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Daily Behavior of Javan Bull (*Bos javanicus javanicus*) in Ragunan Wildlife Park

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Abstract

Indonesia has high biodiversity, including various types of endemic animals. One of these endemic animals is the Javan bull (*Bos javanicus javanicus*) which is now a protected animal. The decline in the population of Javan bulls in nature is caused by various factors such as poaching, habitat destruction, and uncontrolled exploitation. Therefore, conservation efforts are needed to maintain its sustainability. Ragunan Wildlife Park is one of the ex situ conservation locations designed to resemble the natural habitat of animals. This study aims to describe the daily behavior of Javan bulls and to determine the variation in behavior between individual bulls in Ragunan Wildlife Park. Observations were made on several male and female bulls over a certain period of time, using the focal animal sampling method in two daily observation sessions, namely morning and afternoon. Environmental parameters such as temperature and humidity were also recorded as supporting factors. The results showed that Javan bulls exhibited various types of behavior, including eating, drinking, rumination, moving, resting, sleeping, grooming, urination, defecation, and social behavior. Each individual shows different behavioral tendencies, depending on their respective characteristics. Some individuals are more active in social or feeding behavior, while others show more resting or silent behavior. It can be concluded that this study is expected to be a basis for the management and planning of Javan bull conservation in captivity, especially in efforts to maintain their welfare and natural behavior.

Keywords: daily behavior; ex-situ conservation, javan bull, RWP

INTRODUCTION

Indonesia is a country known as a country with abundant biodiversity. In fact, Indonesia is referred to as one of the centers of biodiversity on earth or mega-biodiversity country (Nisa *et al*., 2024; Rostikawati *et al*., 2024; Supratman *et al*., 2024). Indonesia has a high fauna diversity consisting of 115 species of mammals, 1,500 species of birds, 600 species of reptiles, and 270 species of amphibians (KLHK, 2021; Setiawan, 2022). Among the rich fauna, there are various endemic species that are only found in certain areas, such as the Javan Bull (*Bos javanicus javanicus*) which is one of the endemic mammals of Java Island. The Javan bull is a member of the Bovidae family that lives naturally in habitats such as tropical rainforests, secondary forests, and savannas. As a herbivore, the Javan Bull plays an important role in maintaining ecosystem balance through the distribution of seeds and nutrients from the plants it consumes (Bakker *et al.*, 2016). In addition, in the food chain, the Javan Bull also acts as prey for large predators such as tigers and wild dogs (Krishnakumar *et al*., 2020).

The Javan bull is classified as an endangered animal according to the criteria of the International Union for Conservation of Nature (IUCN) with the status Endangered (IUCN, 2025). The decline in its population is caused by poaching, habitat fragmentation and destruction, and competition with domestic

livestock (Hadi *et al.*, 2023; Setyani *et al*., 2025). Therefore, conservation efforts both in-situ and ex-situ are very much needed. One of the ex-situ conservation locations in Indonesia is the Ragunan Wildlife Park (RWP), which is also home to the Javan bull population. The presence of the Javan bull in RWP is a great opportunity to conduct systematic daily behavioral research because the environment is more controlled and easily accessible. Studies on the daily behavior of bull in captivity are important to determine how they adapt to artificial habitats and the activity patterns they display, especially in the context of conservation and environmental enrichment (Hidayat *et al.*, 2022; Fadhella *et al*., 2023).

Animal behavior research, especially in captivity, can inform wildlife managers about animal welfare, environmental needs, and more effective conservation strategies (Rose *et al.*, 2017). In addition, daily behavioral data can assist in planning release programs and conservation education for the community. To date, in-depth studies related to the daily activities of Javan bull in RWP are still very limited. Based on the Decree of the Director General of Natural Resources and Ecosystem Conservation (KSDAE) No. 180/IV-KKH/2015, the Javan bull is also included in the 25 national priority endangered species that must be immediately protected and actively conserved (KLHK, 2021). In fact, this species has also been included in the international Global Species Management Plan (GSMP) program to ensure its global sustainability. Therefore, research on the daily activities of the Javan bull (*Bos javanicus javanicus*) in the ex-situ captivity of the Ragunan Wildlife Park is very important to conduct. This study aims to describe the daily behavior of bull and analyze differences in activity proportions between individuals, in order to support better management and conservation strategies.

