**UNIVERSITI PUTRA MALAYSIA**

***CAPTIVE BEHAVIOUR OF SAMBAR DEER (CERVUS UNICOLOR) AS INDICATOR OF MANAGEMENT***

**NURUL NADIA BINTI RASHID**

# CAPTIVE BEHAVIOUR OF SAMBAR DEER (*Cervus unicolor*) AS INDICATOR OF MANAGEMENT

**NURUL NADIA BINTI RASHID**

A project submitted to the Faculty of Veterinary Medicine, University Putra Malaysia

In partial fulfillment of the requirement for the

DEGREE OF DOCTOR VETERINARY MEDICINE

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It is hereby certified that we have read this project paper entitled "Captive Behavior of Sambar Deer (*Cervus unicolor*) as indicator of management, by Nurul Nadia Binti Rashid and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the course VPD 4999-Project.

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# DEDICATION

I dedicate this thesis with love and appreciate to:

**IN MEMORY OF**

RASHID BIN DARUS

NUZIMAH MD. SHARIFF

LOPE ABDUL RAHMAN

**My Family**

NUZIAH BT MD SHARIFF

NORASHIZAH RASHID

SHAHRUDDIN HARUN

**My Supervisor**

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**My Project Partner**

Nurhidayah Baharudin

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Abstrak daripada kertas projek yangdikemukakan kepada Fakulti Perubatan Veterinar sebagai memenuhi sebahagian daripada Kursus VPD4999 - Projek Tahun Akhir.

**TINGKAH LAKU DI DALAM KURUNGAN RUSA SAMBAR (*Cervus unicolor*) SEBAGAI INDIKATOR PENGURUSAN**

Oleh

**NURUL NADIA RASHID**

**2015**

**Penyelia: Dr. Tengku Rinalfi Putra Tengku Azizan**

**Penyelia Bersama: Dr. Hasliza Abu Hassim**

Persekitaran semula jadi Rusa Sambar atau *Cervus unicolor*ialah di dalam hutan atau di kawasan yang padat dengan belukar.Rusa sambar disimpan dalam kurungan untuk tujuan pertanian tetapi penggunaan sepenuhnyamasih terhad. Objektif kajian ini adalah untuk melihat dan mengenal pasti tingkah laku normaldi dalam kurungan dan tingkah laku berkait tekanan oleh Rusa Sambar .Kajianini telah dijalankan di Ladang Rusa, Taman Pertanian Universiti, Universiti Putra Malaysia, Serdang,Selangor. Sekawanan rusa sambar yang terdiri daripada tiga jantan, lima betina dan dua anak rusa adalah subjek pemerhatian kajian ini. Kajian ini dilakukan dengan cara perangkap

kamera menggunakan sensor pergerakan infra-merah di 3 lokasi berbeza di dalam kurungan. Rakaman video merakam mana-mana pergerakan selama 30 saat dalam masa 24 Jam. Kajian ini telah diadakan pada 12 Januari 2014 hingga 26 Januari 2014, selama 14 hari. Hasil kajian menunjukkan bajet aktiviti harian Rusa Sambar di dalam kurungan di Taman Pertanian Universiti, UPM terdiri daripada 45% Pemakanan, 26% Rehat sambil ruminasi, 5% Rehat, 5% Ragutan, 5% Ruminasi berdiri, 4% Berdiri, 4% Berjalan, 2% Minum, 2% Tingkah laku berjaga, 1% Berdandan dan 1% Interaksi. Sepanjang tempoh kajian, didapati Rusa Sambar berinteraksi dengan baik dengan kawanan Rusa Timor. Kemungkinan tingkah laku kopulasi telah dicerap sebanyak satu kali dalam tempoh kajian, yang menunjukkan bahawa haiwan itu adalahmungkin tidak di bawah tekanan. Hanya 2% daripada tingkah laku berjaga-jaga direkodkan; yang mana haiwan itu mungkin terganggu oleh bunyi persekitaran.Walau bagaimanapun,tiada tingkah laku berkaitan tekanan lain seperti mundar mandir di pagar, berlari, melompat atau tekanan luaran seperti pemangsa diperhatikan.

Kata Kunci :Rusa Sambar; kurungan; tingkah laku; tekanan; perangkap kamera

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD4999 – Final Year Project.

