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Research

Daily Behavioral Patterns of Timor Deer (*Rusa timorensis*) Fawns at CV. Bahtera Satwa Breeding Center, Margorejo Village, Dawe District, Kudus Regency

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ABSTRACT

The phenomenon of the declining population of Timor deer (*Rusa timorensis*) has led the Indonesian government to designate them as a protected species. Captive breeding has become an effort to conserve Timor deer, and daily behavior serves as a measure of the success of the breeding program. The objective of this research was to evaluate the daily behavior patterns of Timor deer fawns, including movement, feeding, resting, social, alert, eliminative, and grooming behavior at the CV. Bahtera Satwa Breeding Center. Data collection for the research was conducted over 14 days using the scan sampling method. The results showed significant differences ($p<0.05$) in movement behavior, feeding, resting, social, and eliminative behavior between morning, afternoon, and evening. The frequency of social behavior in deer fawn was observed more often than in other behaviors, while the duration of resting activities was higher compared to other activities. The conclusion of this study was that the daily behavior patterns of Timor deer fawns, consisting of social and resting behaviors, were consistently performed in the morning and afternoon. The social behavior exhibited by the fawns was an effort to interact and explore their environment, while resting behavior was used to avoid heat and recover energy after morning activities.

Keywords: grooming behavior, sosial behavior, scan sampling

ABSTRAK

Fenomena penurunan populasi rusa timor (*Rusa timorensis*) membuat pemerintah Indonesia menetapkan rusa timor sebagai jenis satwa yang dilindungi. Penangkaran menjadi upaya pelestarian rusa timor, perilaku harian menjadi tolak ukur keberhasilan penangkaran sebagai indikator tingkat stres pada satwa, khususnya anak rusa timor. Penelitian ini bertujuan mengevaluasi pola perilaku harian anak rusa timor yang meliputi perilaku berpindah, perilaku makan, perilaku istirahat, perilaku sosial, perilaku waspada, perilaku eliminatif, dan perilaku grooming pada pagi, siang dan sore hari di Penangkaran CV. Bahtera Satwa Dawe Kudus. Pengambilan data penelitian dilakukan selama 14 hari menggunakan metode scan sampling. Hasil penelitian menunjukkan terdapat perbedaan yang nyata ($p<0.05$) pada perilaku berpindah, perilaku makan, perilaku istirahat, perilaku sosial, dan perilaku eliminatif antara pagi, siang, dan sore hari. Frekuensi perilaku sosial anak rusa lebih sering ditemukan daripada perilaku lainnya, sedangkan durasi aktivitas istirahat lebih tinggi dibandingkan aktivitas lainnya. Kesimpulan dari penelitian ini adalah pola perilaku harian anak rusa timor berupa perilaku sosial dan istirahat konsisten dilakukan di pagi dan siang hari. Perilaku sosial yang dilakukan oleh anak rusa sebagai upaya untuk berinteraksi dan melakukan eksplorasi lingkungan, sementara perilaku istirahat dipergunakan untuk menghindari panas dan memulihkan energi setelah aktivitas pagi hari.

Kata kunci: perilaku grooming, perilaku sosial, scan sampling

INTRODUCTION

The Timor deer (*Rusa timorensis*) is a protected species under the Law of the Government of the Republic of Indonesia No. 5 of 1990 concerning the conservation of biological natural resources and ecosystems. The international community has classified the Timor deer as vulnerable according to the International Union for the Conservation of Nature and Natural Resources (IUCN) (Hedges *et al.*, 2015). To prevent population, decline and extinction, *ex-situ* conservation, specifically captive breeding, is a necessary effort (Sita & Aunurohim, 2013). Captivity is an activity that aims to breed wildlife while maintaining genetic purity (Santosa *et al.*, 2012).

The daily behavior of an animal is an activity performed in response to stimuli originating from its environment. Behavior involves neurobiological mechanisms, namely mechanisms of reception by afferent nerves, processing, and response by efferent nerves. Stimuli originating from the external or internal environment are received and processed in the central nervous system to produce physiological responses. Efferent pathways are activated to respond to stimuli that have been received (Coria-Avila *et al.*, 2022). In general, the daily behavior of fawns closely resembles that of their parents, encompassing moving, feeding, resting, social, alert, eliminative, and grooming behaviors.

