UNIVERSITI PUTRA MALAYSIA

BEHAVIORAL ANALYSIS OF CAPTIVE MALAYAN TAPIRS (*Tapirus indicus*)

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BEHAVIORAL ANALYSIS OF CAPTIVE MALAYAN TAPIRS

(*Tapirus indicus)*

NORHAFIZAH BINTE KAMISAN

A project paper submitted to the
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CERTIFICATION

It is hereby certified that I have read this project paper entitled **"Behavioral Analysis of Captive Malayan Tapirs (*Tapirus indicus*)"**, by Norhafizah Binte Kamisan and in my opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD4999 – Final Year Project

_____

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DEDICATION

In Loving Memory of:
Nasiyah@Salmiah Othman

My mother (Norsazelah Ibrahim) and father (Kamisan Abdullah)
My sister (Norshuhada Kamisan)
My family

For the tough love, and for believing in me even when I could not

ACKNOWLEDGEMENTS

Without His grace, I wouldn't be where I am today.

My greatest appreciation to my supervisor, Dr Tengku Rinalfi Putra Tengku Azizan for his guidance, support, and tolerance in entertaining my nonsense throughout this project. Thank you so much for everything.

I'd like to express my gratitude to the management of Zoo Negara, and specifically to Dr. Mat Naim bin Haji Ramli, Dr. Kavitha Jayaseelan and Dr. Jessie Ho, for their assistance and support in conducting this project. Also to the keepers of the tapirs, I appreciate all the invaluable insight that you have shared.

A big thank you to Nor Azreen Mohamad, my project partner, for the company, the help, and the roof over my head during this period. Also, thank you for the fights, the laughter, the out-of-tune singing, and all the quirkiness you've brought into my life these past years.

To Coco/Carolyn, my wholehearted appreciation for each and every day these five years, your patience all this while, and for loaning me the laptop when I needed it the most. Hopefully, you are now closer to being a saint.

Not forgetting the lecturers and staff of the Faculty of Veterinary Medicine, UPM who were involved directly and indirectly in this project. Thank you!

Last but not least, I'd also like to thank my family, friends, and DVM 2017 for all their support throughout the entirety of this project.

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Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD4999 – Projek Tahun Akhir

ANALISA TINGKAH LAKU TAPIR MALAYA (*Tapirus indicus)* DALAM KURUNGAN

Oleh

NORHAFIZAH BINTE KAMISAN

Mac 2017

Penyelia: Dr. Tengku Rinalfi Putra bin Tengku Azizan

Tapir Malaya (*Tapirus indicus*) yang berada di dalam kurungan, seperti di zoo, semakin meningkat walaupun bilangan mereka makin berkurangan di hutan belantara. Pengurusan yang baik sangat penting bagi memastikan kesihatan dan kebajikan haiwan-haiwan ini dijaga dan dipertingkatkan, selari dengan meningkatkan imej umum dah kesedaran tentangnya. Objektif kajian ini adalah untuk menggambarkan tingkah laku tapir Malaya dalam kurungan di siang hari. Kajian ini dilakukan di Zoo Negara, Malaysia. Kaedah penyiasatan yang digunakan adalah dengan pemerhatian tingkah laku. Empat ekor tapir dipilih selaku subjek kajian ini. Ia terdiri daripada dua ekor jantan dan dua ekor betina yang dikurung di dalam dua kawasan pameran sebagai pasangan mengawan. Pemerhatian untuk kajian ini dilakukan untuk enam jam sehari semasa zoo dibuka

selama dua minggu, dan semua tingkah laku yang diperhatikan dicatat di dalam sebuah etogram. Selain itu, jumlah pelawat yang singgah ke kawasan pameran haiwan-haiwan ini juga dicatat. Hasil kajian menunjukkan bahawa secara purata, sebahagian besar bajet aktiviti siang hari keempat-empat tenuk itu terdiri daripada berehat, berenang, dan makan. Tiada perbezaan yang dapat dikenal pasti antara tahap aktiviti kedua-dua kawasan pameran dan juga antara tenuk betina dan jantan. Korelasi negatif dilihat antara tahap aktiviti tapir-tapir dalam kajian ini dengan jumlah pelawat. Ini mungkin disebabkan tapir-tapir di Zoo Negara telah dibesarkan dalam kurungan, yang memungkinkan mereka telah menyesuaikan diri dengan kehadiran manusia. Di samping itu, tiada tingkah laku berkaitan dengan tekanan dapat dilihat yang menandakan kebajikan yang mencukupi.