**CAPTIVE BEHAVIOR OF SAMBAR DEER*(Cervus unicolor )*AS INDICATOR OFMANAGEMENT**

By

**NURUL NADIA RASHID**

**2015**

**Supervisor: Dr. Tengku Rinalfi Putra Tengku Azizan**

**Co- Supervisor: Dr. Hasliza Abu Hassim**

Sambar Deer or *Rusa Unicolor* natural habitat is primarily in the woods or areas with dense scrub bush. Sambar deers are kept in captivity for farming purposes but their full utilization is still limited. The objective of this study is to observe and identify normal captive behavior and stress related behaviorof the Sambar Deer.This study was conducted atLadang Rusa, Taman Pertanian Universiti, University Putra Malaysia, in Serdang, Selangor. A herd of Sambar Deer which consists of three males, five females and two fawns was a subject of this study. This study was done by means of camera trapping using motion sensor infra-red camera in 3 different locations inside the enclosure. The camera recorded video of any movement for 30 seconds during 24 Hours period. The study was held from 12 January 2014 until 26 January 2014,for 14 days.

The result shows the daily activity budget of captive Sambar Deer in Taman Pertanian Universiti, UPM consist of 45% Feeding, 26% Resting while Ruminating, 5% Resting, 5% Grazing, 5% Standing Ruminating, 4% Standing, 4% Walking, 2% Drinking, 2% Standing Alert, 1% Grooming and 1% Interaction. During the study period, the captive Sambar Deer is observed to be interacting well with captive Timor Deer. Possible copulation was also observed once during the period of study indicating that the animal is in low stress environment. Only 2% of standing alert behavior is recorded; which is a state whereby the animal was in high alert due to surrounding noise that can be related to stress behavior. However, no other stress behavior such as fence pacing, running, jumping or external stressors such as predators was observed.

Keyword: Sambar Deer; Captivity; Behavior; Stress; Camera Trapping.

## 1. INTRODUCTION

The Sambar Deer (*Cervus Unicolor*) is the most widely spread deer species in the world. They are one of the largest deer species in terms of size and their coat is coarse and shaggy. The males have a mane around the throat and neck. Their habitat is primarily in the woods or areas with dense scrub brush. Their population is mainly in Southeast Asia from the Philippines through Southern China, Indonesia and Burma to India and Sri Lanka. Populations have been introduced to the United States, Australia and New Zealand for hunting purposes. Their diet in the wild is mainly on grass, foliage and fruit (Leslie, 2011).

Morphology:

**Length**: Males are 5.5 to 8 ft and females are 5 to 6 ft

**Height:** 3.5 to 4.5 ft

**Weight:** Males are 290-540 lbs, females 240-400 lbs.

**Lifespan**: 20 years in captivity

Sambar Deers are nocturnal. Males live solitary lives while females live in pairs or small group. Males have antlers, which can grow up to 2.5 ft long. Young males start to grow their antler at 2 years old. The male is darker and larger than the female. They have acute sense of smell and hearing. The Sambar tends to alertly watch a predator and will keep giving alarm calls until the danger has passed instead of fleeing (Leslie, 2011).

They have a peculiar bare patch of skin in the middle of the throat about 3 inches across with tiny spots of blood in the center. The purpose of this glandular lesion is unknown, but it disappears in captivity (Leslie, 2011). Sambar Deer is sexually mature at 2-4 years old and usually the mating season is from November through December. When the female is in heat, the male will start to sharpen their antlers until the skin on the antlers is exposed and appear wounded while exposing the tough part of the antlers (Leslie, 2011).During mating season, a male will gather females who are on heat and vocalize as a warning sign for other males. , Fights can occur and losers are usually wounded (Suba *et al.*, 2007).

The gestation period is 8 months, single birth and the fawn stays with the mother for one year. Deer mother have the habit of hiding the fawn after birth in the middle of bushes or some remote place. Deer's also elicit the habit of nursing each other if one is wounded or sick.

Taman Pertanian Universiti Putra Malaysia or TPU was founded on the 1st of December 2001 for teaching purposes, research purposes and to provide services in agriculture for students, staffs and the community. Captive management of Sambar Deer in TPU is an intensive system, the current enclosure area is 1 acre for 50 deers. It uses cyclone type fencing and the height of the perimeter fence is 2.6 m, and the paddock fence height is 2 m. Deer's are fed twice a day with grass and pellet. They are also provided with unlimited supply of fresh water.

The total area of the deer farm is 9.694 ha (TPU, 2011). The farm is located at the east side of UPM campus and surrounded by North-South Highway, SILK Highway and ERL train route to KLIA. This area includes pasture area in Ladang 15 and Ladang 16 with the area size of approximately 88 ha. There is few other farms located in this area which are; dairy farm, goat farm, and equine. The Sambar Deer is managed as 3 groups: adults, mother and fawn, and grower. Adult male and female deers are kept separated in different paddocks. As for the mother &fawn group, the fawn will be separated from their mother at 3 to 4 months after weaning. As the fawns grow up to 1 year old, they will be separated and kept as a "grower" group (TPU, 2011).

