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MONITORING THE REPRODUCTIVE STATUS OF SAMBAR DEER (*CERVUS UNICOLOR* KERR) BASED ON SEXUAL BEHAVIOR IN LIVESTOCK AREA OF PALANGKA RAYA

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Abstract
Sambar Deer (*Cervus unicolor Kerr*) is increasingly threatened due to habitat destruction and illegal hunting. However, with proper habitat management, this decline can be prevented. One of the Sambar deer-protected areas in Central Kalimantan is the Livestock Area of Palangka Raya. This research aims to monitor the reproductive status of sambar deer based on sexual behavior in the Livestock Area of Palangka Raya, Central Kalimantan. This research used six samples of sambar deer consisting of two female deer with sample codes A1 and A2, two female deer with sample codes B1 and B2, and two male deer with sample codes J1 and J2. This research used three methods: Focal Animal Sampling, Ad Libitum Sampling, and One Zero Sampling. The results showed that sexual activity was the lowest activity with a percentage of 1.9% (average time 13 minutes) per 11 hours. Meanwhile, the ANOVA test results showed no significant difference in sexual activity between the deer groups ($p>0.05$). It is thought to be due to the low level of sexual activity during observations.
Keywords: Sexual Activity, Sambar Deer

MONITORING STATUS REPRODUKSI RUSA SAMBAR (CERVUS UNICOLOR KERR) BERDASARKAN TINGKAH LAKU SEKSUAL DI KAWASAN PETERNAKAN KOTA PALANGKA RAYA

Abstrak
Keberadaan rusa sambar (Cervus unicolor Kerr) semakin terancam akibat rusaknya habitat dan perburuan liar. Namun, dengan pengelolaan habitat yang tepat, penurunan ini dapat dicegah. Salah satu kawasan lindung rusa sambar di Kalimantan Tengah adalah Kawasan Peternakan Kota Palangka Raya. Penelitian ini bertujuan untuk memantau status reproduksi rusa sambar berdasarkan perilaku seksual di Kawasan Peternakan Kota Palangka Raya, Kalimantan Tengah. Penelitian ini menggunakan enam sampel rusa sambar yang terdiri dari dua ekor rusa betina yang diberi kode sampel A1 dan A2, dua ekor rusa betina menyusui dengan kode sampel B1 dan B2 dan dua ekor rusa jantan dengan kode sampel J1 dan J2. Penelitian ini menggunakan tiga metode yaitu Focal Animal Sampling, Ad Libitum Sampling, dan One Zero Sampling. Hasil pengamatan menunjukkan bahwa aktivitas seksual merupakan aktivitas yang terendah dengan persentase 1,9% (rata-rata waktu 13 menit) per 11 jam. Sedangkan, hasil uji ANOVA menunjukkan tidak ada perbedaan signifikan dalam aktivitas seksual antara kelompok rusa ($p>0.05$). Hal ini diduga karena masih rendahnya aktivitas seksual selama pengamatan.
Kata Kunci: Aktivitas Seksual, Rusa Sambar

INTRODUCTION

Sambar Deer (*Cervus unicolor*) is a type of large tropical deer that can only be found on Sumatra, Kalimantan and several small islands around it. Male deer usually weigh between 136-320 kg and a withers height of up to 160 cm, while females weigh between 135-225 kg and a withers height of up to 115 cm. Their fur is brown, with variations towards black in male or older deer, rough in texture, and not too thick. Sambar deer have ears that are quite wide and point forward relatively short tails, and medium with length fur. Their feathers on the sides of the neck form a kind of mane or panicle. In male deer, the fur color will change from light brown to darker as the mating season approaches. (Semiadi *et al* ., 2014).