Captive habitats inherently differ from natural habitats, necessitating adaptation for the Timor deer. In particular, Timor deer fawns require a comfortable habitat to support their growth. Captive management must ensure fawns receive optimal care, as it is one of the benchmarks of success in captivity (Sofyan & Setiawan, 2018). Research on the daily activities of animals is essential as an indicator of the presence or absence of abnormal activity, which can reflect the animal's stress level (Purbaya *et al.*, 2022).

Environmental factors such as temperature, humidity, and sunlight intensity throughout the day (morning, afternoon, and evening) are known to influence the daily behavior of fawns. Behaviors such as feeding, movement, and social interactions with their doe or with other deer contribute to the formation of social bonds and adaptability of fawns in *ex situ* habitats. Currently, information on the daily behavior patterns of fawns remains limited, both in the wild and *ex situ* captivity. Therefore, this study was designed to evaluate the daily behavior of Timor deer fawns in the morning, afternoon, and evening periods at CV Bahtera Satwa, Dawe District, Kudus Regency, Central Java. The results obtained from this study are expected to be a valuable scientific resource and contribute to the improvement of captive management of Timor deer in *ex-situ* habitats.

MATERIALS AND METHODS

Study Location, Duration, and Ethical Clearance

This study was conducted for fourteen days at the Timor Deer Breeding facility CV. Bahtera Satwa, located on the Dawe-Dengkol, Margorejo Village, Dawe District, Kudus Regency, Central Java, Indonesia. The map of the research location is shown in Figure 1. All procedures and implementation of the study were approved by the Animal Ethics Commission of the Faculty of Animal Husbandry and Agriculture, Diponegoro University, under approval number 60-06/A-12/KEP-FPP.

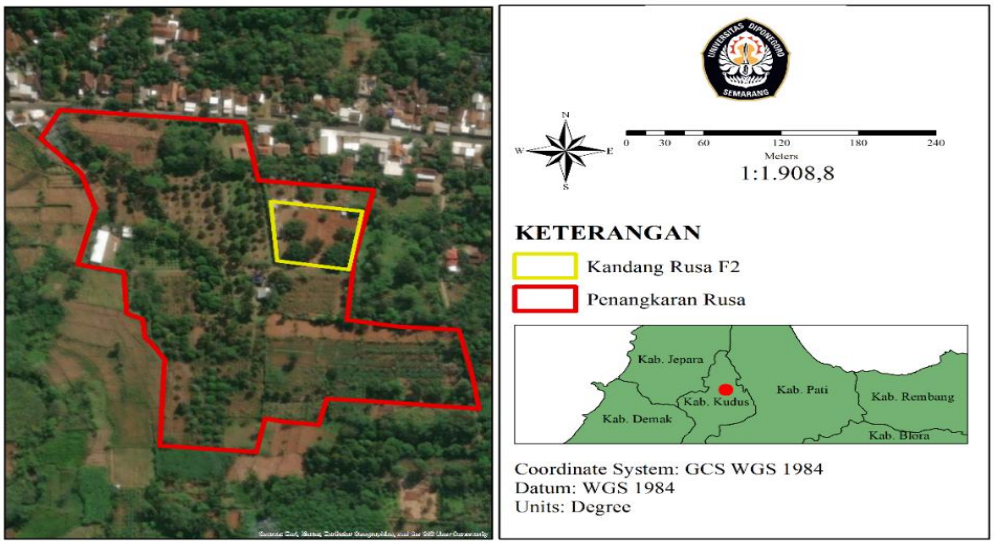

Figure 1. Map of the research location

Research Enclosure and Habitat Description

Timor deer occupy communal enclosure F2 in the breeding area (Figure 1). Enclosure F2 is equipped with two shelters for feeding, resting, and sheltering. The drinking area consists of a water pond located under a tree. Several ficus and teak (*Tectona grandis*) trees are found within the enclosure area. Each tree is fenced with wrought iron, which serves to prevent damage and is used by the adult male deer for rubbing their antlers. The enclosure housed a colony consisting of male deer, female deer, and fawns.