# 2. LITERATURE REVIEW

## 2.1 CAPTIVE BEHAVIOR

In captivity, animals have been protected and the environment of captive animals is different from the natural habitat, in which animal could not choose and change the environment factors, but the behavioral modes of captive animals could be changed at the specific extent to make the best response to the artificial environment (Xiuxiang, 2008).

### 2.1.1 Behavioral adaptation

In evolutionary process, wildlife develops species and population specific behavioral modes to adapt to their environment. In order to adapt to special habitat, resource and climatic environment, wildlife could adjust their relation with the environment through behavioral adaptation (Xiuxiang et al, 2008).

### 2.1.2 Feeding Behaviour

How much food an individual ruminant ingests per day depends on the time spent feeding, and the time available for feeding may limit an individual's daily forage intake and therefore affect its body condition, reproductive success and survival (Bruno and Lovari, 1989). The increased vigilance may therefore indicate decreased feeding (Ruckstuhl *et al.*, 2003).

2.1.3 Feeding Pattern in Captivity

Sambar deer actively grazed from midnight to early morning (0100-0500 h) and in the late afternoon and late evening (1700--2100 h), with only a few sightings during the morning and the middle of the day (Semiadi et al, 2011). Generally feeding activity was conducted almost the all day long,especially at 09.00 - 12.00, continued at 16.00, 18.00 -22.00 and 03.00 - 06.00, with the highest at 10.00 -11.00, 16.00 - 17.00, 18.00 - 19.00 and between 03.00 -04.00

2.1.4 Daily activities Pattern

It is concluded that the highest activity of captive Sambar Deer in the University of Lampung Sanctuary is feeding (45.8%), followed by sleeping (30.6%) and resting (23.7%) respectively. The microhabitat preference of captive Sambar Deer in the University of Lampung sanctuary is areas with grass, bushes and trees for feeding activity and areas with shrubsfor sleeping and resting. Feeding activities include reaching, taking and putting the food into the mouth. Resting activities are non-movement such as grooming, laying down, bathing and sitting. (Gusmasari and Rustiati, 2004)

## 2.2 NORMAL BEHAVIOUR IN THE WILD

From an early age, Sambartend to conserve energy,calves being less active and spend more time hiding. This may Deer have evolved as a natural defence against predator (Semiadi, 1993). Selection for behaviour to avoid predators may also have contributed to nocturnality in Sambar Deer (Semiadi et al, 2011)

### 2.2.1 Feeding Behavior in the Wild

In wildlife, the time allotted to feeding will vary depending on a number of factors, including feed availability, physiological process and season etc (Relyea *et al.*, 1994).

While feeding, animals must also be vigilant to avoid predation. Vigilance is a behavior that increases the probability that an animal will detect a given stimulus at a given time, which may serve to detect a variety of relevant stimuli, and its primary function appears to be the detection and avoidance of predators and potential disturbance (Xiuxiang et al, 2008).

## 2.3 MANAGEMENT

For tropical regions, the present study indicates that farming Sambar is possible, although conventional management needs to be altered. As wild Sambar is flighty and nervous animals, Sambar farming can be initiated using artificially reared animals (Semiadi, 1993)

## 2.4 STRESS

Stress canbe defined as the experience of having intrinsic or extrinsic demands that exceed an individual's resources for responding to those demands (Dantzer, 1991). In comparison, chronic, long-term stress results in prolonged elevation of GCC levels that in effect become self-sustaining, as prolonged high levels of circulating GCCs damage areas of the brain responsible for terminating the stress response (Morgan & Tromborg, 2006).

### 2.4.1 Stress Behavior in Captivity

Behaviorally, chronic stress may be indicated by reduced reproductive behavior (Gronli et al., 2005; Hemsworth et al., 1986a), increased abnormal behavior (Carlstead and Brown, 2005; Schouten andWiegant, 1997), reduced exploratory behavior and increased behavioral inhibition (Carlstead and Brown, 2005; Carlstead et al., 1993b; Vyas and Chattaji, 2004), increased vigilance behavior and increased hiding (Carlstead et al., 1993b), reduced behavioral complexity (Rutherford et al., 2004), increased aggression (Bartolomucci et al., 2004; Mineur et al., 2003), increased fearfulness and frequency of startle (Boissy et al., 2001)

#### 2.4.1.1 Confinement

Hediger (1955, 1964) considered restricted movement due to space limitations to be one of the primary contributors to captivity-induced stress, and

some of the earliest studies of abnormal behavior in captive animals supported this contention (e.g., Levy, 1944).