Sambar deer's population, a protected deer species in Indonesia, is declining due to deforestation and increased illegal hunting

(Putranto, 2010). Sambar deer have been registered in the Decree of the Minister of Forestry No 305/Kpts-11/1991, dated 19 June 1991, and PP No. 7 of 1999 concerning the Preservation of Plant Types and Animals are protected species. Apart from that, according to the IUCN (International Union for Conservation of Nature), sambar deer are categorized as threatened (vulnerable) animals due to their population continuing to decline (IUCN 2010). Conservation efforts are needed, in their natural habitat (in-situ) and captive breeding (ex-situ), to maintain their survival. One of the deer breeding places is located in the Palangka Raya City Livestock Area, Jalan Bromo, Palangka Village, Jekan Raya District, which is under the supervision of the Central Kalimantan Province Food Crops, Horticulture and Livestock Service.

One strategy for developing deer populations in captivity is understanding their reproductive characteristics. Research about the reproductive biology of captive tropical deer in their natural habitat, including the deer mating season, which usually lasts from June to August, is still lacking. During the mating season, there is usually a competition between male deer for control of the group of females with which they can mate. This competition will form a power structure called a hierarchy, with the male who controls the group of females referred to as the dominant male. (Semiadi *et al.*, 2014).

In several developed countries such as Australia and New Zealand, Sambar deer have been successfully bred and developed well, even though the deer are not indigenous in these countries. In Indonesia, maintenance is still in captive breeding, including in the Palangka Raya City area, Central Kalimantan. In general, the main purpose of raising deer as livestock in foreign countries is to produce deer meat or venison and antlers (*ranggah*). This antler, often called a velvet antler, is usually used when it is still young. Velvet antlers are antlers that are still growing and are covered with soft hairs. Throughout their life cycle, antlers experience phases of hard, deciduous and young antlers, which occur continuously (Semiadi *et al*., 2014).

Currently, knowledge about deer reproduction is mainly focused on deer originating from Europe, such as Red Deer (*Cervus elaphus*), and is still very lacking on deer from tropical areas (Semiadi *et al.*, 2014). A good understanding of the reproductive conditions of certain types of deer will be beneficial in efforts to increase deer populations in captivity, including through reproductive management strategies. Information on reproductive physiology is fundamental before conservation efforts continue with advanced production technology (Putranto *et al*., 2007 a, b, c). Therefore, it is crucial to conduct a study on monitoring reproductive status based on the behavior of captive-bred Sambar Deer in the Livestock Area of Palangka Raya, Central Kalimantan.

MATERIALS AND METHODS

This study observed and recorded the activities of two female sambar deer (A1 and A2), two lactating female sambar deer (B1 and B2), and two male sambar deer (J1 and J2) throughout the morning, afternoon, and evening (11 hours of observation). The equipment used in this research included a Canon EOS 1100D DSLR camera with 20-megapixel resolution to capture each deer's activity, a logbook to record the behavior of each deer in the farm area, ARSSON Binocular Outdoor Magnification 300x25 Long Range Night Vision-XB821PP, thermometer, hygrometer, stationery, and a stopwatch to calculate the duration of the deer's moving, eating, resting, and other activities.

Place and time

This study was conducted from September to October 2023 in the Livestock Area managed by the Central Kalimantan Provincial Horticulture and Livestock Food Crops Service, located on Jalan Bromo, Palangka Village, Jekan Raya District, Palangka Raya. Before starting observations, a habituation process was carried out for 14 days to get the deer used to the researcher's presence, to avoid disturbing the deer's activities, and to minimize stress on the research object. Observations and data collection were carried out 14 days after the habituation process.

Research methods

Data was collected for 11 hours with a time lag every 5 minutes. The social activities of sambar deer were observed using the Focal Animal Sampling method, which involves

observing the social behavior of target deer by following their movements individually from morning to evening. After completing observing one individual, the researcher immediately moved on to the next individual (Bosholn & Anciaes, 2018). This research also applies the ad libitum sampling method, namely recording as much individual behavior as possible that can be observed (Mercy *et al.*, 2013). The one-zero sampling method is used to assess the activities carried out by the target individual. A value of one is given if there is activity, and a value of zero is given if there is no activity.