Feeding Management

The breeding staff provides drop-in deer feed, which consists of grass and concentrate. The types of grass identified are elephant grass (*Pennisetum purpureum*), teki (*Cyperus rotundus*), grinting (*Cynodon dactylon*), kremah (*Alternanthera sessilis*), and jamarak (*Setaria barbata*). Grass feed is provided three times a day (morning, afternoon, and evening), with three bundles at each feeding time (each bundle weighing 10-15 kg). Concentrate feed is provided three times per week, with each feeding consisting of approximately 15 kg of concentrate.

Objects of Research and Habituation

The subjects for observation were four Timor deer fawns aged 5-9 months that were still suckling from their doe. These fawns were kept in communal cages alongside their doe and other adult deer. Researchers conducted a seven-day habituation period prior to collecting research data. The purpose of habituation aimed to reduce the animal's level of alertness to the presence of researchers, thereby ensuring that the subjects' natural activities were not disturbed during observation.

Behavioral Parameters

The observed daily behavior of Timor deer fawns consists of seven main parameters, defined as follows (Sofyan & Setiawan, 2018):

1. Moving (locomotion) behavior: the activity of fawns moving from one area to another.
2. Feeding behavior: the activity of fawns looking for, taking, putting food in their mouths, chewing, and swallowing food.
3. Resting behavior: the activity of fawns when taking shelter or sleeping under trees/shelters.
4. Social behavior: fawn activities include interaction with doe, suckling, vocalization, and playing.
5. Alert behavior: fawns stop their activity, raise their heads, move their ears, and look in suspicious directions.
6. Eliminative behavior: defecation and urination activities.
7. Grooming behavior: licking and rubbing activities using the mouth, legs, hooves, and teeth.

Data Collection

Data were collected by direct observation in the enclosure for fourteen days. Incomplete behavioral data were confirmed through closed-circuit television (CCTV) recordings installed at four points in the enclosure area. The method of observing the daily behavior of Timor deer fawns used the scan sampling method (Dewi & Wulandari, 2011). Behavioral observations were conducted from 6:00 a.m. to 6:00 p.m., followed by recording the duration and frequency of each 10-minute interval. Measurements of environmental factors were made daily, including light intensity using a luxmeter, temperature, and humidity using a thermohygrometer.

Data Analysis

The data observed in the morning, afternoon, and evening were analysed using analysis of variance (ANOVA) at the 5% significance level, followed by the Tukey test to determine specific differences. Additionally, the total frequency and duration of daily behavior were calculated. The percentage of daily behavior was calculated according to the formulation used by Gusmalina et al. (2018):

$$Behaviour\ percentage = \frac{Frequency\ of\ daily\ behaviour}{Total\ number\ of\ all\ daily\ behaviours} \times 100\%$$

RESULTS

The results of the study of the daily behavior of captive Timor deer fawns are presented in terms of mean frequency and duration during the fourteen days of observation in Table 1. The percentage of frequency and duration of daily behavior is illustrated in Figure 2A-B.

The results of the frequency and duration of fawn behavior based on the division of observation time (morning, afternoon, and evening) can be seen in Tables 2 and 3. The frequency of moving, eating, resting, and eliminative behavior showed significant differences ($p<0.05$) across the the morning, afternoon, and evening, while the frequency of social, alert, and grooming behavior remained no difference in the morning, afternoon, and evening. The duration of fawn behavior in captivity showed significant differences ($p<0.05$) across the three observation times, specifically for moving, eating, social, and

elimination behaviors. In contrast, alerting and grooming behaviors remained similar in duration across the morning, afternoon, and evening (Table 3).

Feeding behavior represented a relatively high percentage of the total frequency and duration (Figure 2A-B), with the longest duration primarily concentrated in the morning and evening compared to the afternoon (Tables 2 and 3, Figure 3A). In terms of overall activity, resting activity had the highest mean and percentage duration among all of the fawn's behavior (Table 1 and Figure 2). Furthermore, fawn resting behavior (Figure 3B) was longer during the day, especially after feeding, exploration, or moving activities in the morning.