2.4.1.2 Human as Stressor

Conditions under which animals are kept in captive breeding facilities vary. Prey species often view humans as predators (Andersen et al. 1996), but high levels of exposure to humans may induce habituation, which affects the animals' timidity and amount of time devoted to vigilant behavior (Tyler, 1991).If human activity is frequent enough and of no actual consequence (nuisance disturbance), animals will ignore the activity, and a general reduction in antipredator behaviors results in reduced vigilance(Shochat et al. 2004).

2.4.2 Stress related behavior

When fence pacing increases and head movements are more frequent, such occurrence would suggest a greater motivation to escape.It is possible that pacing the fenceline indicates stress (Hodgett et al., 1998). Mixing of unfamiliar groups of deers should be avoided.(Pollard et al.,, 1999). Stress manifests inconflict or disturbed behavior (Wiepkema, 1990). Care must be taken not to alarm groups of deer as they may take flight, but this depends on the level of familiarity with the immediate environment and their habituation to human presence (Recarte et al., 1998).

## 3.0 MATERIALS AND METHODS

The study was done at the Sambar Deer enclosure in Ladang Rusa, Taman Pertanian Universiti, Universiti Putra Malaysia. 10 deers were subjects of this study; 3 Males, 5 Females and 2 Fawns. Time frame of study period is 2 weeks which is from the 12$^{th}$ of January 2015 until the 26$^{th}$ of January 2015.

The method that was used in this project is by means of remote video behavioral data collection using motion sensor infra-red camera. The camera recorded any movement for 30 seconds for 24 hours period.

An initial study was done by ad-libitum focal observation before placing the camera traps. The camera traps were placed at the area at which higher movement of Sambar Deer was initially observed. Then remote focal observation was done by placing camera traps at 3 different locations. First location is at the Grass feeding area (N 02°59.639' E101° 43.787'). The second location is at the pellet feeding and drinking area (N 02°59.641' E 101°43.799') and the third location is at the fence area (N 02°59.628' E 101°43.781').

As for data collection analysis, identification of normal behavior and stress related behavior was done. Ethogram of 30 sec active and 30 sec rest was done. The ethograms were analyzed in Microsoft Excel and Correlation Analysis was done using SPSS 21.

Behavior index were identified and clarified. The behavior indexisas listed in the following tables.

| **Behavior** | **Definition** |
|---|---|
| Feeding | Activities include reaching, taking and putting the food into the mouth |
| Grazing | To feed on growing grass and pasturage |
| Interaction | Direct body-touching activities without obvious conflict among individuals |
| Resting | Animal is lying on the ground or in sternal recumbency in inactive or in relaxed state |
| Walking | Animal is moving without any accompanying behaviors |
| Grooming | Animal expresses activities directed to itself, including self-grooming |

| | |
|---|---|
| | with mouth and self-scratching |
| Drinking | Act of drinking water from water source |
| Standing | Animal is still in upright position on all four limbs |
| Ruminating | Animal expresses typical behavioral series of rumination, namely regurgitating, chewing, swallowing while in standing position |
| Resting while Ruminating | Animal expresses typical behavioral series of rumination whilst resting when in sternal recumbency |
| Standing Alert | Animal is still, alert and gazing at stimuli or potential stimuli |

Table 1: Behavior Index

## 4.0 RESULT

The captive Sambar Deer daily activity budget is as shown in the pie chart in (Figure 1). The daily activity budget of captive Sambar Deer involve 45% of feeding, 26% of resting with ruminating, 5% resting, 5% grazing, 5% ruminating, 4% walking, 4% standing, 2% drinking, 2 % Standing, 1% interaction and 1% grooming.