Observation Variables

Moving Activities. Observe the deer's moving activity and record the time and duration of the deer's movement during the 11 hours of observation.

Eating Activities. Observations of eating and drinking patterns, as well as the activity of looking for and putting forage into the mouth, known as grazing, were observed from active daily eating patterns during the 11 hours of observation.

Rest Activities. Observe resting activity by looking at where the deer are resting and taking shelter. Record the time and duration of the deer's rest, from a distance so as not to disturb the resting herd.

Social Activities. Observation of social activities can be defined as activities other than moving, eating, and resting, such as grooming, rubbing against each other, wallowing, vocal, and sexual activities (mating).

Figure 1. Female sambar deer with marking codes A1 (left) and A2 (right)

Figure 2. Lactating female sambar deer with marking codes B1 (left) and B2 (right)

Figure 3. Male sambar deer with marking codes J1 (left) and J2 (right)

Data Analysis

Data was analyzed using two approaches, namely quantitative and descriptive analysis. Quantitative analysis includes recording all daily behaviors of sambar deer, which are further converted into a percentage of observed daily activity (Madja *et al*., 2018). The results of this calculation are then displayed in the form of tables and graphs. The daily activity percentage of deer is calculated based on the total activity time divided by the observation duration, as shown in the following formula (Gusmalinda *et al* ., 2018):

$$\text{Deer Daily Activities} = \frac{Total\ Activity\ Time}{Long\ Observation} \text{ x } 100\ \%$$

Meanwhile, descriptive analysis is a method used to illustrate the issue being handled by describing what happened during the research (Margareta, 2013). Descriptive analysis is used to describe the daily behavior of sambar deer (Sofyan & Setiawan, 2018).

RESULTS AND DISCUSSION

General Condition of The Livestock Area

The development of the livestock area in Palangka Raya began in 2008, with the initial location on Jalan Bromo, Palangka Village, Jekan Raya District with a land area of ± ½ hectare or 5000 m². The Central Kalimantan Province Department of Horticultural Food Crops and Livestock manages this livestock area. The deer being developed are Sambar deer (*Cervus unicolor*), imported from the Penajam area, East Kalimantan, initially comprising 2 bucks and 6 does. Over time, the deer population continues to increase. By 2018, there were a total of 33 animals, consisting of 16 bucks and 17 does, with many of them relocated to livestock areas in Tangkiling and Jalan Batuah. Currently, the deer population has increased to 42, consisting of 8 bucks, 30 does, and 4 fawns (Provincial Department of Horticultural Food Crops and Animal Husbandry 2022).

The research was conducted during the dry season (September-October) with the highest temperature range of 30-31°C and the highest average humidity of 76-78.5%. There was some grass vegetation such as elephant grass (*Pennisetum purpureum*) and legumes, but in the dry season, it looked more barren than during the rainy season. Feed was provided twice, in the morning and evening, and a water source was available at all times. Meanwhile, the conditions in the deer's wallowing area looked drier due to the low rainfall. Wallowing is one way for deer to lower their body temperature during hot conditions.

Sambar Deer Daily Activities

Breeding Sambar Deer in the Palangka Raya City Livestock Area is one of the steps taken to protect this species through ex-situ conservation, preserving natural resources, and also as an effort to produce meat and antlers. The success of reindeer breeding depends on the maintenance and reproduction management implemented because the conditions of captive breeding habitats are different from natural habitats (Setiawan *et al*., 2015).

Based on the characteristics of the breeding habitat, there will be an increase in nutrition, an increase in competition for food, a decrease in predation by predators, a significant decrease in disease and parasites, and an

increase in interactions with humans (Dewi & Wulandari, 2011). Monitoring of reproductive status was carried out based on observations of emerging sexual behavior and other daily activities. During observations, ten daily activities of Sambar Deer were detected, namely: moving, eating, drinking, resting, grooming, sheltering, wallowing, vocalizing (only for females), rubbing against ants (only for males), and sexual activity (mating).