METHOD

This study was conducted for 12 days. Observations were conducted for 5 hours each day, which were divided into two sessions, namely 08.00–11.00 WIB and 13.00–15.00 WIB. The observation location was at Ragunan Wildlife Park. The tools used in this study included stationery for data recording, tally sheets for data grouping, watches as time indicators, digital cameras for visual documentation, and hygrometers to measure air temperature and humidity. The objects in this study were four Javanese bulls consisting of individuals with different genders, namely Bejo, Raju, Amy, and Susi. This research was conducted through several stages, starting with observing the daily behavior of Javanese bulls, continuing with data recording, and ending with data analysis. Observations were conducted using the focal animal sampling method, which is a method that focuses on one individual to record its behavioral activities in detail over a certain period of time (Altman, 1974).

The types of data collected consisted of primary data and secondary data. Primary data were obtained through direct observation of the daily behavior of Javanese bulls. Meanwhile, secondary data were collected through interviews with zookeepers and relevant literature studies. Data analysis was carried out by grouping daily behavior into several categories, namely eating, drinking, rumination, moving, resting, sleeping, grooming, urinating, defecating, and social behavior. All behavioral data obtained from the focal animal sampling method were then calculated in percentage form. The results of the calculation are presented in the form of a graph to facilitate comparison between behavioral categories in each individual. The resulting graph is then explained through a narrative description. The calculation of the percentage of behavior is carried out using the following formula:

$$Activity = \frac{total\ activity}{total\ whole\ activity} x100\%$$

RESULT AND DISCUSSION

The behavioral research of Javan bulls in Ragunan Wildlife Park was conducted by observing all daily behaviors in the form of eating, drinking, rumination, moving, resting, sleeping, self-care, urinating, defecating and social behavior. The results of the observation of the daily behavior of Javan bulls obtained different percentages of daily behavior in each individual. The research data can be seen in table 1.

Table 1. Percentage of daily behavior of javan bull in ragunan wildlife park

Daily Behaviors	Bejo	Raju	Amy	Susi
Eating	23,56%	21,78%	35,00%	49,44%
Drinking	1,78%	3,33%	0,33%	0,67%
Rumination	2,00%	8,56%	8,44%	3,56%
Moving	5,33%	3,56%	3,78%	4,89%
Resting	24,44%	39,56%	26,00%	22,89%
Sleeping	5,22%	2,56%	4,44%	0,00%
Grooming	3,78%	2,78%	4,78%	3,44%
Urination	0,89%	0,22%	0,44%	0,22%
Defecation	0,44%	0,44%	0,33%	0,89%
Social	32,56%	17,22%	16,44%	3,56%

The results of the observations showed that the four Javanese bulls had varied daily behavior patterns, reflecting differences in individual characteristics and environmental factors that influenced their activities. Eating behavior was one of the dominant activities, especially in individuals Susi and Amy. Susi showed the highest percentage of eating behavior. In contrast, Raju showed a lower eating frequency compared to other individuals. Drinking behavior was observed at a relatively low frequency in all individuals. Raju showed the highest drinking frequency, while Amy had the lowest frequency. Rumination behavior was most prominent in Raju and Amy. Movement behavior was recorded as quite balanced among all individuals, with slight differences between individuals. This shows that the four bulls tend to be active in exploring or moving in the pen area, although it is not a dominant behavior.

