

Short Communication: Daily activities of Javan langurs (*Trachypithecus auratus*) in Gembira Loka Zoo, Yogyakarta, Indonesia

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Abstract. Fitriyani N, Purba LHPS. 2023. Short Communication: Daily activities of Javan langurs (*Trachypithecus auratus*) in Gembira Loka Zoo, Yogyakarta, Indonesia. *Biodiversitas* 24: 5278-5282. The Javan langur (*Trachypithecus auratus*) is one of the endemic primates of Java, Bali, and Lombok. The status of this species is vulnerable in their wild population; thus, the conservation effort is important to keep their existence. One of the conservation efforts is ex-situ conservation. Since this conservation is out of the animal's natural habitat, we must care about all aspects of animal welfare, including the physical and mental state, which can be observed from its behavior. This study aimed to analyze the daily activities of Javan langur living in an ex-situ conservation area named Gembira Loka Zoo. We observed and recorded the daily activity of seven individuals of Javan langur for about 250 hours, including holiday and non-holiday periods. This observation during holiday and non-holiday periods is intended to see whether there are differences in the behavior of Javan langur. The differences in number of visitors during the holiday period can reach thousands, whereas during the non-holiday period, there are only tens up to hundreds of loyal visitors per day. The result showed that the individuals spent most of their time on resting behavior (62.28% on holiday and 61.83% on non-holiday), followed by feeding (15.82% on holiday and 20.70% on non-holiday) and moving (12.01% on holiday and 12.64% on non-holiday). We analyzed the difference in their daily activities between holiday and non-holiday periods to observe the frequency of activity among those types of days. The Javan langurs showed a significant difference between those days only in social behavior (Mann-Whitney, $p = 0.03$). This study provides new behavioral data about the population of captive Javan langurs in Gembira Loka Zoo, which can be used as basic data for the conservation management of Javan langurs in captivity.

Keywords: Conservation, daily activities, Gembira Loka Zoo, Javan langurs

INTRODUCTION

The Javan langur (*Trachypithecus auratus* É.Geoffroy Saint-Hilaire, 1812) is an endemic primate on Java, Bali, and Lombok islands (Hansen et al. 2020). Based on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List (Nijman 2021), this species was classified as vulnerable. Its population may face various threats due to escalating anthropogenic pressure (Leca et al. 2013). Javan langur belongs to the subfamily Colobinae, which predominantly eats leaves due to morphological and physiological adaptations in their digestive tract (Huan et al. 2020). However, this species' diet is more versatile than other folivorous colobine, including fruit or seeds, flowers, and other types of food (Tsuji et al. 2019; Wardhana et al. 2022). Javan langurs live on trees, eat lots of leaves, and play a role in plant regeneration as seed dispersers because the animal feeds on fruits (pulp and seed) up to 35.8% of their monthly diet (Tsuji et al. 2017). Most of the leaves eaten by Javan langurs are young leaves; the rest are old leaves, stems, and leaf shoots (Tsuji et al. 2019). Javan langurs are naturally arboreal, occupying the upper story of the trees. The dense canopy supports their daily activity as feeding, resting, locomoting, and socializing (Sari et al. 2020). The high

density of trees also helps the species to move from one tree to another. In nature, most species of the subfamily Colobinae spend their time to rest (>45%) compared to the other activities (Akbar et al. 2019).

Conservation is important to maintain diversity and populations of various flora and fauna. Since the global extinction crisis continues, effective conservation efforts are much needed. Zoo is one of the conservation institutions that aims to protect animal species from extinction outside their natural habitat (Gusset and Dick 2011). Aside from being a conservation institution, zoos also have other functions such as education, quarantine, showcasing sources of broodstock and genetic reserves to support in-situ populations, healthy recreation facilities, and scientific research and development facilities (McCann and Powell 2018). Gembira Loka Zoo is a modern ex-situ animal conservation area in Yogyakarta. Apart from fauna conservation, the zoo also functions for public education to conduct research and scientific development (Bueddefeld and Van Winkle 2016). Implementation of ex-situ conservation must pay attention to animal welfare. The five domains of animal welfare include (i) freedom from hunger, thirst, and malnutrition, (ii) freedom from discomfort or environmental challenge, (iii) freedom from functional impairment, injury, and disease, (iv) freedom

from fear, anxiety, and long-term stress, and (v) freedom to express natural behavioral or free from interactive restriction (Mellor 2017; Mellor et al. 2020). Therefore, behavioral research in captive populations in ex-situ conservation might provide information on how animals interact with each other and adapt to their environment. Therefore, by observing the daily behavior of captive animals, we could predict their welfare, especially the freedom to express their natural behavior, which might promote successful conservation. Animal behavior research in captivity is the focus of this emerging conservation behavior (Mellor et al. 2020). Collaboration between university-based research projects could help zoos promote their scientific functions, such as education, conservation, and research. Accordingly, this study aimed to analyze and evaluate the daily activities of captive Javan langurs in Gembira Loka Zoo, Yogyakarta. We compared the activity between the holiday and non-holiday periods that might affect the behavior due to the presence of visitors.