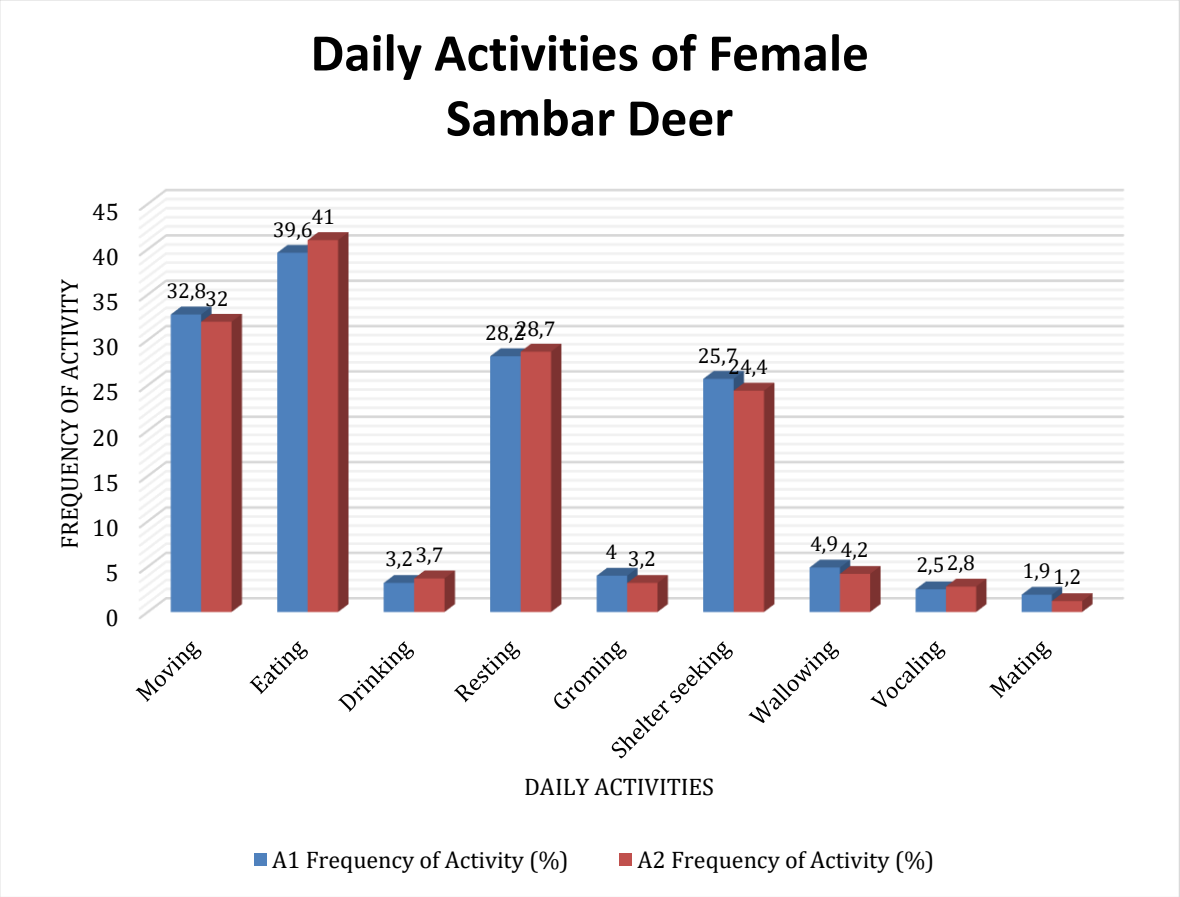

Figure 4. Bar diagram of daily activity of female sambar dee

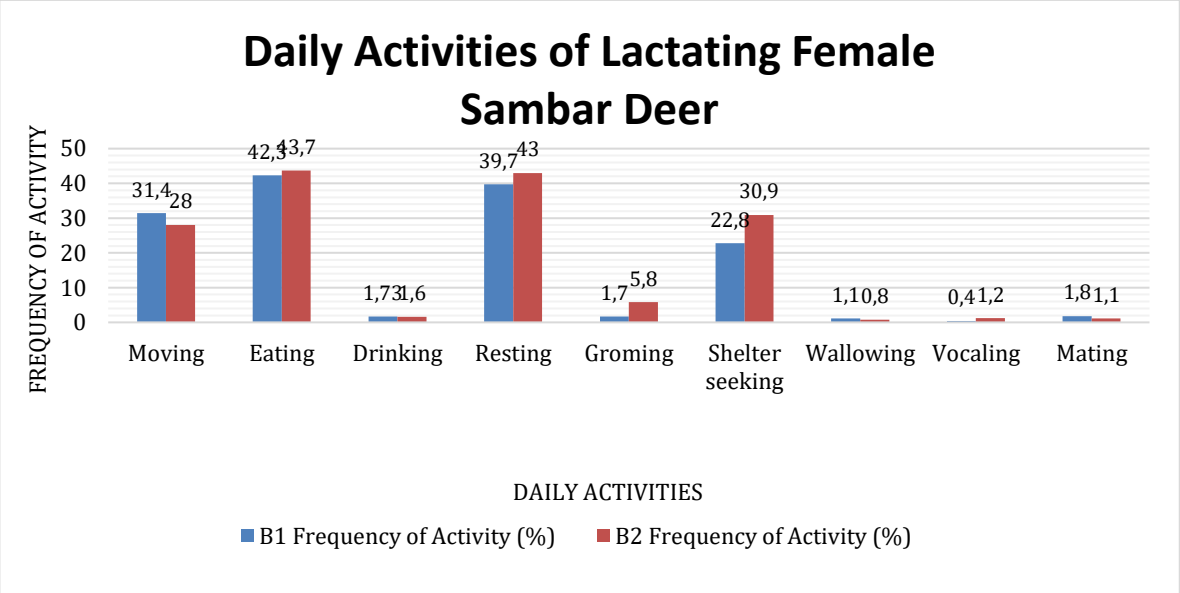

Figure 5. Bar diagram of daily activities of lactating female sambar deer

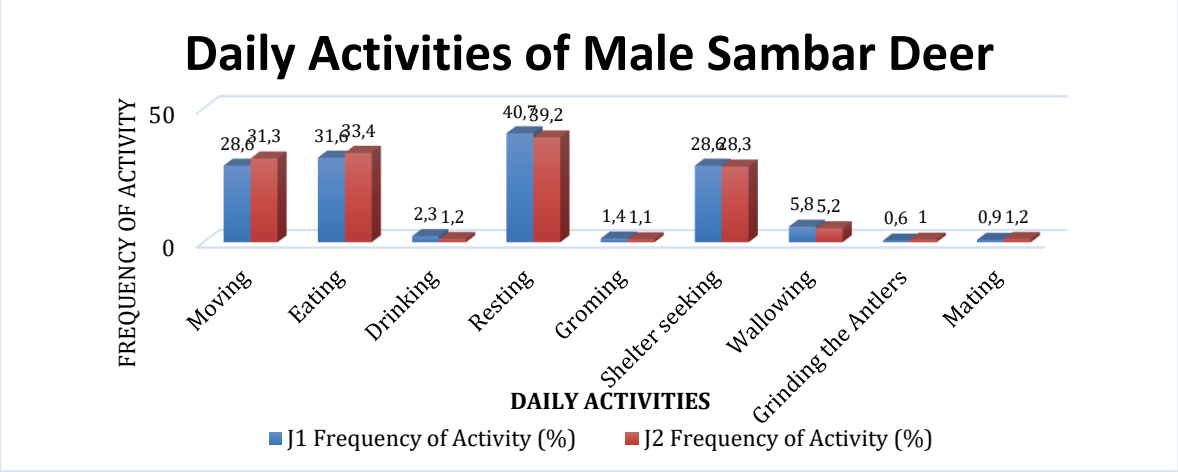

Figure 6. Bar diagram of daily activity of male sambar deer

Based on the bar diagram above, the highest daily activity in does was movement (32.8%) and eating (41%), while in lactating female deer, it was eating (43.7%) and resting (43%). The highest daily activity for the bucks was eating (33.4%) and resting (40.7%). The observation results also showed that does had a higher movement activity (32.8% or 3 hours 35 minutes per 11 hours of observation) compared to lactating does, (31.4% or 3 hours 27 minutes per 11 hours of observation), and bucks, (31.3 % or 3 hours 25 minutes per 11 hours of observation). In general, Sambar deers are usually active in the morning and evening, either looking for food in the farm area or approaching the food provided by the cage keeper. During the day, Sambar deers usually move to find shelter and go to their drinking places. In the afternoon, they often actively move around, looking for a place to wallow. Deers generally carry out this migratory behavior to move from one place to another, usually from one area of vegetation to another, to find food or shelter that is safer from disturbances (Sofyan & Setiawan, 2018).

