


Daily Behaviors of Long-tailed Macaque *Macaca fascicularis* (Primates: Cercopithecidae) in the Semi-natural Enclosure on Tinjil Island, Banten, Indonesia

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Abstract

The research investigates the daily behaviors of Long-tailed Macaques *Macaca fascicularis* within a semi-natural enclosure on Tinjil Island, Banten, Indonesia, aiming to enhance understanding of their adaptability and social dynamics. Data were collected through scan sampling over five days, focusing on 20 individuals of varying age and sex. The results highlight locomotion, feeding, and resting as dominant activities, with feeding strategies adapting to food availability and environmental conditions. Social behaviors, including grooming and play, were critical for group cohesion, hygiene, and development. Supplementary feeding reduced competition for resources, stabilizing social interactions within the group. Agonistic and vocalization behaviors further underscored the species' complex social structure. These findings offer valuable insights for improving conservation management, enhancing the welfare of captive populations, and addressing the species' Endangered status. This research contributes to a foundational understanding of *M. fascicularis* behavior, guiding future conservation and management efforts for this ecologically and scientifically significant primate.

Keywords: daily behavior, Long-tailed Macaque, *Macaca fascicularis*, semi-natural enclosure, Tinjil Island.

Introduction

The Long-tailed Macaque *Macaca fascicularis* is a primate species with a wide distribution across Southeast Asia, including Indonesia (Fitriana *et al.* 2024; Syafutra 2024; Syafutra *et al.* 2024a, 2024b;). This species has become a key research subject in various fields, ranging from ecology and socio-economics to biomedical studies. One of the macaque's most significant roles is its use in laboratory settings for vaccine development and cell culture, making it an essential component of scientific advancements (Hasanah *et al.* 2022). In addition, this primate is often featured in ecotourism destinations, where the general public can observe its natural behaviors (Syafutra *et al.* 2023, 2024c).

Long-tailed Macaques are well known for their high adaptability to various environments. They can inhabit a range of ecosystems, from coastal mangrove forests and lowlands to mountainous regions with elevations of up to 2,000 meters above sea level. This adaptability has enabled Long-tailed Macaque populations to persist, despite the increasing loss of their natural habitats due to human activities (Setiawan *et al.* 2023, 2024). In terms of social structure, Long-tailed Macaques live in groups whose size varies depending on their habitat type. In mangrove forests, groups typically consist of 10-20 individuals, while in primary forests, the number can reach 20-30, and in secondary forests, up to 30-50 individuals. Their social system is multi-male and multi-female, with a home range spanning between 50 to 100 hectares per group. The daily travel distance covered by Long-tailed Macaques reflects environmental and social conditions that influence their movement patterns and can serve as an important indicator for understanding population dynamics in this primate species (Darmono *et al.* 2020; Hasanah *et al.* 2022).

The Long-tailed Macaque has been listed in Appendix II of CITES (Convention on

International Trade in Endangered Species) since 1977, meaning it can be traded as long as it originates from captivity. However, illegal captures exceeding the government's established quotas continue to occur, posing a potential threat to the species' survival in the wild (Sayektiningsih & Broto 2021). In March 2022, the Long-tailed Macaque's conservation status on the IUCN Red List was elevated from *Vulnerable* to *Endangered*, due to high rates of capture from the wild (Hansen *et al.* 2022) and the ongoing reduction of its natural habitat in Indonesia (Hasanah *et al.* 2022).

Research on the daily behaviors of Long-tailed Macaques offers valuable insights into their adaptation to semi-natural captivity conditions. This information is crucial for supporting conservation efforts and managing Long-tailed Macaque populations in the wild and captivity. The research aims to collect detailed data on the macaques' daily behaviors, providing a foundation for developing more effective conservation strategies in the future.

Methods

The research was conducted during the 25th Annual Field Course in Conservation Biology and Global Health on Tinjil Island from August 8 to 29, 2015. The event was organized by the Center for Global Field Study at the University of Washington in collaboration with the Primate Animal Study Center, Institute for Research and Community Service-Bogor Agricultural University (PSSP, LPPM-IPB).