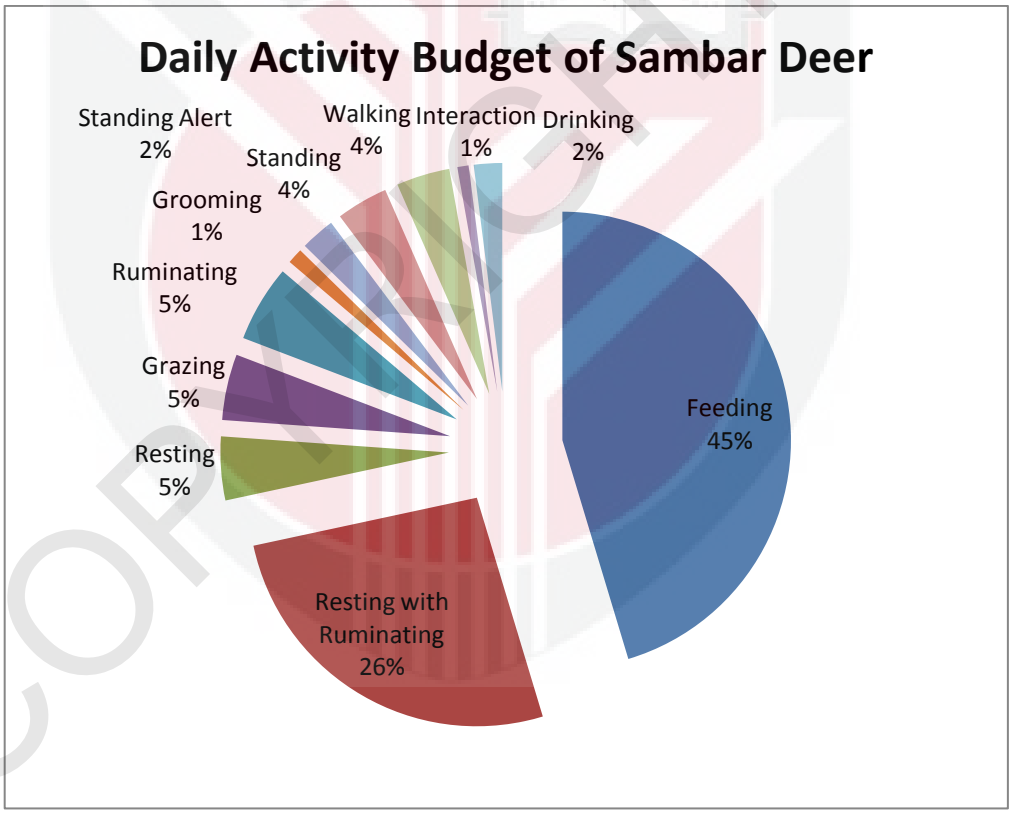


Figure 1: Daily activity budget of captive Sambar Deer in 24 Hours

Figure 2 shows a feeding behavior pattern within 24 hours. The captive Sambar Deers start their feeding activities at 10 am, which correlated to the management feeding schedule. This activity continues in the evening until dawn and until midnight.

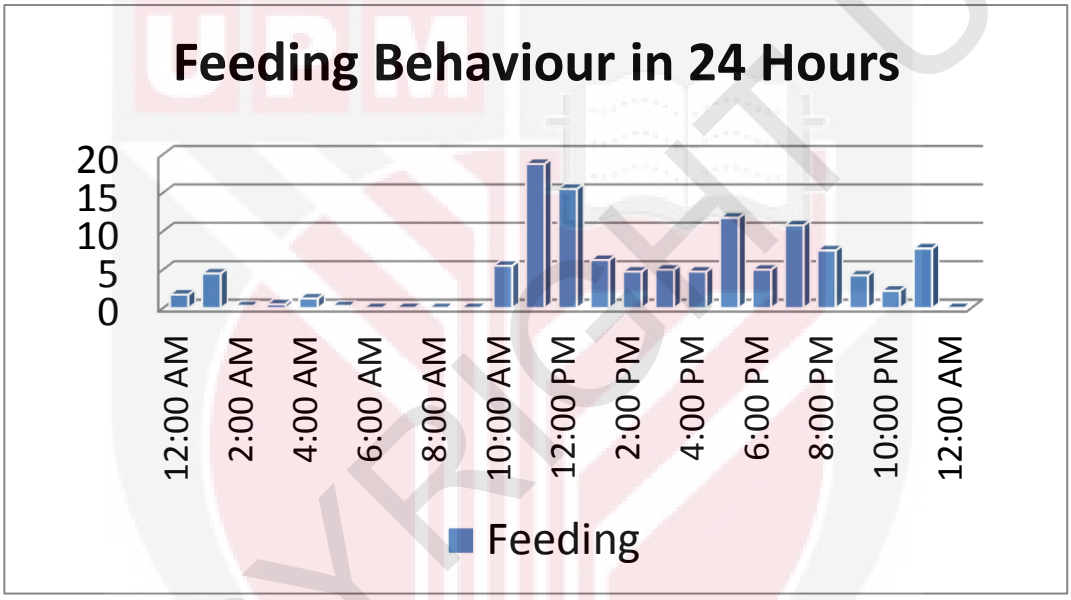


Figure 2: Feeding Behavior Pattern within 24 Hours

In figure 3, a bar graph shows resting while ruminating behavior within 24 hours. They started the activity of resting while ruminating from 1 pm until 4 pm and again at 6pm until 11pm. They continued these activities a few times during after midnight hours. There were also a positive correlation between feeding behavior and resting while ruminating behavior within 24 hours.