Eating is an essential activity for all organisms, including animals, to obtain food. Deers generally eat plants, but they are also able to adapt to changes in diet, especially in different environments. In this farming area, Sambar deers were fed grass such as elephant grass (*Pennisetum purpureum*) and legumes twice a day, morning and evening. Observations showed that the highest total feeding time was for lactating does, (4 hours 48 minutes in 11 hours of observation), followed by does (4 hours 30 minutes), and bucks (3 hours 40 minutes). This behavior validates the research result by Dewi and Wulandari (2012), that on average, Sambar deer spends between 3 hours 10 minutes to 3 hours 45 minutes eating in 11 hours of observation. Apart from that, food availability also influences the deer's eating behavior, because limited forage and uncertainty about when to feed them caused the deer to do many grazing activities or snatch leaves from trees that the Sambar Deer's body can still reach. This result is synonymous with the research by Manshur (2011), which states that the leaves on trees that the bodies of Sambar Deer can still reach are the types of leaves that they first eat.

Resting activity is performed as a behavior that fills the gaps between feeding periods and usually involves lying under a tree while chewing the cud. This activity also aims to protect the deer from the hot sun during the day and maintain body temperature stability. Usually, this activity is carried out under the shade of jackfruit trees and palm trees around the livestock area.

Based on the observations, Sambar Deer usually rested at noon (10.00-14.00) after eating. During rest periods, they often chewed the cud. It was characterized by resting behavior in groups with close distance between individuals. However, in the afternoon (17.00-18.00), individuals usually rested in small groups away from each other. Resting activity in female Sambar Deer that were breastfeeding had the highest percentage, namely 43% or 4 hours 44 minutes in 11 hours of observation, compared to male deer, namely 40.7% or 4 hours 25 minutes, and female deer, namely 28.7% or 3 hours 9 minute.

Sambar Deer Sexual Activity

Sexual activity is an important activity for developing offspring. The mating activity of Sambar Deer in the livestock area was the lowest detected activity during the observation process. This low result was because it was past the mating season for Sambar Deer, which usually occurs from June to August. Apart from that, the length of estrus and the time of ovulation are very important to be noted, because they are related to the most appropriate mating time. The following are the results of the ANOVA test on Sambar Deer's daily activities (Table 1).

There were significant differences in the deer's moving, eating, drinking, resting, grooming, wallowing, and chewing activities. On the other hand, there were no significant differences in shelter behavior and sexual activity. This is thought to be because sexual activity is the lowest activity compared to other activities. Various factors could caused Sambar Deer's productivity to decline. One of them was that female Sambar Deer have non-seasonal polyestrous, which means they can go into heat at any time throughout the year. If they did not get pregnant, they would come into heat in the next cycle so that they could give birth all year round.