MATERIALS AND METHODS

Study area

This research was conducted from April to June 2023 with an observation duration of approximately 60 days, including 10 days of habituation with a total observation time of 250 hours. The research location is at the Gembira Loka Zoo, Kebun Raya Street Number 2, Rejowinangun, Kotagede District, Yogyakarta City, Yogyakarta Special Region, Indonesia.

Procedures

Habituation and identification

Habituation is carried out before the observation begins to familiarize the animal with the observer's presence in the surrounding environment. Habituation is done by standing near the cage in the same position, wearing the same dark clothes, and without flashy colors (Hanson and Riley 2018). Each individual in Javan langur has been identified by sex and age classifications (Tahir et al. 2017). In addition, we carried out identification based on the physical conditions of the monkeys, such as body hair color, facial hair color, and whether or not there were defects on the body (Farida et al. 2019).

Observation

Observation of the daily behavior of the Javan langurs has been done using instantaneous scan sampling (Martin and Bateson 1993). We recorded any behavior of each individual that seemed relevant to the observer, or in other words, collected as many activities as possible by the Javan langur in one day without any restrictions on time. In addition, recording rules: an *instantaneous vocal sampling* of individual behavior within a predetermined period, namely every 5 minutes. Observations begin at 09:00-15:00, adjusting the opening and closing hours of the Gembira Loka Zoo with a one-hour break.

Data analysis

Daily behavior data were obtained and analyzed using Microsoft Excel. Daily behavior would be grouped into 5 categories: moving, resting, eating, socializing (playing, allomothering, agonistic, grooming, sexual/mating behavior, vocalization), and foraging. Statistical test using the R version 4.3.1 program with the Mann-Whitney test to see differences in daily holiday and non-holiday behavior in Javan Langurs at the Gembira Loka Zoo. The formula for obtaining the percentage value of the Javan langur's daily behavior as follows:

$$\% \text{ Behavior} = \frac{\text{the time needed to perform the activity}}{\text{long observation time}} \times 100\%$$

(Martin and Bateson 1986)

Table 1. The total of individual Javan langurs (*Trachypithecus auratus*) in Gembira Loka Zoo

Individual	Total
Adult male	2
Adult female	3
Juvenile	1
Infant	1
Total individual	7

Table 2. The definition of daily behavior

Activity group	Activity	Description
Moving	Moving	Including walking (quadrupedal), hanging, and jumping from one place to another
Resting	Resting	Can be doing no activity, meaning the Javanese langurs sit quietly and sleep
Feeding	Feeding	Taking food from the box provided in the cage after the keeper has placed the feed, chewing, and eating the feed
Foraging	Foraging	Seeking and grabbing food items about to eat
Social	Grooming	Scratching, rubbing, licking, grabbing some germs or mites from another body hair. In addition, there is allogrooming when an individual performs probing behavior on the bodies of other individuals
	Agonistic	Aggression between individuals, common in male individuals of cage A with males of cage B
	Playing	Often occurs in young individuals, including jumping, circling the cage, playing with the leaves/plants in the cage, interacting with another individual (including chasing and biting)
	Vocalization	Making a sound like an alarm call
	Allomothering	Caring for and breastfeeding infant individuals

RESULTS AND DISCUSSION

Daily behavior of Javan langurs in Gembira Loka Zoo

The daily behavior of primates is usually categorized into feeding, resting, moving, and social interaction (Khatiwada et al. 2020; Lousa et al. 2022). In this study, we categorized the daily behavior of the Javan langur at the Gembira Loka Zoo into five categories: socializing, feeding, foraging, moving, and resting (Table 2). The most dominant daily activities of the Javan langur at the Gembira Loka Zoo is resting (62.45%) followed by feeding (19.11%) (Figure 1). This result is similar to the observed highest activity in captive Javan langurs in Bronx Zoo (Roth and Cords 2020). The dominant activity exhibited by captive individuals differed from the wild population. Wild Javan langurs in Bromo Tengger Semeru National Park, East Java, Indonesia, spent most of their time moving and ranging activities (Subarkah et al. 2011). However, another observation found in Taman Wisata Alam Gunung Pancar, West Java, Indonesia, that the most frequent activity was resting (Sulistiyadi et al. 2013).