The percentage frequency of fawn social behavior was higher than that of other behaviors. The time required for social behavior was longer in the morn-ing, especially suckling activity (Figure 3C). Meanwhile, the percentage and mean frequency of fawn alarm behavior were the lowest among all other be-haviors, and its frequency and duration remained no difference regardless of the time of observation. Conversely, the duration of fawn grooming behavior was generally shorter than that of other behaviors (Table 1 and Figure 2B), and both its frequency and duration showed no significant difference between the morning, afternoon, and evening.

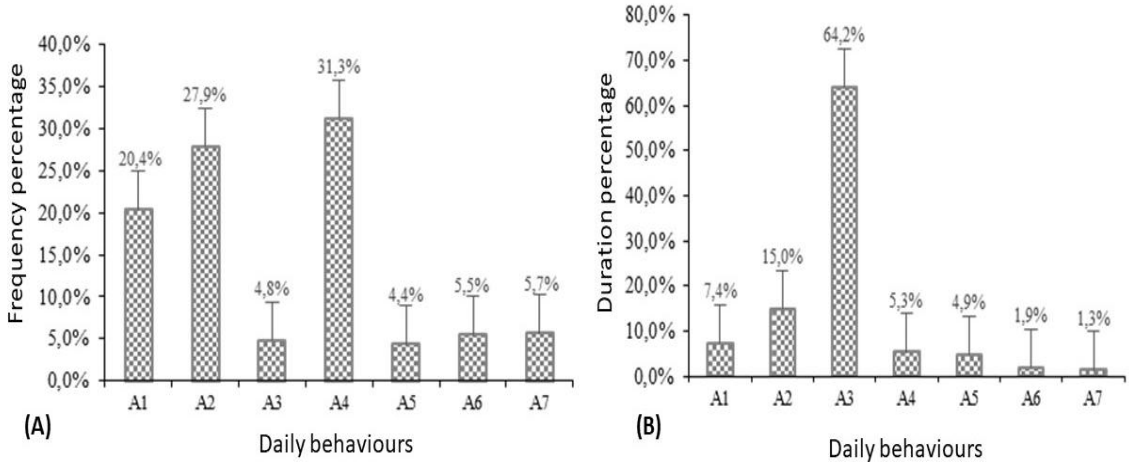

Figure 2. Percentage of frequency (a) and duration (b) of daily behaviors of fawns. A1: Moving, A2: Feeding, A3: Resting, A4: Social, A5: Alert, A6: Eliminative, A7: Grooming