Kata kunci: *bajet aktiviti, etogram, kurungan, tapir Malaya (Tapirus indicus), tingkah laku*

ABSTRACT

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

BEHAVIORAL ANALYSIS OF CAPTIVE MALAYAN TAPIRS (*Tapirus indicus*)

By

NORHAFIZAH BINTE KAMISAN

March 2017

Supervisor: Dr. Tengku Rinalfi Putra bin Tengku Azizan

Malayan tapirs (*Tapirus indicus*) in captivity have been increasing in numbers, especially with their wild populations facing a declining trend. Good management is imperative to ensure their health and welfare is upheld, along with their public image to improve awareness of these animals. Behavioral observations were carried out with the aim of describing the tapirs' diurnal behavior in captivity. Four Malayan tapirs living as pairs in two exhibits from Zoo Negara, Malaysia, were included in this study. Focal sampling was done with behaviors recorded for six hours during the opening hours of the institution. Additionally, the frequencies of visitors to the exhibits were noted. Diurnal activity budgets, exhibit use, and visitor frequency effects were calculated from the data collected. The data revealed that on average, all four tapirs spent a large amount of time resting, swimming and eating. Neither gender differences nor exhibit differences were observed between the activity levels of the tapirs. A negative correlation between their activity levels and visitor numbers were also identified. These findings may be explained by the tapirs having been bred in captivity, and having adapted to the presence of humans.

The results conformed to the tapirs' expected crepuscular behavior, with no stereotypic behaviors seen.

Keywords: *activity budget, behavior, captivity, ethogram, Malayan tapir (Tapirus indicus)*

1.0 INTRODUCTION

The family Tapiridae, more commonly known as the tapirs, is one of the three in the order Perissodactyla, alongside the horses and rhinoceroses (Ferguson, 1997). These ungulates are large herbivorous mammals, which, from time to time, have been known as "living fossils" because of their long existence (Downer, 2003).

There are five surviving members of the Tapiridae family today, namely the Malayan tapir (*Tapirus indicus*), the Baird's tapir (*Tapirus bairdii*), the Lowland tapir (*Tapirus terrestris*), the Mountain tapir (*Tapirus pinchaque*), and the recently "discovered" Kabomani tapir (*Tapirus kabomani*). The tapirs traditionally have habitats located in Mexico, Central and South America, as well as Southeast Asia (Downer, 2003).

According to the IUCN's Tapir Specialist Group (TSG) (2008), tapirs play an important role in the health of an ecosystem, as well as maintaining the diversity of it. This is supported by numerous studies as reviewed by O'Farrill, Galetti, and Campos-Arceiz (2013), which indicated tapirs to be seed predators and dispersers, being able to disseminate seeds over long distances. Unfortunately, four of the five species have been classified as either endangered or vulnerable in the IUCN Red List of Threatened Species (Garcia *et al.*, 2016; Lizcano *et al*., 2016; Naveda *et al.*, 2008; Traeholt *et al.*, 2016), which poses a real threat to the rainforests and multiple ecosystems in the future.

Of the five known tapir species, the Malayan tapir is the largest, and the only species found in Southeast Asia (Traeholt *et al.*, 2016). Listed as endangered, the Malayan tapir population is still facing ongoing decline, with threats ranging from habitat loss to hunting and poaching (Traeholt *et al*., 2016).

The Malayan tapir is considered a flagship species in Malaysia, and conservation of the species plays an important role in sustaining other flora and fauna in the tropical rainforests as well. Conservation efforts for the Malayan tapirs have been ongoing since years ago, such as seen with the efforts of those involved with the Malay Tapir Conservation Project, which began in 2002 (Malay Tapir Conservation Project). Unfortunately, with the decreasing trend in their numbers and fragmentation of forests causing increased population isolation and a lack of genetic exchange, *in situ* conservation efforts alone may not be sufficient. Eventually, *ex situ* measures will grow to be essential in ensuring the continual survival of this species, albeit in captivity. However, effective management of captive tapirs is compromised when there is a want for information on the animals' behavior (Shoemaker *et al*., 2003). A study reviewing multiple zoological parks in the United States indicated that captive Malayan tapirs suffered from problems such as obesity as well as a decline in activity (Rose & Roffe, 2012) in comparison to their wild counterparts.