Resting behavior dominated in Raju while Susi showed the lowest rest time. Sleeping behavior showed significant variation. Bejo and Amy had relatively higher sleep duration compared to other individuals, while Susi did not show any sleep behavior at all during the observation period, which could be due to limited observation time or the individual's level of alertness. Grooming behavior appeared in moderate intensity and was relatively balanced, with Amy as the individual who groomed the most. Urination and defecation behavior appeared with low frequency in all individuals, with Raju and Susi urinating the least, while Susi defecated slightly more. Social behavior was very prominent in Bejo, who showed the highest social interaction compared to other individuals. In contrast, Susi showed the lowest level of social behavior.

The feeding activity of Javanese bulls at RWP is fully supported by the zoo management. The types of feed provided consist of main feed and additional feed. The main feed is odotan plants (*Pennisetum purpureum*), which are given as much as two bunches per cage every day. One bunch of these plants weighs around 40–50 kg and is usually given at 09.00–10.00 WIB. Additional feed consists of 1 kg of fine bran and concentrate in the form of pellets, with a ratio of 1:3 between concentrate and bran, and a handful of table salt is added. The purpose of providing this concentrate mixture is to increase digestive efficiency. According to Astuti & Santosa (2015) the use of concentrates, both commercial and bran, can increase the total digestibility of rations, accelerate the flow rate of feed in the digestive tract, and increase rumen emptying. This stimulates hunger so that feed consumption increases.

Additional feed is given every day at 07.30–08.00 WIB. It is given in the morning because the bulls will come out of their sleeping pens after consuming feed, making it easier for the keeper to clean the sleeping pens. The keeper also routinely adds table salt to the additional feed, or provides special ruminant mineral salts in the form of lick blocks that are hung near the feeding area. This salt is important to meet mineral needs, especially micro minerals that play a role in the metabolism and growth process. Ikhsanunddin *et al.* (2022) stated that mineral block salt is an important supplement for ruminant livestock because it contains various essential minerals to support animal growth and health. Based on the results of observations, the highest eating behavior was observed in young female bulls. This is due to the higher nutritional needs during the growth period. Subeno (2007) stated that male individuals and young bulls tend to allocate more time for eating activities to support the growth and development process. In addition,

young bulls tend to have smaller mouth sizes than adult bulls, so the time needed to chew and swallow feed is longer, which ultimately increases the duration of daily feeding. The Javan bull's feeding activity can be seen in Figure 1.

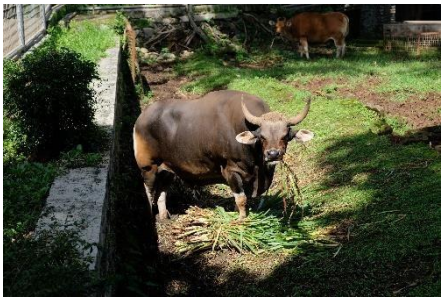

Figure 1. The javan bull's feeding activity
Source: Afghan, 2024

Drinking behavior in Javanese bulls generally occurs after eating. At RWP, drinking water provided for bulls is fresh water without any additives, and is provided in a special container. Bulls drink by licking the water periodically using their tongues, then inserting part of their mouths into the water container to sip. Zookeepers routinely change the drinking water every two days to maintain its cleanliness and avoid microbial contamination. Cleanliness of water is very important for animal health, especially ruminant animals such as bulls. Master *et al*. (2024) stated that bulls need clean water every day to maintain the balance of body metabolism. Poor water quality can trigger health problems, such as digestive tract infections or mild dehydration which have an impact on decreasing the animal's daily activity (Rahardja *et al*., 2020).

Based on observations in the field, adult male individuals are the group that most often exhibits drinking behavior. This is thought to be related to their larger body size and higher body fluid requirements. Subeno (2007) explained that large herbivorous animals such as bulls can consume as much as 10% of their body weight per day. Therefore, the greater the body weight of a bull, the more water volume it needs to maintain body homeostasis. In addition to body size, environmental conditions such as temperature and humidity can also affect the frequency of animal drinking. In a study by Santoso *et al.* (2023), it was explained that drinking activity in ruminant animals tends to increase when the environmental temperature is high, as a physiological response to regulate body temperature and prevent dehydration. The drinking activity of Javan bulls can be seen in Figure 2.