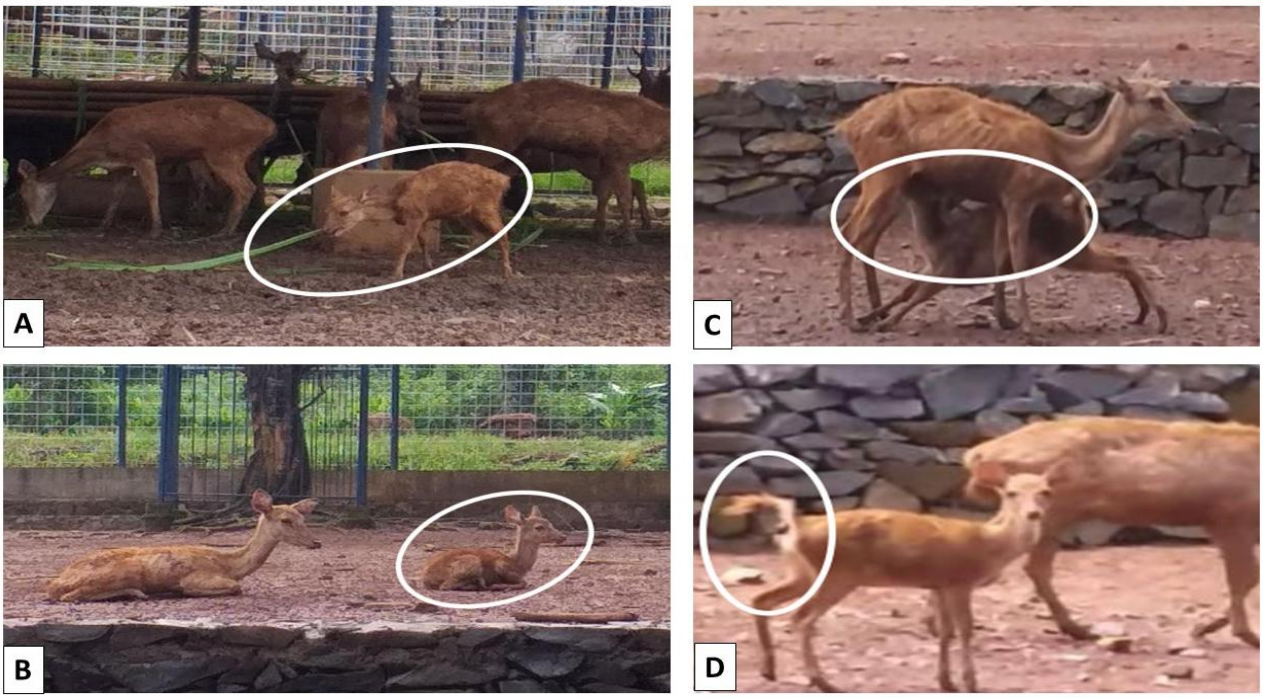

Figure 3. Daily behavior of fawns. A: feeding behavior, B: resting, C: social, lactation, D: defecation. The white solid line shows fawns in the activity

Table 1. Frequency and duration of daily behavior of Timor deer fawns in Timor Deer Breeding.

No	Variable	Frequency (times/hour) X ± SD	Duration (seconds/hour) X ± SD
1	Moving	33.35 ± 14.23	419.00 ± 199.49
2	Feeding	45.57 ± 21.12	844.08 ± 471.90
3	Resting	7.9 ± 3.79	3609.30 ± 2452.17
4	Social	51.23 ± 20.87	295.81 ± 146.44
5	Alert	7.19 ± 3.32	276.44 ± 148.99
6	Eliminative	8.92 ± 3.5	105.91 ± 38.87
7	Grooming	9.35 ± 4.42	74.99 ± 26.42

Notes: Data shown are mean (X) ± Std. Deviation (SD).

Table 2. Frequency (times/hour) of daily behavior of Timor deer fawns in the morning, afternoon, and evening.

Variable	Morning X ± SD	Afternoon X ± SD	Evening X ± SD
Moving	31.93 ± 13.10^{ab}	43.07 ± 14.05^{b}	25.07 ± 9.61^{a}
Feeding	60.57 ± 15.36^{b}	26.14 ± 11.27^{a}	50.00 ± 19.35^{b}
Resting	6.86 ± 1.79^{a}	11.93 ± 2.89^{b}	4.93 ± 2.37^{a}
Social	53.86 ± 17.75^{a}	50.00 ± 24.92^{a}	49.86 ± 20.68^{a}
Alert	7.50 ± 2.77^{a}	7.71 ± 4.30^{a}	6.36 ± 2.76^{a}
Eliminative	9.36 ± 3.50^{ab}	10.86 ± 2.98^{b}	6.57 ± 2.74^{a}
Grooming	10.36 ± 3.86^{a}	10.00 ± 4.74^{a}	7.71 ± 4.46^{a}

Notes: Means with different superscripts in the same row indicate significantly different ($p<0.05$).
Data shown are mean (X) ± Std. Deviation (SD).