Figure 1. Map of Tinjil Island, Banten Province, Java.

This research was conducted on a habituated group of Long-tailed Macaques around the basecamp of Tinjil Island, Banten, Indonesia ($6^{\circ}56'59.37''S$, $105^{\circ}48'46.65''E$) (Fig. 1). Tinjil Island, located in the Indian Ocean off the southern coast of Java and within the administrative region of Pandeglang Regency, Banten, has been a semi-natural breeding site for Long-tailed Macaques since 1988. The island is managed by the Primate Research Center of IPB University and functions as a breeding ground for Simian Retrovirus (SRV) - free Long-tailed Macaques. Tinjil Island also plays a strategic role in conservation and breeding efforts, aimed at increasing the species' population to reduce extinction risks and meet both domestic and international market demands (Hasanah *et al.* 2022).

Observations were conducted from August 14 to 16 and August 18 to 19, 2015. Data collection employed the *scan animal sampling* method (Fitriyah *et al.* 2021), which involved recording individual behaviors at 15-minute intervals during two daily observation periods: morning (07:00–11:00 AM) and afternoon (01:00–03:00 PM), with a 5-minute rest between scans. The macaques were observed for a total of 5 days. Behavioral categorization was based on an ethogram adapted from Fitriyah *et al.* (2021) (Table 1).

Table 1. Daily behavior ethogram of Long-tailed Macaque.

Behavior	Description
Feeding	The individual engages in feeding behaviors, including searching for food (foraging), selecting, carrying, eating, and rejecting food.
Drinking	The individual drinks water or other liquids to quench thirst.
Resting	The individual lies down or sits in a stationary position (still), either with eyes open or partially open or eyes closed (sleeping).
Locomotion	The individual moves or changes location, demonstrating all types of movement using its limbs.
Agonistic	The individual engages in conflict, including fighting, escaping, or freezing in place.
Sexual	The individual engages in mating behaviors, including physical contact, courtship, or genital inspection, followed by sexual intercourse.
Grooming	The individual cleans hair or skin (removing dirt or skin flakes) using hands, tongue, lips, or teeth.
Play	The individual engages in chasing, rolling, swinging, or mock fighting that does not escalate into agonistic behavior.
Defecation	The process of expelling feces through the anus as a form of bodily excretion.
Urination	The process of expelling urine through the genital area as a form of bodily excretion; may also serve as territorial marking.
Vocalization	The individual produces sounds (noises) from the mouth, such as calls. These calls may serve as greetings toward others (greeting call), expressions of disturbance (disturbing call), communication between individuals (calling), or courtship signals (courtship call).

The research utilized binoculars, a watch, writing tools, and a camera to document the macaques' behaviors. Observations included 20 individuals categorized by age and sex: 4 adult males, 5 adult females, 8 juveniles, and 3 infants. Behaviors recorded included feeding, drinking, resting, locomotion, agonistic, sexual, grooming, play, defecation, urination, and vocalization. Data analysis focused on quantifying the duration and frequency of these activities, providing insights into the macaques' daily behavioral patterns within the semi-natural enclosure.

Results and Discussion

The dominant behaviors observed in the Long-tailed Macaques *Macaca fascicularis* on Tinjil Island were locomotion, feeding, and resting (Fig. 2 and Table 2). The macaques showed higher levels of locomotion and feeding during the cooler morning hours while resting behavior dominated the hotter afternoon period. This trend aligns with thermoregulatory behavioral adjustments seen in other primates, where temperature variations influence activity levels (Thompson & Hermann 2024). Locomotion, which accounted for 28.21% of total behaviors, was largely associated with foraging efforts, as these macaques are highly opportunistic feeders (Reinegger *et al.* 2023).