Although there have been numerous studies carried out on tapirs, published journal researches on the behavior of the Malayan tapirs in captivity is minimal, as agreed upon by Gilmore (2001). This is even more so in the Malaysian context. Additionally, according to the Malayan Tapir Conservation Workshop Final Report, there was also a lack of information on the ecology, behavior and also distribution of the Malayan tapirs (Medici *et al*., 2003).

This result of study will provide insight into the behavior of Malayan tapirs in captivity in Malaysia. Furthermore, it may provide baseline data for use in the evaluation of Malayan tapirs in local institutions, or even as support in future works

to improve their management locally and to support the enhancement of their public image.

1.1 Objective

The objectives of the study include:

i. To analyze the diurnal behavior of captive Malayan tapirs
ii. To determine exhibit use in relation to behavior of captive Malayan tapirs
iii. To observe the effects of zoo visitors on the activity levels of captive Malayan tapirs

1.2 Hypothesis

H_0: Visitor numbers have no effect on the activity levels of captive Malayan tapirs

H_{alt}: Visitor numbers have an effect on the activity levels of captive Malayan tapirs.

2.0 LITERATURE REVIEW

2.1 General

Generally, tapirs are stocky, and muscular herbivorous mammals. They have a tapered body, with a vertically flattened head, and a short proboscis (Downer, 2003; Huffman, 2004). Additionally, these animals have four digits on their front limbs, and three on their hind limbs (Downer, 2003). Overall, this body shape allows these animals to be able to travel with ease through dense vegetation in the rainforest.

The Malayan tapirs, in particular, have bodies that can grow to be about 180 cm to 250 cm long, and can stand at a height of 90 cm to 105 cm tall (Downer, 2003). These animals are the largest of all five tapir species, and can easily weigh 250 kg to

320 kg, with the females generally being larger than the males (Downer, 2003). However, the most distinctive physical feature of the Malayan tapirs is the white "saddle" pattern on its back, as well as the white coloration on the tips of its ears (Huffman, 2004), which allow them to camouflage in the rainforest to avoid predators.

2.2 Distribution and Habitat

Malayan tapirs are the only species that belong to the Old World, and hence the only one with a home range in Southeast Asia. Currently, they range through Southern Myanmar, Thailand, Peninsular Malaysia, and the Indonesian island of Sumatra (Figure. 1) (Traeholt *et al.*, 2016; Williams).

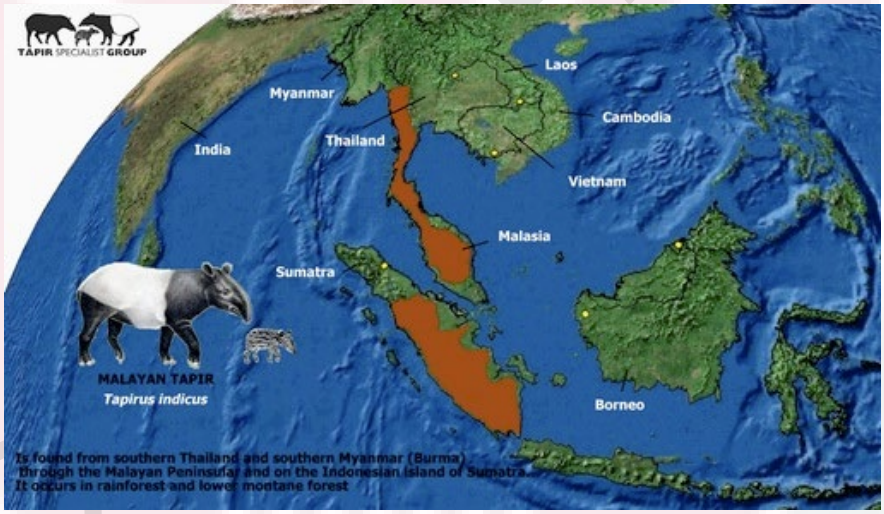


Figure 1: Habitat range of Malayan tapirs in the wild (Pedraza, 2008)

According to Grzimek's Animal Life Encyclopedia, tapirs can normally be found in dense, tropical lowland rainforests going up to about 1800m high (Downer, 2003). This is agreed upon by the TSG, whereby the Malayan tapirs are mentioned to survive well in secondary rainforests that are regenerating and in lower montane regions as well (Williams, 2008).

