losing their resting habitat station.

On the other hand, long-tailed macaques can experience a chronic population with this very limited group size. It can impact mating, which can become a serious problem in the future (Rahayu & Nugroho, 2015). New research is needed to study the long-tailed macaque population and conservation status on Mount Slamet to ensure the survival of the species' condition.

The size of the long-tailed macaques in Cikakak-Wangon is the most frequently found in scientific articles. Based on Table 1, statistically, the group size includes AM (adult male) individuals, the \bar{x} mean value = 4.47, AF individuals (adult female) \bar{x} = 12.33, SM individuals (sub-adult male) \bar{x} = 7.53, individual SF (sub-adult female) \bar{x} = 4.27, individual JM (juvenile male) \bar{x} = 10.13, individual JF (juvenile female) \bar{x} = 6, and individual I (infant) \bar{x} = 3.53. It can be seen that AF (adult female) individuals or adult females have the highest number of individuals, followed by JM (juvenile male) individuals or male offspring. According to (Pramudya et al., 2015), a large number of mature female individuals (AF) in the group allows adult males (AM) to mate and determine multiple females (multi-female) and at the same time reduce mating competition between each individual AM. The size of the troop (group size) which is quite large in Cikakak-Wangon is also influenced by the habitat's carrying capacity for long-tailed macaques to maintain their survival. The habitat conditions are possible for abundant food supplies (Hadi, 2005; Nasution & Rukayah, 2020, 2018).

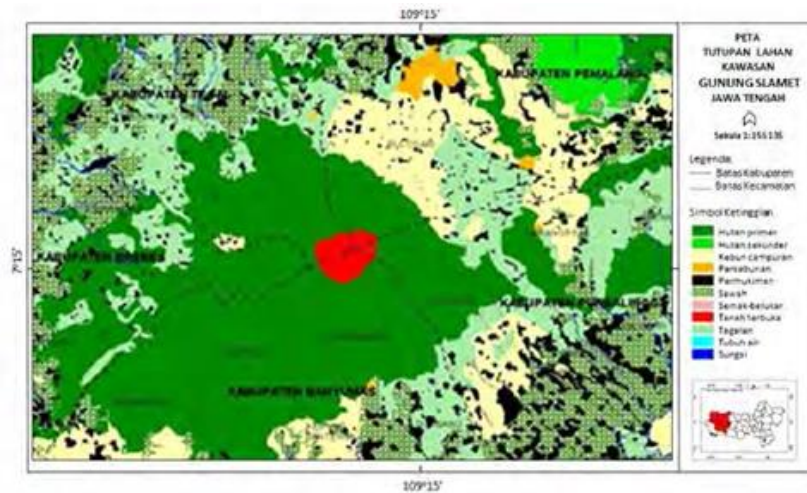


Fig. 1. Satellite image of 2003 land cover map at Mount Slamet. Source: (Maryanto et al., 2012).

The troop size (group size) of long-tailed macaques in Kalisalak-Kebasen based on Table 1 looks the second largest after the study in Cikakak-Wangon. Statistically, group size includes AM (adult male) individuals, the mean \bar{x} = 12, individual AF (adult female) \bar{x} = 15.75, individual SM (sub-adult male) \bar{x} = 11.25, individual SF (sub-adult female) \bar{x} = 12.25, individual JM (juvenile male) \bar{x} = 13.50, individual JF (juvenile female) \bar{x} = 14.50, and individual I (infant) \bar{x} = 6.75. The number of adult female individuals (AF) was the highest compared to the number of other individuals, followed by female chicks (JF) and male chicks (JM). This is similar to finding the number of AF individuals in Cikakak-Wangon, with the highest number of individuals. Still, in Kalisalak-Kebasen, it can be ascertained that the number of puppies there is quite high in the number of individuals. Statistically, the number of adult individuals with young individuals and puppies is included in the increasing population (progressive population). Habitat conditions in Kalisalak-Kebasen also support the survival of the long-tailed monkeys that inhabit the habitat there (Al Hakim, 2021; Al Hakim, Nasution, Aoliya, et al., 2021; Al Hakim, Nasution, Rizaldi, et al., 2021; Nasution et al., 2021).

Research in the Dieng Mountains, there is still a lack of data. The results of the study only stated that long-tailed macaques were living around the Dieng Mountains according to local community interviews, and neither group size studies nor long-tailed macaque population studies in the Dieng Mountains were found (Nijman & Van Balen, 1998; Setiawan et al., 2010; Setiawan & Nijman, 2001). Further research is needed to determine the group size and population of long-tailed macaques around the Dieng Mountains.

3. Further Research and Propose Work

We review that the group size of the long-tailed macaques varied and consisted of several troops, in Mount Slamet requires special attention to ensure the survival of the long-tailed macaques in there. While in Cikakak-Wangon and Kalisalak-Kebasen condition troop size (group size) is a high category for the number of adult female individuals compared to the number of other individuals. It must be the plan for the future that can make sure the survival rate in these sites.

Further research is needed to determine the cause of the distribution found in several areas in Banyumas Regency and to study the population of long-tailed macaques in Mount Slamet, Cikakak-Wangon, Kalisalak-Kebasen, Dieng Mountains to determine the latest condition of the long-tailed macaque population and conservation efforts.

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