Daily Behaviors

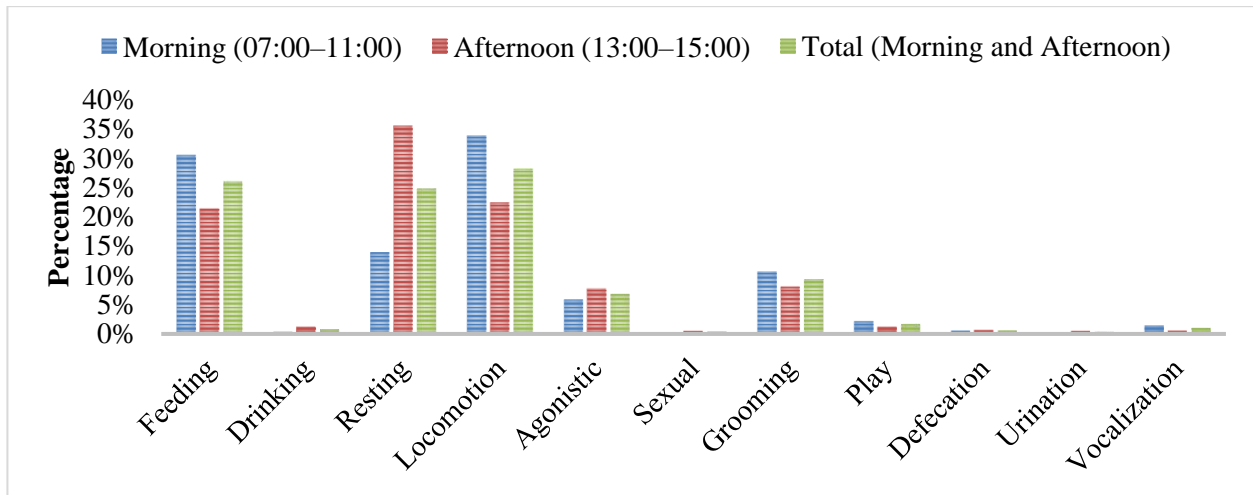


Figure 2. Percentage of daily behaviors observed in the Long-tailed Macaque group.

Table 2. Frequency and percentage of daily behaviors observed in the Long-tailed Macaque group.

Behavior	Morning (07:00–11:00 AM)		Afternoon (01:00–03:00 PM)		Total Frequency (times)	Total Percentage (%)
	Frequency (times)	Percentage (%)	Frequency (times)	Percentage (%)		
Feeding	2,481	30.62	868	21.43	3,349	26.03
Drinking	29	0.36	50	1.23	79	0.80
Resting	1,134	14.00	1,442	35.60	2,576	24.80
Locomotion	2,751	33.96	910	22.46	3,661	28.21
Agonistic	474	5.85	312	7.71	786	6.78
Sexual	19	0.23	22	0.54	41	0.39
Grooming	867	10.70	327	8.06	1,193	9.38
Play	173	2.13	49	1.20	221	1.67
Defecation	47	0.58	27	0.67	74	0.63
Urination	11	0.14	22	0.54	33	0.34
Vocalization	116	1.43	23	0.56	139	1.00
Total	8,102	100	4,051	100	12,153	100

Feeding was a prominent activity, representing 26.03% of observed behaviors (Table 1). The macaques' feeding strategies varied based on food location. Arboreal foraging involved securing food from trees and consuming it in comfortable spots, while ground-based foraging required food inspection to ensure suitability for consumption. This adaptive feeding strategy mirrors findings by (Reinegger *et al.* 2023), who highlighted the broad dietary preferences of *Macaca fascicularis*, including fruits, invertebrates, fungi, leaves, flowers, seeds, and tubers. Eating constituted the majority (72.17%) of the macaques' feeding activity (Fig. 3), underscoring the significant time investment required for this behavior.

Supplementary feeding, consisting of bananas such as *pisang kepok*, *pisang mas*, and *pisang raja*, supplemented the macaques' diet. This feeding reduced competition for natural resources and helped stabilize group dynamics in the semi-natural enclosure, as (Ewen *et al.* 2015) noted.