Apart from that, the length of the hard antler, which is related to the active reproductive period in Sambar bucks, is also influenced by the does being in estrus at any time. According to Putranto *et al*. (2010), during visual observations, Sambar bucks showed ten mating behaviors, including vocalization, aggressiveness, licking the does, kissing the doe's genital area, riding on the does, penile erection, intromission and copulation, flehmen, rubbing the body against the does, and following the does.

Observations showed that female deers, whether breastfeeding or not, had sexual activity of around 1.1-1.9% or approximately 7-12 minutes in 11 hours of observation. Meanwhile, bucks had sexual activities of around 0.9-1.2% or approximately 5-7 minutes in 11 hours of observation. Several mating behaviors could be observed in Sambar Does on farms, such as appearing restless, doe mounting other does, doe refusing bucks, and doe remaining still when mounted by bucks. In male Sambar Deer, behaviors that could be observed include flehmen, showing the buck's interest in does, bucks chasing does, buck kissing and licking the doe's genital organs, bucks mounting does, and copulation followed by ejaculation.

Semiadi (2014) stated that the external indicator of a female deer in estrus is crucial in the mating cycle because it signals to the buck that the doe is ready to mate. If these indicators are not visible, the reproductive process will be hampered because the male deer cannot know when the female deer is ready to mate. Sambar Deer mating activity on farms was usually detected in the morning (with a temperature of around 27.25°C and humidity of 78.5%) and afternoon (with a temperature of around 28.29° and humidity of 76.43%), when the air temperature begins to cool. and deer are starting to be active again after resting.

Table 1. Anova test results on daily activities of Sambar deer

Activity Type	Sambar Does	Lactating Sambar Does	Sambar Bucks	F-test	Sig
Moving Activities	213.93 ^{a}	196.07 ^{b}	197.50 ^{ab}	3.95*	0.027
Eating Activities	266.07 ^{a}	283.92 ^{a}	214.64 ^{b}	21.48**	0,000
Drinking Activities	22.86 ^{a}	11.07 ^{b}	11.42 ^{b}	21.99**	0,000
Rest Activities	187.85 ^{a}	273.21 ^{b}	263.57 ^{b}	43.02**	0,000
Grooming Activities	23.93 ^{a}	25.00 ^{a}	8.21 ^{b}	13.43**	0,000
Shelter Activities	165.71 ^{ns}	177.50 ^{ns}	187.86 ^{ns}	1.39	0.264
Wallowing Activities	30.00 ^{a}	6.42 ^{b}	36.43 ^{c}	109.60**	0,000
Chewing Activities	28.57 ^{a}	30.71 ^{a}	5.36 ^{b}	109.34**	0,000
Sexual Activities	10.36 ^{ns}	9.64 ^{ns}	6.78 ^{ns}	3.11	0.056

Information: * signifies significance at level 5%

** signifies significance at level 1%

Figure 7. A Sambar buck kisses (left) and licks the doe's genital organs (right)

Figure 7. B Sambar buck mounts a doe (left), and copulation is followed by intromission (right)

CONCLUSION

Based on the results of monitoring the reproduction of Sambar Deer in the Palangka Raya Livestock Area, sexual activity was the least observed behaviour during the 11 hours of observation. Some of the mating behaviors of Sambar Deer in livestock areas include restlessness, does rejection towards bucks, attraction of males to females, flehmen, bucks chasing does, bucks sniffing and licking the genital organs of does, bucks mounting the does, as well as copulation followed by intromission (ejaculation).

Further research is needed on different deer breeding areas in the Palangka Raya for comparison. The digital infrared thermal imaging (DITI) method is used to detect the estrus and heat phase in deer effectively and efficiently.

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