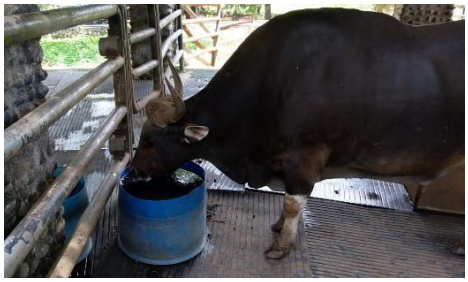

Figure 2. Javan bull drinking water
Source: Afghan, 2024

Rumination behavior is a common activity carried out by ruminant animals, including Javanese bulls, as part of the secondary digestion process (Kusuma *et al*., 2015; Hartati *et al*., 2022). Rumination involves the act of regurgitating previously swallowed feed into the rumen to be re-chewed, before finally being swallowed again and further digested in other parts of the stomach. This process is typical of animals

with a double stomach digestive system (four parts), namely the rumen, reticulum, omasum, and abomasum, which allows them to digest crude fiber from plants more efficiently. Javanese bulls generally ruminate after completing their feeding activities. This activity can occur in various body positions, such as lying down, standing, or sitting, depending on comfort and environmental conditions. Research shows that rumination activity tends to increase during quiet times such as afternoon and evening, when physical activity decreases.

Factors that influence the duration and frequency of rumination include the age of the animal, the type and quality of feed, and the amount of feed consumed (Jumiarni *et al*., 2019; Irawan, 2022; Wiyono *et al*., 2022). In this study, the highest rumination behavior was observed in adult male Javanese bull, which physiologically have greater feed intake requirements than young or female individuals. Ruminant animals require daily feed consumption of around 10% of their body weight, so rumination activity is an important process to ensure efficient absorption of nutrients from this large amount of feed. Adult male bull usually ruminate in a lying or standing position, with a duration of around 2–5 hours per day. During this process, the re-chewing speed can reach 48–56 times per minute, depending on the type and texture of the feed consumed (Jumiarni *et al*., 2019). Rumination is also an important indicator in evaluating animal welfare. Ruminant animals that experience stress or health problems generally show a significant decrease in rumination activity (Yulianto *et al.*, 2020). Therefore, monitoring this behavior in captivity can provide a comprehensive picture of the physiological and psychological conditions of the bull. The ruminant activity of the Javanese bull can be seen in Figure 3.

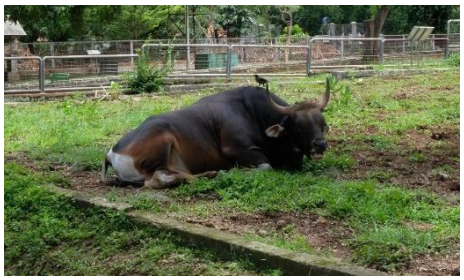

Figure 3. Javan bull rumination in sitting position
Source: Afghan, 2024

Movement behavior is defined as the activity of moving from one place to another, either in the form of walking or running. Javan bull in RWP shows a low percentage of movement behavior compared to individuals in their natural habitat. This is due to the limited area of the enclosure which limits the animal's movement space. This is different from Javan bull in in situ conservation areas, where movement activity is higher, especially in the morning when they walk towards the savanna to look for natural food (Jumiarni *et al*., 2019). In ex situ conservation areas such as RWP, the movement activity of bull tends to be more limited because all food and drinking water needs have been provided in the enclosure area. In addition, the calmer environmental conditions and minimal external stimuli make bull allocate more of their time to rest. According to Yulianto *et al.* (2020), limited space and minimal environmental variation cause animals to tend to reduce daily physical activity. The movement activity of Javan bull can be seen in Figure 4.