Grooming was a key social behavior, accounting for 9.38% of total activities. This behavior included auto-grooming and allo-grooming, with the latter being more prevalent among adult females. Grooming served dual purposes: reinforcing social bonds within the group and maintaining hygiene by removing ectoparasites. This aligns with findings from Pfoh *et al.* (2021), who observed similar social and hygienic grooming functions in *Cebus apella* populations.

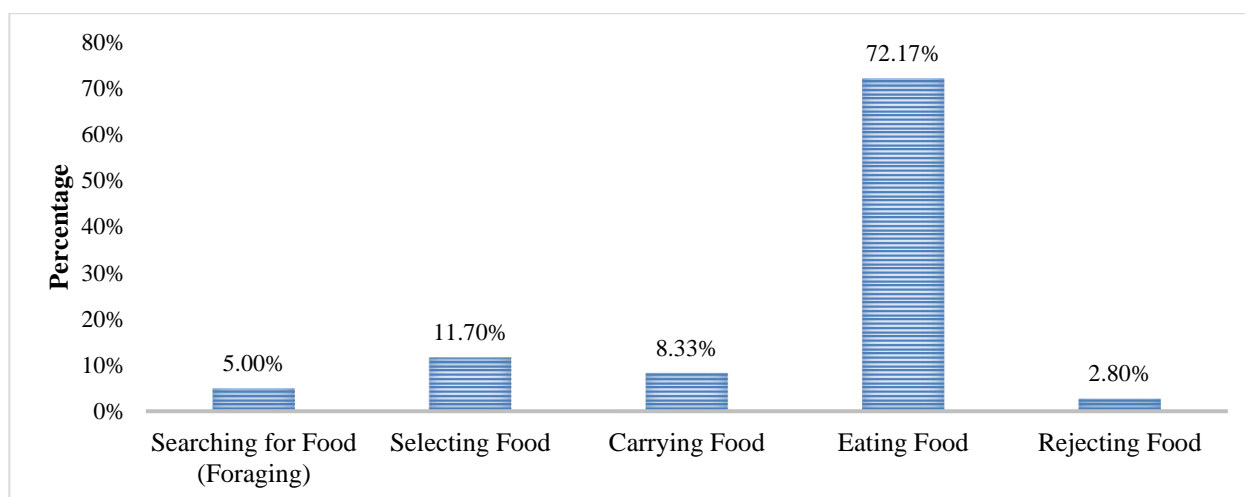


Figure 3. Percentage of feeding activities observed in the Long-tailed Macaque group.

Agonistic behaviors, observed in 6.78% of total activities, were predominantly performed by adult males. These interactions likely play a critical role in maintaining dominance hierarchies, a common feature in primate social systems (Klass 2021). Sexual behaviors, accounting for 0.39% of total activities, were limited to adult macaques. This behavior is consistent with seasonal breeding patterns and the reproductive strategies of *M. fascicularis* in semi-natural environments (Hasanah *et al.* 2022).

Play was more frequent among juveniles, who engaged in this activity 1.67% of the time. These interactions often occurred between juveniles or mothers and their offspring, reflecting the developmental importance of play in motor skills and social learning (Heintz *et al.* 2017). Vocalization, although less frequent (1.00%) was critical for group communication, including alarm calls and coordination during foraging activities (Xie *et al.* 2024).

Conclusion

The research highlights the diverse daily behaviors of *M. fascicularis* in the semi-natural enclosure on Tinjil Island, showcasing their adaptability and complex social dynamics. Locomotion, feeding, and resting were identified as the primary activities, influenced by temperature and food availability. This research emphasizes the importance of supplementary feeding in minimizing resource competition and promoting social stability. Social behaviors, such as grooming and play, are essential for fostering group cohesion, promoting hygiene, and supporting individual development. The insights gained from this research provide valuable data for improving conservation management, enhancing the welfare of captive populations, and supporting efforts to mitigate the species' Endangered status. This understanding of behavior provides a vital foundation for advancing research and guiding conservation initiatives for *M. fascicularis* in both natural and managed environments.

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