Table 3. Duration (seconds/hour) of daily behavior of Timor deer fawns in the morning, afternoon, and evening

Variable	Morning X ± SD	Afternoon X ± SD	Evening X ± SD
Moving	489.59 ± 215.43^{b}	475.52 ± 195.40^{b}	291.92 ± 121.36^{a}
Feeding	1150.57 ± 485.59^{b}	469.29 ± 245.74^{a}	912.40 ± 385.61^{b}
Resting	3132.08 ± 1567.99^{a}	5980.15 ± 2230.48^{b}	1715.67 ± 1170.79^{a}
Social	380.91 ± 163.08^{b}	285.41 ± 111.57^{ab}	221.12 ± 121.11^{a}
Alert	329.40 ± 163.93^{a}	300.22 ± 133.79^{a}	199.70 ± 123.55^{a}
Eliminative	110.90 ± 38.56^{ab}	121.08 ± 34.08^{b}	85.75 ± 37.50^{a}
Grooming	68.16 ± 15.72^{a}	89.52 ± 28.84^{a}	67.31 ± 27.98^{a}

Notes: Means with different superscripts in the same row indicate significantly different ($p<0.05$).
Data shown are mean (X) ± Std. Deviation (SD).

DISCUSSION

Moving behavior leads to the activity of fawns walking or running to feed, seek shelter, follow their doe's and peers, explore, and avoid disturbances. The percentage of moving frequency in this study was lower than that reported by Sofyan & Setiawan (2018) and Husna *et al.* (2024). This difference in results may be due to differences in habitat condition, age, herd size in the population, and feed availability. Other studies, such as Tajchman *et al*. (2022) on fallow deer fawns, found higher running activity in the evening than in the morning. These results differ from the movement activity found in the current study. Moving activity is also related to stimuli that arise from the internal and external environment. The stimulation of hunger causes fawns to walk or run towards the feeding site. A doe's vocalization, indicating either lactation time or danger, further stimulates fawns to move in search of the doe. The urge to explore the environment also encourages fawns to move around the cage. As Tomkins *et al*. (2018) reported, deer will move and change places while sniffing out odors or detecting predators.

In the present study, the high activity of moving fawns in the morning and afternoon was thought to be due to the stimulation of hunger in the morning and the need to find a place to rest during the day. stimulation of hunger encourages fawns to move towards the feeding site. The increase in movement activity during the day is related to the activity of fawns looking for shelter under shelters or under trees. After resting for some time during the day, fawns continue their foraging activities and explore the environment. Sumerah *et al.* (2020) stated that hunger is caused by an empty stomach and increases ghrelin secretion, which encourages foraging behavior.

The grazing behavior (eating) of Timor deer fawns in the morning and evening was higher than that of fallow deer fawns (*Dama dama*), as reported by Tajchman *et al.* (2022). The increased eating activity in the morning and evening may be related to the digestive tract being empty, causing sensory receptors in the stomach to send signals to the hunger center in the brain, thus increasing ghrelin secretion, stimulating appetite, and causing the fawns to move to find food. Furthermore, Shi *et al.* (2018) stated that hunger stimuli can activate the arcuate nucleus in the hypothalamus to secrete neuropeptide Y, which contributes to increasing appetite. The preference for eating in the morning or evening was also associated with cooler temperatures. The recorded ambient temperature in captivity in the morning was around 29°C with 92% humidity and a light intensity of 990 lux. These environmental factors also influence fawns' feeding activity. The results of this study are consistent with Van Beest *et al.* (2019), who observed that fawn feeding activity was higher in the morning and evening when the ambient temperature was low. Conversely, hot ambient temperatures reduce appetite and foraging activity.

The age of fawns in captivity ranges from 5 to 9 months, so fawns in captivity exhibited a relatively high frequency and duration of resting behavior following other daily activities. The percentage frequency of resting behavior in this study was higher than the observations of Sofyan & Setiawan (2018). Fawns require 7.75 h/day of sleep, with each sleep session lasting 46.52 minutes. Longer sleep and rest in fawns are critical for cognitive health, immune system development, supporting physiological functions, and growth (Mortlock *et al.*, 2024). Rest time is also crucial for rumination. Furthermore, resting is also performed when there is an increase in environmental temperature during the day (30-34°C).

Temperature change signals are sent to the hypothalamus, which then regulates body temperature change signals are sent to the hypothalamus, which then regulates body temperature. One expression of the cooling mechanism includes the behavior of seeking shelter or resting under trees. Van Beest *et al*. (2019) stated that fawns do a lot of resting during high temperatures to prevent hyperthermia.