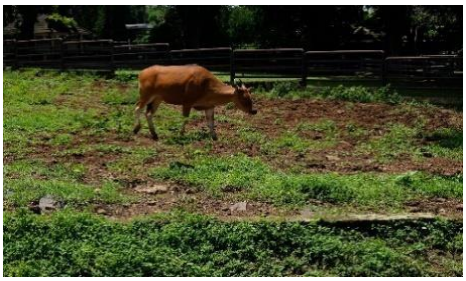

Figure 4. Moving behavior of javan bull
Source: Afghan, 2024

Resting behavior in Javanese bulls in RWP is generally done in the morning and afternoon, after eating and drinking. This activity is characterized by a still position, taking shelter, standing without moving, or lying down (Subeno, 2007). Bulls tend to choose shady, dry, and slightly sloping places, such as under trees or bushes. That bulls prefer resting locations that have vegetation covering the canopy, avoid direct exposure to sunlight, and have a flat and non-muddy ground surface. The ideal resting place for bulls is a location with dense vegetation cover and soil conditions that are not damp (Master *et al.*, 2024). The resting activity of Javanese bulls can be seen in Figure 5.

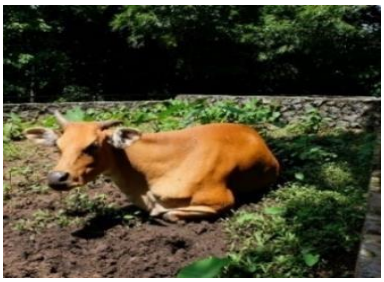

Figure 5. Resting behavior of Javan bull
Source: Afghan, 2024

Javanese bulls are animals with diurnal and partly nocturnal activity patterns, which means they can be active during the day or night depending on environmental conditions and their needs. In the wild, especially in situ areas, bulls often carry out activities such as looking for water and food at night to avoid predators (Hidayat *et al.*, 2022). However, in ex situ conservation areas such as RWP, sleeping behavior generally occurs in the morning or afternoon, after receiving additional food from the guard. Bulls do not have permanent sleeping places, but prefer locations that are covered by dense or thorny bushes that provide a sense of security and comfort . Javanese bull sleeping activities can be seen in Figure 6.

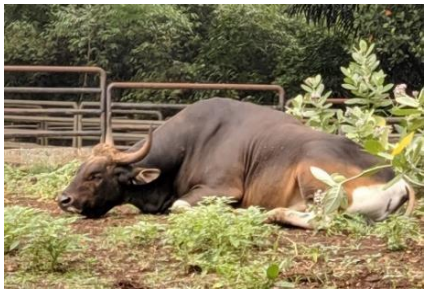

Figure 6. Javan bull sleeping during the day
Source: Afghan, 2024

Grooming behavior or body care is a form of bull response to disturbances from the environment, especially from insects such as flies and mosquitoes. Javanese bulls groom by wagging their tails, shaking their heads, or moving their bodies to ward off these disturbances. In addition, bulls also form a symbiotic mutualistic relationship with crows (*Corvus enca*) and starlings, which perch on their bodies to eat parasites such as ticks. The presence of these birds helps reduce irritation to the bull's skin and at the same time provides food for the birds (Jumiarni *et al*., 2019). Javan bulls appear calmer when these birds perch, because of the benefits obtained from the interaction. The grooming activity of Javanese bulls can be seen in Figure 7.

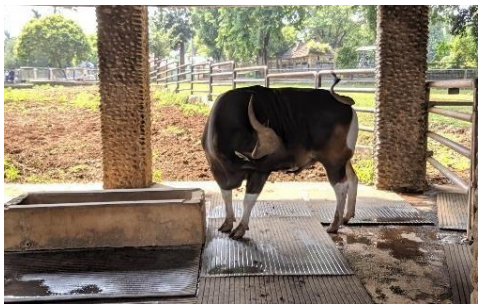

Figure 7. Javan bull shaking its head and wagging its tail
Source: Afghan, 2024

Urination is the process of removing liquid metabolic waste from the body. This behavior does not have a fixed time pattern, but is generally done after drinking (Irawan, 2022). Based on observations at RWP, adult male bulls tend to urinate more often than females, which is most likely due to body size and higher fluid consumption volume. Urination activity can be seen in Figure 8.