Not only do tapirs require terrestrial habitats, they also require some form of water body as these animals do spend a large amount of time in the water as well. Thus, these animals do require areas such as mud holes, rivers, and even swamps, which allow them to wallow and swim (Gearty, 2012). Wallowing in water bodies not only helps to keep their bodies cool, it also helps in avoiding insects that bite (Gearty, 2012).

2.3 Behavior and Activity Budget

Traditionally, tapirs were thought to be fully nocturnal, but have also been described as being crepuscular (Mangini, Medici, & Fernandes-Santos, 2012). Being crepuscular in activity means that these animals favor periods near dawn and dusk to carry out most of their activities, and their activity levels tend to peak during these times (Downer, 2004; TSG, 2008).

In a previous study done by Mahler (1984) on the Lowland tapirs, the activity budgets of these animals in zoos revolved mostly around activities of maintenance, and locomotion. Specifically, these behaviors include feeding, investigating, and also resting. Additionally, the study also mentioned that activities of the tapirs and their spatial use varied, depending on the zoo's daily regimes (1984).

Another study performed by Gilmore (2001) showed captive Malayan and Baird's tapirs to spend a large percentage of their day resting, followed by investigating, feeding and swimming. Furthermore, she found the males appeared to spend more time feeding than the females as well (Gilmore, 2001).

2.4 Stereotypical Behavior in Captive Animals

Animal welfare in captive animals is of growing concern these days. A number of variables can be used to determine and objectively measure the level welfare of the

animals in an institution. One of these includes the animal-based indicator that is stereotypical behavior (Manteca & Salas, 2015). An over-simplification of this would mean that the presence of stereotypies tend to indicate a certain level of compromised welfare.

Mason summarized stereotypical behavior as “repetitive, invariant behavior patterns with no obvious goal or function” (Mason, 1991). She further described this type of behavior as being driven by factors of stress and deprivation (Rushen & Mason, 2006).

Stereotypy can manifest in a multitude of behaviors. In ungulates, which are considered some of the most prominent captive animals with stereotypic behavior, these are expressed in the form oral stereotypies, such as crib-biting in horses, and tongue-rolling in cattle and giraffes (Bergeron, Badnel-Waters, Lambton, & Mason, 2006). On the other hand, in the case of carnivores, stereotypy is commonly seen in the form of pacing (Clubb & Vickery, 2006). In the case of Malayan tapirs, White (2003) has described their stereotypical behavior to be similar to that of tigers, seen in the form of pacing in rigid repetitive pattern.

2.5 Visitor Effects on Captive Mammals

Stereotypic behavior can be caused by multiple factors, one of which is the environment that the animal is in. In a zoo setting, human visitors make up a great portion of this external environment, and their presence may affect the animals’ behaviors. These effects of human visitors can either be positive, as an activity stimulus, or negative, as a stress-inducing element. Various studies in primates and also ungulates have shown a wide spectrum of behavioral effects in response to visitor

numbers (Birke, 2002; Farrand, Hosey, & Buchanan-Smith, 2014; Nimon & Dalziel, 1992).

3.0 MATERIALS AND METHODS

3.1 Location

This study was conducted at Zoo Negara, Malaysia. Two exhibits, namely A and B, which housed a pair of male and female Malayan Tapirs each, were observed.

Exhibit A (refer to Appendix I) was located on the main trail and tram route, whereby the animals had visual access to the all visitors and vehicles passing by. This particular exhibit also had a night stall whereby the tapirs were held at night. For analysis of exhibit use, exhibit A was divided into four sections; i) A, where the substrate was grass and most of the feeding areas were located, ii) B, a roofed shelter with cement flooring, with an area where the tapirs could be hidden from the sight of visitors, iii) C, where the pool was located, and iv) D, an open area, with grass as most of the substrate, and a group of bushes which could provide cover for the tapirs.