Each activity category is then compared based on holidays and non-holidays to determine whether there are differences in Javan langurs' daily activities (Figure 2). We found no significant differences in the frequency of all behavior categories (resting ($p = 0.56$), moving (p -value = 0.84), feeding ($p = 0.71$), foraging ($p = 0.47$)) in the holiday and non-holiday periods except for the social activity. The frequency of social activity showed a significant difference between the holiday and non-holiday periods ($p = 0.03$), possibly due to the increasing human and animal interaction during the holiday seasons. During the holiday season, the visitors of Gembira Loka Zoo were rising to thousands per day in contrast to the non-holiday period of only hundreds of visitors per day. Furthermore, the social activities between individuals during the holiday season as the strategy of the langurs to reduce stress from the significantly increased number of visitors (Roth and Cords 2020).

Discussion

The daily behavior of Javan langur at the Gembira Loka Zoo is similar to the activities observed in the wild population of Javan langurs (Subarkah et al. 2011; Santono et al. 2016). In daily behavior activities, resting (holidays = 62.28 %, non-holidays = 61.83%) was the most frequent activity, followed by feeding (holidays = 15.82%, non-holidays = 20.70%) (Figure 2). The high percentage of both behaviors is thought to be caused by the cage conditions, which do not allow the langurs to carry out many activities freely. Javan langur is a folivorous primate specializing in their digestive system. The animal fermented foregut to digest leaves, requiring higher rest times (Matsuda and Clauss 2022). In addition, the high level of rest and eating behavior also have an important relationship; the Javan langur requires rest time to digest the leaves that have been consumed (Korstjens et al. 2010). Interestingly, the high proportions of resting and feeding, among other activities, are found across species of Colobinae (Kraus and Strier 2022).

Resting behavior between holidays and non-holidays was not significantly different ($p = 0.56$). Based on frequency data, resting behavior appears to occur more frequently in adult male Javan langurs; this is because, generally, adult male primates' resting behavior is influenced by age. Similar results were also found that most species of colobines spend more time resting (46.3%) in *T. cristatus* (Akbar et al. 2019). Adult males who consume large amounts of food might need more rest time to digest food ingredients.

Moving behavior in hanging and running is often done quadrupedally, namely walking using all four legs in a horizontal and vertical direction (Wiradateti et al. 2009). The purpose of moving behavior is to move from a tree to a resting place, from a resting place to a food source, and vice versa. The moving behavior of the Javan langur at the Gembira Loka Zoo both on holiday and non-holiday conditions, looks equally low (p -value = 0.84). Regarding the daily activities of the Javan langur in the Masigit Kareumbi Hunting Park area of West Java states that the most dominant activity of the Javan langur is locomotion, with an average percentage of 25.20%, which indicates a difference in behavior between the Javan langur in Gembira Loka Zoo with Javan langur in nature (Santono et al. 2016). This is presumably due to the limited size of the enclosure in captivity, which causes the locomotion behavior of the monkeys to be less than the monkeys in their natural habitat because the Javan langur has a fairly wide home range, reaching 15 ha (Wiradateti et al. 2009; Sari et al. 2020).

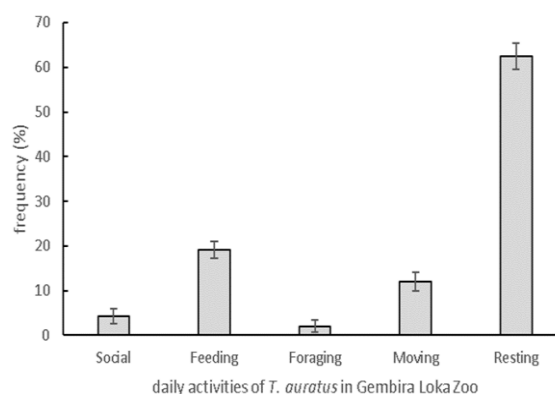


Figure 1. Percentage of daily activities of *T. auratus* in Gembira Loka Zoo based on standard error