Fawn's social behaviors observed included vocalization, interaction with doe's, suckling, and play. The social behavior of fawns is thought to be related to their developing social adaptation. During this adaptation process, fawns also learn to interpret social signals from the environment or from members of the captive deer population. The social behavior of captive fawns in this study was higher than the results of Sofyan & Setiawan's (2018) research.

One of the many social behaviors observed in the morning was suckling activity. This lactation behavior initiates with the doe's call to the fawn. When the fawn discovers the presence of the doe, it locates and sucks on the doe's nipple. The suckling activates sensory nerve endings, transmitting the stimulus to the hypothalamus, where it is received by the hypothalamic neurosecretory cells. These neurosecretory cells then secrete oxytocin through the posterior pituitary. Oxytocin, received by the myoepithelium receptors of the mammary gland, causes muscle contraction and milk ejection. Putri *et al.* (2021) declared that one of the stimuli for oxytocin secretion is the stimulation of sucking the nipple by the child. Litherland *et al*. (2020) suggested that the stimulation of a fawn sucking on the doe's nipple also triggers prolactin release from the anterior pituitary. The presence of prolactin can stimulate the mammary glands to produce and secrete milk. The frequency and duration of suckling in Timor deer fawns in this study were combined with other social behaviors and differ from those reported by Tajchman *et al*. (2022), that the frequency and duration of suckling in fallow deer fawns were higher during the evening than in the morning, at 1.73 times and 0.61 minutes, respectively.

A fawn's alert behavior is characterized by a momentary pause in activity, followed by a movement of raising both ears and paying attention to the suspected direction. However, this alert behavior was found to be the least; it is suspected that fawns feel comfortable and safe in a captive environment due to available food resources and the absence of predators or other disturbing animals, thus reducing the level of alertness of fawns. This finding supports the statement by Dewi *et al.* (2024) that captive conditions differ from natural habitats, which can affect vigilance levels of fawns. The limi-

ted space in captivity and the lack of challenges from natural predators keep fawns safe.

Eliminative behavior in fawns includes defecation and urination, both of which occur after feeding. Defecation in fawns (Figure 3D) is often carried out in a walking position, generally starting with a short stop, and then the fawn will excrete feces. Urination is marked by raising the tail, followed by both hind legs slightly lowering, and then urine will be released. The eliminative behavior of fawns in this study was lower than that of adult deer reported by Husna *et al.* (2024). Kurniawan *et al.* (2015) suggested that the defecation process begins with the entry of undigested feed residue, which is converted into feces, and then collects in the rectum, triggering stretching of the rectum. This stimulus is delivered to the defecation center in the spinal cord by afferent nerves, then triggers contraction of the rectal smooth muscle and relaxation of the anal sphincter, which causes feces to leave the body.

Grooming behavior in fawns is carried out between resting periods and sometimes occurs after feeding, for a short duration. Rasyidi *et al.* (2022) reported that the Timor deer grooming activity lasted 13 minutes longer than that of fawns in the present study. Meanwhile, Heine *et al.* (2016) reported that white-tailed deer fawns groomed for 0.042 minutes, including autogrooming and allogrooming. Grooming behavior is initiated when the skin's sensory nerves receive an itch or dirt stimulus. The itch signal is transmitted to the central nervous system or the reflex center. Then, the central nervous system interprets and transmits the information to the skeletal muscles via the motor nerves to respond by producing certain movements such as licking, scratching, or shaking the body. Based on observations, grooming in fawns is often done by the doe, who licks the fawn to clean dirt or attached parasites. Dewi *et al*. (2024) stated that the grooming ability of fawns is not perfect, so they still depend on their doe. Anggraeni *et al.* (2023) suggested that grooming activities are linked to motor control and reflexes, causing animals to automatically clean body parts affected by feces or remove parasites. Grooming activities can strengthen social bonds, especially allogrooming, which involves cleaning each other between two individuals, such as doe and their children.

It can be concluded that the daily behavior patterns of captive Timor deer fawns do not form a specific sequence, but each behavior is associated with others. Resting behavior is consistently carried out during the day, which functions to avoid heat and support the rumination process of the fawns.

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