Exhibit B (refer to Appendix I) was located on an inner path whereby the animals were blocked off from any passing vehicles by a barrier of trees, with noise from these vehicles reduced as well. Exhibit B did not have a night stall. For the purpose of exhibit use analysis, this exhibit was sectioned into five main areas; i) A, which was of earthen substrate, and had trees obstructing visual access to the public, ii) B, an open grassy area, iii) C, a similar open grassy area as in B, iv) D, the location where all the feeding areas are, and v) E, where the pool was located.

The study was carried out over a period of two weeks from 20th January 2017 to 31st January 2017.

3.2 Sample

In this case, four captive tapirs were chosen as study subjects. All the animals were born and bred in captivity. All the animals were identified by their physical characteristics.

In exhibit A, the male tapir was named Jessi, while the female tapir was named Tuffy (refer to Appendix II). Both of these tapirs were aged more than five. The body condition score for both these animals appeared to be three out of five, based on a scale developed by Clauss, Wilkins, Hartley, & Hatt (2009).

In exhibit B, the male tapir was named Tuah. He was about eight years of age with a body condition score of three out of five. The female tapir in this exhibit was named Tissy. She was about 15 years of age, with a body condition score of four out of five. (refer to Appendix II)

The daily routine for all four tapirs were similar. The tapirs were all fed twice a day; once in the morning, and once before closing time. The diet for all the tapirs consisted of local forage and also a combination of ruminant pellets with cut fruits and roots. Enrichment for the tapirs was occasionally done.

3.3 Behavioral Observation

To eliminate observer effect, the tapirs were allowed to acclimatize to the observers' presence for a period of two days, during which time a pilot observation was carried out to confirm the behavior index developed (refer to Appendix III).

The ethogram consisted of 23 behaviors in total. For the purpose of data analysis, these behaviors were further grouped into seven main behaviors of eating, foraging, walking, swimming, standing, resting (to include sitting and lying down), and others (to include all other behaviors not mentioned).

A total of 48 hours of observation was done over a period of eight days during the opening hours of the zoo (9 am – 5 pm), with 24 hours of data collected at each exhibit. Continuous focal sampling with 30 seconds of observation and one minute of break was done in two sets of 3-hour blocks each day, from 9 am to 12 noon, and 1 pm to 4 pm.

3.4 Visitor Enumeration

Visitor frequencies were quantified using a manual counter concurrent with the behavior recordings.

3.5 Statistical Analysis

The results were compiled using Microsoft Excel. Normality was tested for the data, and seeing as the data was not normally distributed, non-parametric analyses were done. Data analysis was performed using the Kruskal-Wallis Test and Mann-Whitney U Test in SPSS 20. Additionally, correlation analysis was done using Spearman's *rho*.

4.0 RESULTS

4.1 Activity budget analysis

4.1.1 *Overall diurnal activity budget of Tapirus indicus over 6 hours*

Approximately 3783 observations were recorded for all four tapirs over the period of the study. Overall, the animals spent a large percentage of their day resting (60.59%), which included activities such as sitting and lying down. Following that, swimming (11.36%) and eating (9.04%) made up the second most performed activity by these individuals (Figure 2). The activities above were followed by walking (5.79%), others (4.75%), foraging (4.70%), and standing (3.77%).