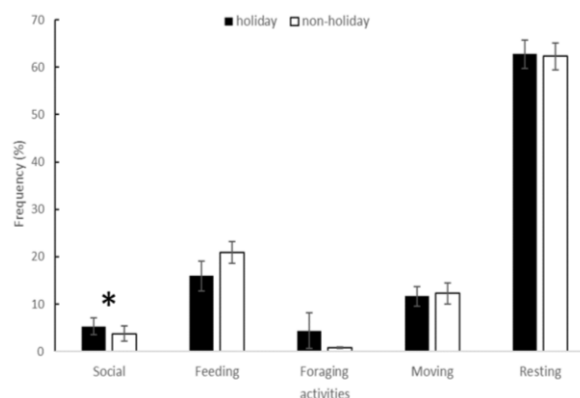


Figure 2. Percentage of daily behavior on holidays and non-holiday periods based on standard error (*percentage was significantly different between holiday and non-holiday observation)

The feeding behavior of Javan langurs at the Gembira Loka Zoo occurs when the keepers start giving food in the morning. Primate eating activity generally increases in the morning when the temperature is low. This low temperature can cause an increase in appetite; if the temperature increases, eating activity will tend to decrease (Wirdateti et al. 2009). During the observation, it was observed that adult female Javan langurs had the longest feeding duration. Other studies also found that adult female langurs spend more time eating than juvenile langurs (Akbar et al. 2019; Asri et al. 2019). The results of the percentage of Javan langurs eating behavior between holidays and on non-holidays is the second highest behavior value after resting (holidays = 15.82%, non-holidays = 20.70%); the feeding behavior on holidays and non-holidays did not differ significantly ($p = 0.71$). Presumably, this is because the location of the feeding points is very easy to reach for each Javan langur, and the feeding is abundant and varied. Similar research also found on the feeding activity of langurs (*T. cristatus*, Raffles, 1812) in captivity that the high percentage value of eating behavior was observed by the availability of food throughout the day so that the time used for langurs to find food was also less than langurs in nature (Wirdateti et al. 2009).

The foraging behavior of the Javan langur at the Gembira Loka Zoo, besides in the morning, is usually during the day when the amount of feed has shortened. Based on the results of the Mann-Whitney test, foraging behavior between holidays and non-holidays was not significantly different ($p = 0.47$). The percentage of foraging behavior between holidays and holidays is low, which means that this behavior is rarely carried out by any individual Javan langur at the Gembira Loka Zoo because the keepers provide food. In the wild, primates spend up to 60% of their day foraging. However, in captivity, the time spent foraging is adapted since the food is readily available (Majolo et al. 2013). The percentage of foraging behavior for adult female Javan langurs was the highest compared to adult males, infant females, and juvenile males. This is because adult males tend to have more priority of access to food than females, so males do not need to forage and sort feed. Since the lower nutrition requirements and smaller gut volume of juvenile individuals, they were found to spend more time playing (social) compared to adult individuals (Asri et al. 2019). Feed availability also influences it; the Javan langur does not have to move much for foraging. In nature, Javan langurs have certain routes in their daily journeys to vary their food (Sari et al. 2020).

The social behavior of the Javan langur at Gembira Loka Zoo consists of playing, probing (allogrooming and autogrooming), agonistic, sexual interaction, vocalization, and allomothering behavior. Social behavior is often done during breaks, usually after 12.00 pm. The Javan langur social behavior differs between holiday and non-holiday periods (p -value = 0.03). This difference is thought to be due to the environmental conditions of the Gembira Loka Zoo during holidays, which are more crowded by visitors than non-holiday. Based on our brief observation and personal communication with the staff of Gembira Loka

Zoo, the number of visitors in the holiday season is increasing to thousands of visitors per day. Presumably, the Javan langur would interact more with visitors during the holidays compared to non-holidays. It is also found in many species of zoo animals, which reduces their resting time in the presence of more visitors (Roth and Cords 2020). In addition, there are individuals of Javan langurs who are still juveniles who are thought to be one of the factors influencing the percentage value of the social behavior of the Javan langurs at the Gembira Loka Zoo. These juvenile Javan langurs tend to spend their time playing (social activities) (Asri et al. 2019). This finding was different from the result obtained from Javan langurs in Bronx Zoo, who spent more time sleeping with a higher number of visitors, which might be the strategy to cope with stress caused by aversive stimuli (Roth and Cords 2020).

Based on the study results, the percentage of Javan langur movement behavior at the Gembira Loka Zoo was lower than in nature, which might be caused by the limited area for the cage. Thus, it is necessary to add environmental enrichment to enhance the health of the Javan langur, such as energy balance. The percentage of foraging also appears to be lower than that of feeding behavior in the wild. This could be improved by spreading out the foods in several places within their enclosure to increase the percentage of foraging behavior in Javan langurs at the Gembira Loka Zoo, Yogyakarta. In the future, the analyses of the relationship between the number of zoo visitors and the behavior of Javan langurs might help the zoo to increase their efforts for animal welfare.

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