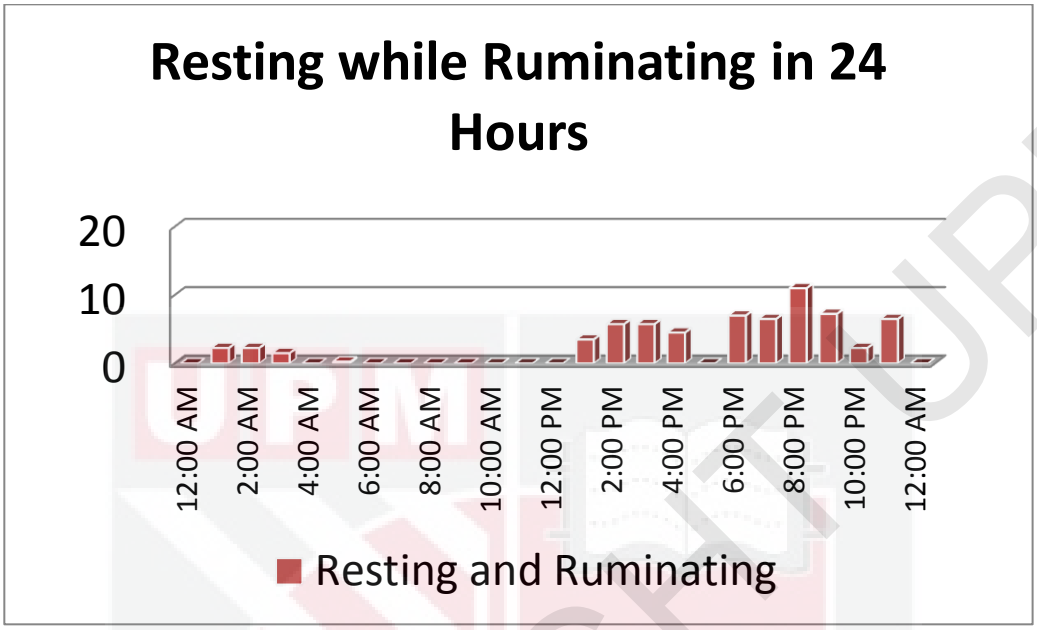


Figure 3: Resting while Ruminating Behavior Pattern within 24 Hours

Other behavior such as resting, grazing, ruminating, walking, standing, drinking, standing, interaction and grooming were dispersed throughout the 24 hours period. However, from 7 am until 10 am, there is no movement observed at all during the study period. It is presumed they were in hiding.

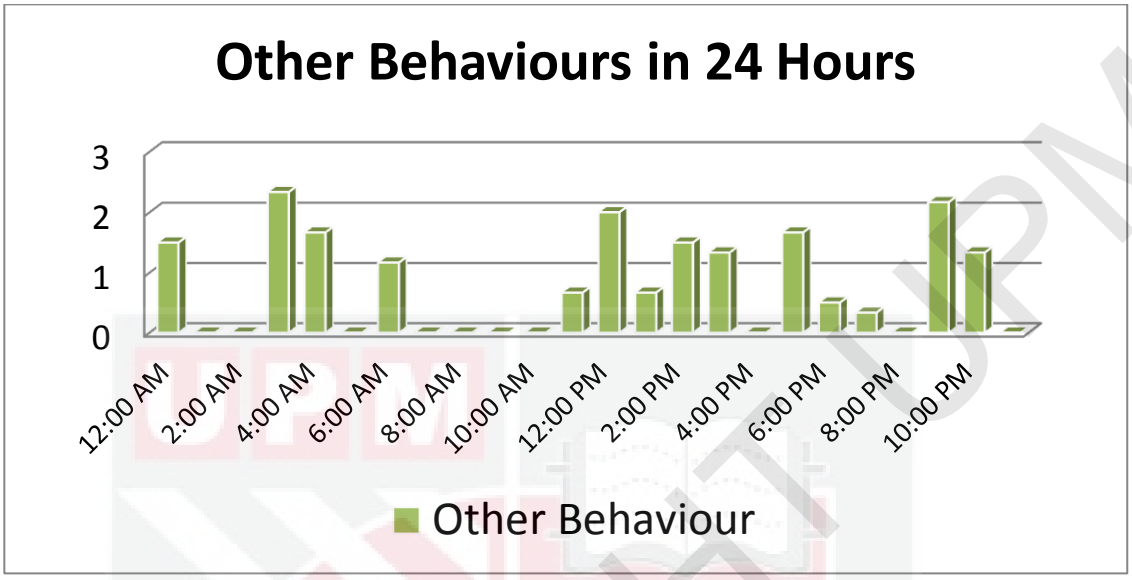


Figure 4: Other Behaviors Pattern Within 24 Hours

The captive Sambar Deer spent 86% of their time on Grass Feeding area, whereby only 9% at the Pellet and Drinking area. This can be explained as the pellet were not available ad-libitum and were only given every two days, thus they only spent their time there during the pellet feeding time. They also spent 5% at the fence area for walking, standing and grazing behavior.