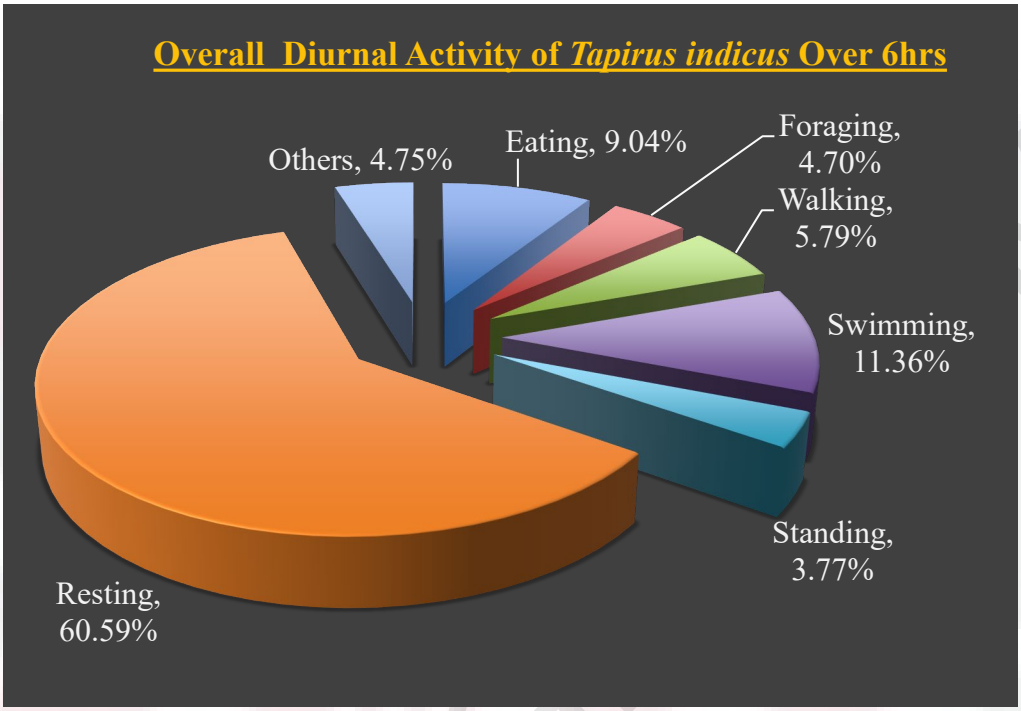


Figure 2: Pooled diurnal activity budget over 6 hours for all tapirs

Statistically, a Kruskal-Wallis H test showed that there was a significant difference in time spent performing each of the activities over the observation period of six hours each day ($p = 0.000$). Additionally, Mann-Whitney U tests were carried out, identifying resting ($p < 0.05$) to be performed significantly more than all the other activities.

Over the duration of this study, no stereotypical behaviors such as pacing were observed in all the tapirs.

4.1.2 *Diurnal activity budget of Tapirus indicus over 6 hours in exhibit A*

The pooled activity budgets of Tuffy and Jessi in exhibit A showed a chart similar to that of combined activity budgets of all four tapirs. Similarly, resting (60.95%) made up the largest portion of the observation period. Swimming (13.89%) was the second most performed activity, with walking (7.54%), foraging (7.08%),

others (5.99%), eating (2.89%), and standing (1.65%) making up the rest of the observations. (Figure 3)

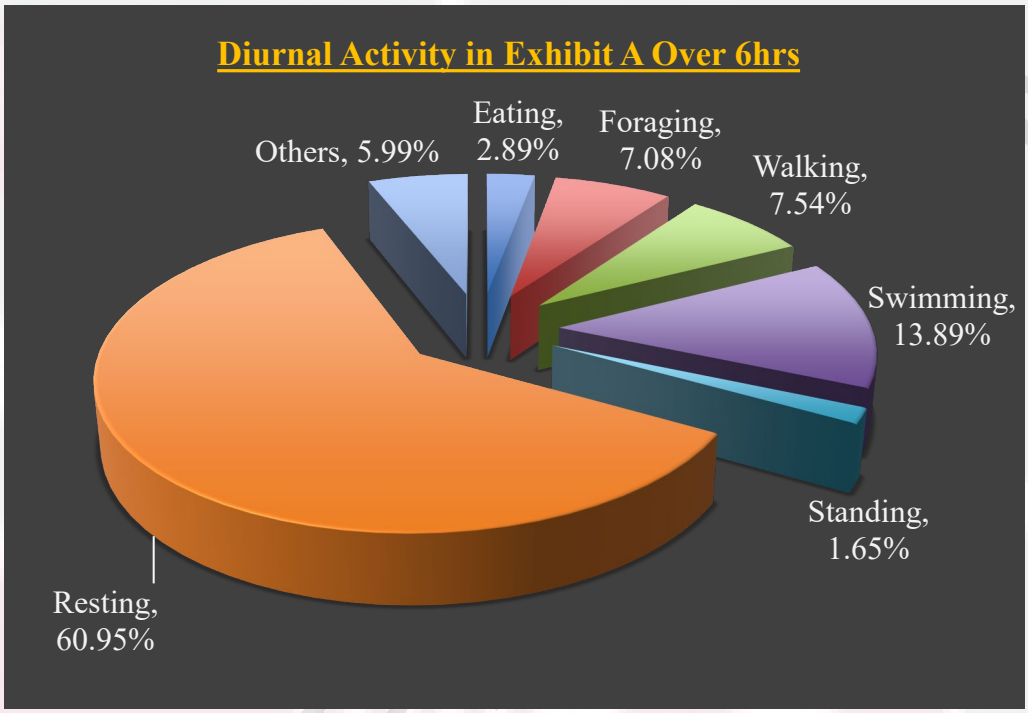


Figure 3: Diurnal activity budget over 6 hours for exhibit A (Tuffy, Jessi)

Between the two tapirs, Tuffy and Jessi, no significant differences were seen in their behaviors, with similar activity budgets between the two (Figure 4).