Figure 8. Javan bull urinating
Source: Afghan, 2024

Meanwhile, defecation is the process of removing digestive waste in the form of feces. This activity usually occurs after eating or in the morning. The texture of the feces excreted is also an important indicator for assessing the digestive health status of the bull. The bull feces in the RWP are not only observed but also used for biogas production. Zookeepers periodically collect feces every two days because of their rich organic content (Rahardja *et al*., 2020; Irawan, 2022). Defecation activity can be seen in Figure 9.

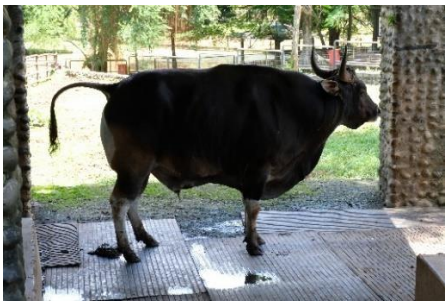

Figure 9. *Javan bull* Defecating by Lifting Tail
Source: Afghan, 2024

Javan bulls are social animals that naturally live in groups. One group usually consists of an adult male as a leader, several female parents, their offspring, and young males. This social behavior aims to increase group security, especially from predator attacks. Adult male bulls play a role in leading the group's movement to the grazing location, while female bulls play a role in guarding and supervising their offspring and maintaining vigilance towards the surrounding environment (Hidayat *et al*., 2022). This habit of living in groups shows the complexity of the social behavior of bulls which is important to understand in the context of conservation, especially so that natural interaction patterns can still occur even in ex-situ environments such as RWP. The social activities of Javan bulls can be seen in Figure 10.

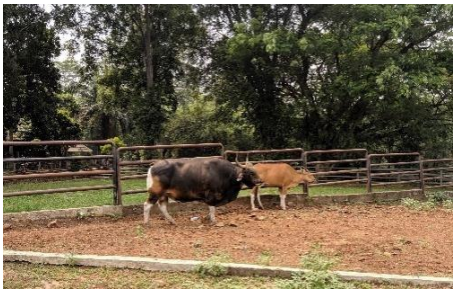

Figure 10. Javan bull gathering in the shade
Source: Afghan, 2024

CONCLUSION

Based on the results of the study, there were variations in daily activities between individual Javanese bull (Bos javanicus javanicus) observed at Ragunan Wildlife Park. Bejo showed dominant behavior in the social aspect, with a percentage of 32.56%, while the lowest behavior was defecation at 0.44%. Raju showed dominance in resting behavior at 39.56%, with urination behavior as the lowest at 0.22%. Meanwhile, Amy had dominance in eating behavior at 35.00%, and drinking and defecation activities were the lowest behaviors at 0.33% each. Finally, Susi also showed dominance in eating behavior at 49.44%, and did not show any sleeping behavior at all (0.00%) during the observation period. These results indicate that each individual bull has different behavioral tendencies, which can be influenced by factors such as age, gender, physiological conditions, and social interactions within its group. Understanding these daily behavioral patterns is very important, especially in managing wildlife in ex-situ conservation environments such as zoos. This research provides national benefits because the daily behavior data of Javan bull can be used as a basis for developing conservation policies, compiling animal welfare standards in conservation institutions, and as a reference in reintroduction or captive breeding programs based on natural behavior. In addition, the results of this study can also strengthen Indonesia's position in the Global Species Management Plans (GSMP) program and expand public

knowledge about the existence and importance of preserving Javan bull as part of national biodiversity wealth.

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