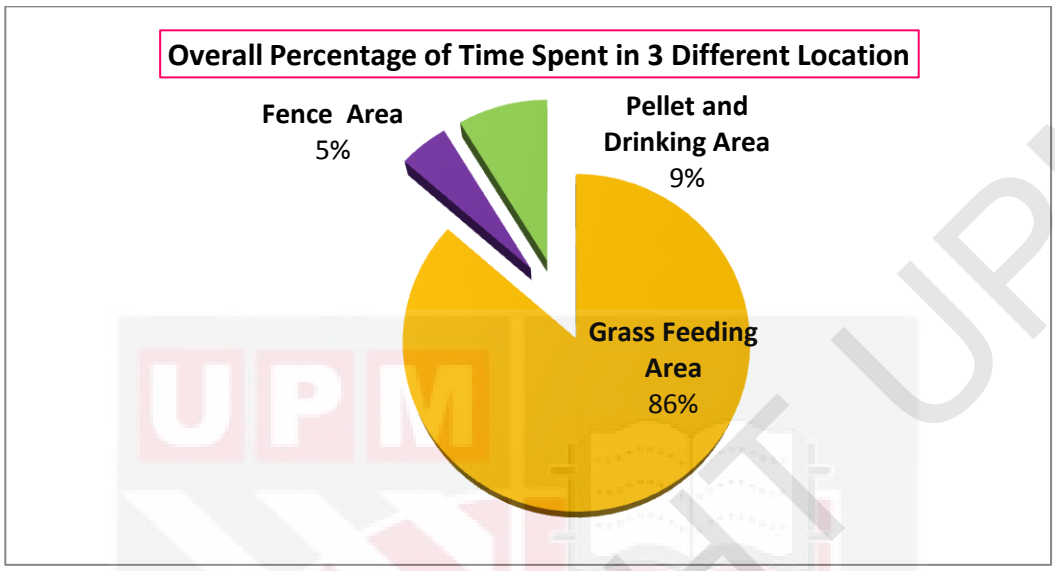


Figure 5: Overall Percentage of Time Spent In 3 Different Locations

Another finding during this study period was a possible copulation related behavior was elicited through the behavior of ano-genital sniffing by the Males to the Females. This showed that there is a possible mating behavior, which indicated that the captive Sambar Deer were in low stress environment. Good interaction with Timor Deer in the neighboring enclosure during pellet feeding time showed that there was no antagonistic behavior between the different species, which in turn indicated good bond between the two species. Rutting behavior as such the males rubbing its antlers on the fence was also observed a few times during the night.

Stress related behavior involved fence pacing, frequent running, reduced reproductive behavior, reduced feeding activity, increase vigilance and agitation and also reduced exploratory behavior were not observed during study period thus indicating the captive Sambar Deer were in low stress environment.

## 5.0 DISCUSSION

Adaptation, management of farm, human interaction and feeding behavior in wild environment and captive environment are the four main elements that will be discussed in discussion. Sambar Deers were introduced in Taman PertanianUniversiti 9 years ago in 2006. It is best to say that after that long period of time, the deers have adapted to the environment of the enclosure in Taman Pertanian Universiti (TPU), UPM.

TPU management, which left the enclosure with lots of shrubs, is actually suitable for the Sambar Deer. This semi-wild environment represent as close as possible example of their preferred habitat. However, loud noise coming from transportation due to being in close proximity to the roadside and highway causing the Sambar Deer to be on standing alert. Standing alert is a normal behavior which related to a stress factor. According to result, only 2% of standing alert was observed thus indicating a low stress environment.

Prey species which are kept in captive breeding facilities often view humans as predators (Andersen et al, 1996). Sambar Deer will still be in flight response when human approaches in comparison to Timor Deer. This is due to lack of exposure by the caretaker. If human activity is frequent enough with no actual consequence of either nuisance or disturbance, animals will ignore the activity and will trigger general reduction in anti-predator behaviors (Sochat et al., 2004).

Sambar Deer tend to conserve energy, become less active and spend most of their time in hiding. This may evolved as a natural defense against predator (Semiadi, 1993). Feeding behavior is highlighted here as it is the most frequent behavior observed during this study and also feeding behavior reflects a low stress environment. In the wild, the time allotted to feeding will depend on a number of factors. First is food availability, as compared to in captivity, the deers were given the food compared to having to forage in the wild. , they are also vigilant to avoid predation and feeding activity was influenced by seasonal change (Relya et al, 1994).

Behavior to avoid predators may also have contributed to nocturnality in Sambar Deer. However, according to the result, feeding activity in captive was influenced by the feeding schedule. They feed during daylight until late night and few during midnight.

## 6.0 CONCLUSION AND RECOMMENDATION

As a conclusion, during the study period there was very low stress related behavior observed. This can be due to adaptation and proper management. Standing alert was only observed at2% which also indicate low stress environment. Daily activity budget of Captive Sambar Deer in Taman Pertanian Universiti, UPM consisted of 45% feeding, 26% resting while ruminating and 29% of other normal behavior. During the 24 hours observation, from 7 am till 10 am there was no movement observed on the camera trapping, hence it is presumedthat they were in hiding.

As a recommendation, it is advised that the study be prolonged with inclusion of wet and dryseasons to compare stress level over the two seasons. Increasing the number of camera used and locations shouldbe done to increase video recording data in order to minimize error in the study. Furthermore, study should be done to find out their hiding location to facilitatebehavioral study during their hiding time. Further study on wild deer behavior and comparison between wild and captive deers should be done to facilitate future studies. As for captive deer, their nutritional requirement can be a studied objectively to appropriately create a feeding protocol. Evaluation of the captive deer body score is also recommended.

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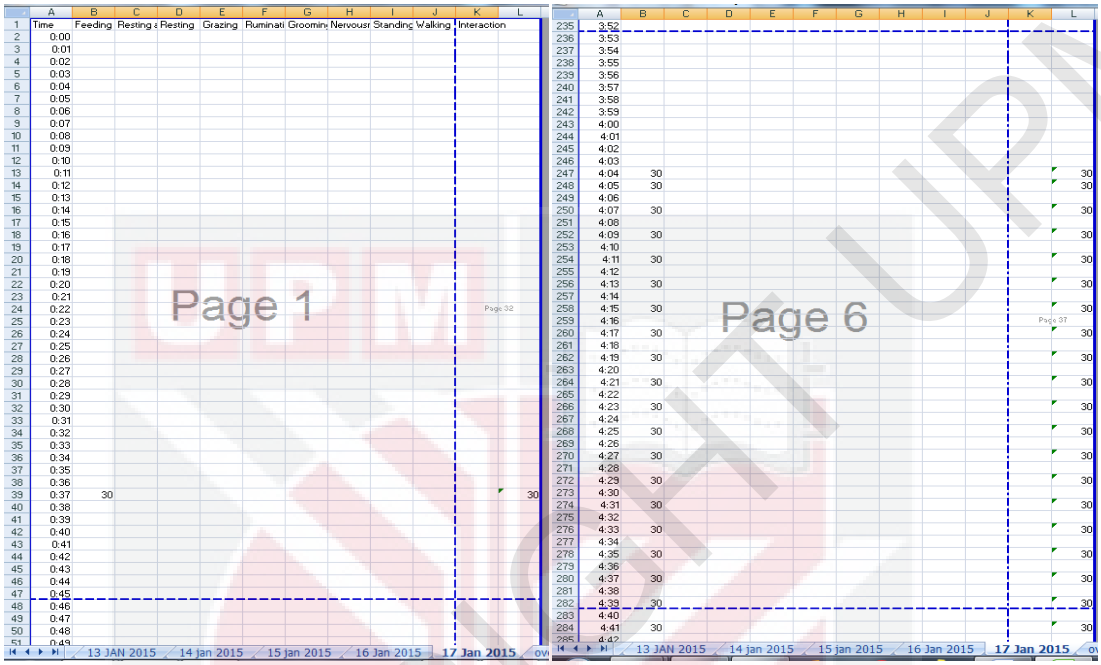
# APPENDICES




Microsoft Excel - over overall

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | Feeding | Resting ar | Resting | Grazing | Ruminatir | Grooming | Nervousn | Standing | Walking | Interactio | Drinking | | |
| 2 | Stone | 5511.429 | 3448.571 | 590 | 0 | 636 | 144 | 230 | 380 | 340 | 60 | | 11340 | |
| 3 | Pagar | | | | 492 | 30 | | | | 96 | 15 | | 633 | |
| 4 | Pellet | 435 | | | 120 | 45 | | 90 | 100 | 60 | 30 | 262.5 | 1142.5 | |
| 5 | | 5946.429 | 3448.571 | 590 | 612 | 711 | 144 | 320 | 480 | 496 | 105 | 262.5 | | |
| 6 | | | | | | | | | | | | | | |
| 7 | | Feeding | Resting ar | Resting | Grazing | Ruminatir | Grooming | Nervousn | Standing | Walking | Interactio | Drinking | | |
| 8 | | 5946.429 | 3448.571 | 590 | 612 | 711 | 144 | 320 | 480 | 496 | 105 | 262.5 | | |
| 9 | | | | | | | | | | | | | | |

Example of raw ethogram data