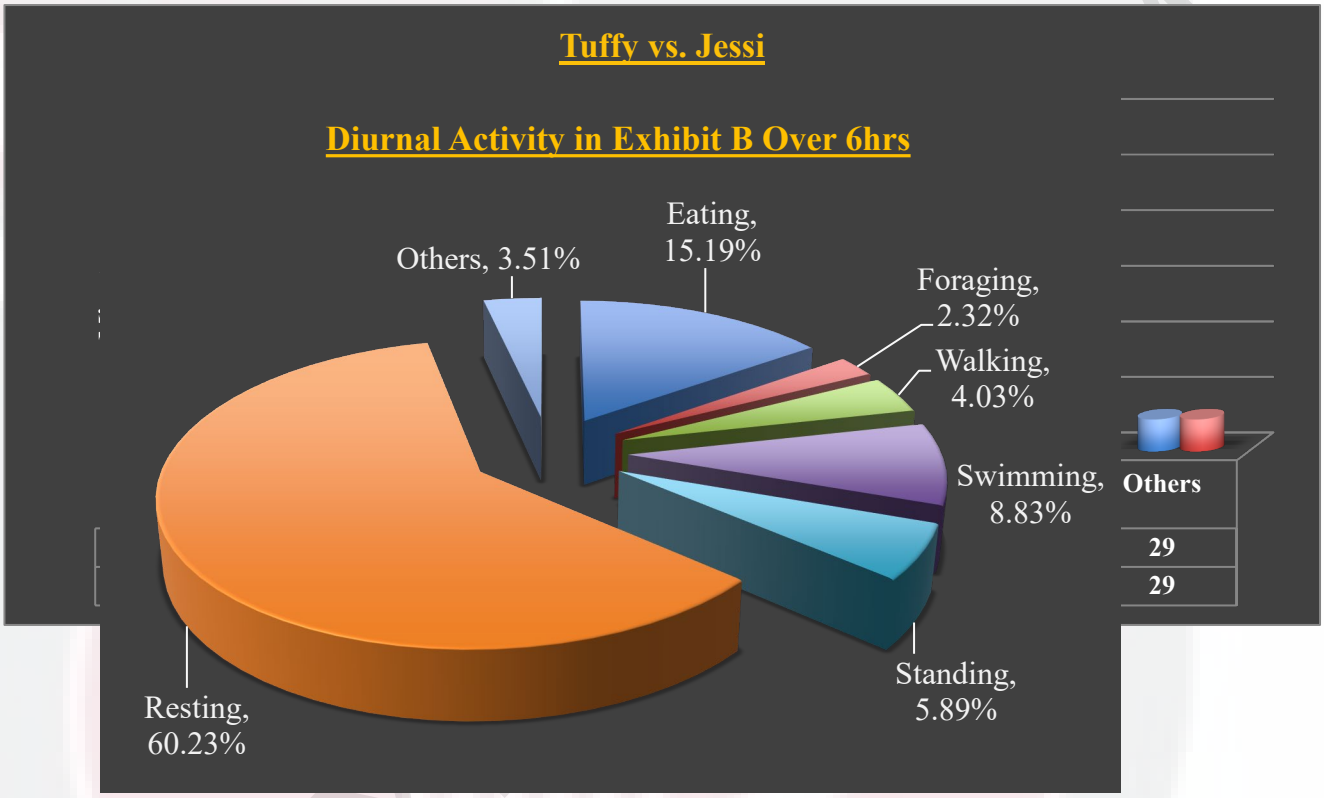


Figure 5: Diurnal activity budget over 6 hours for exhibit B (Tissy, Tuah)

4.1.3 *Diurnal activity budget of Tapirus indicus over 6 hours in exhibit B*

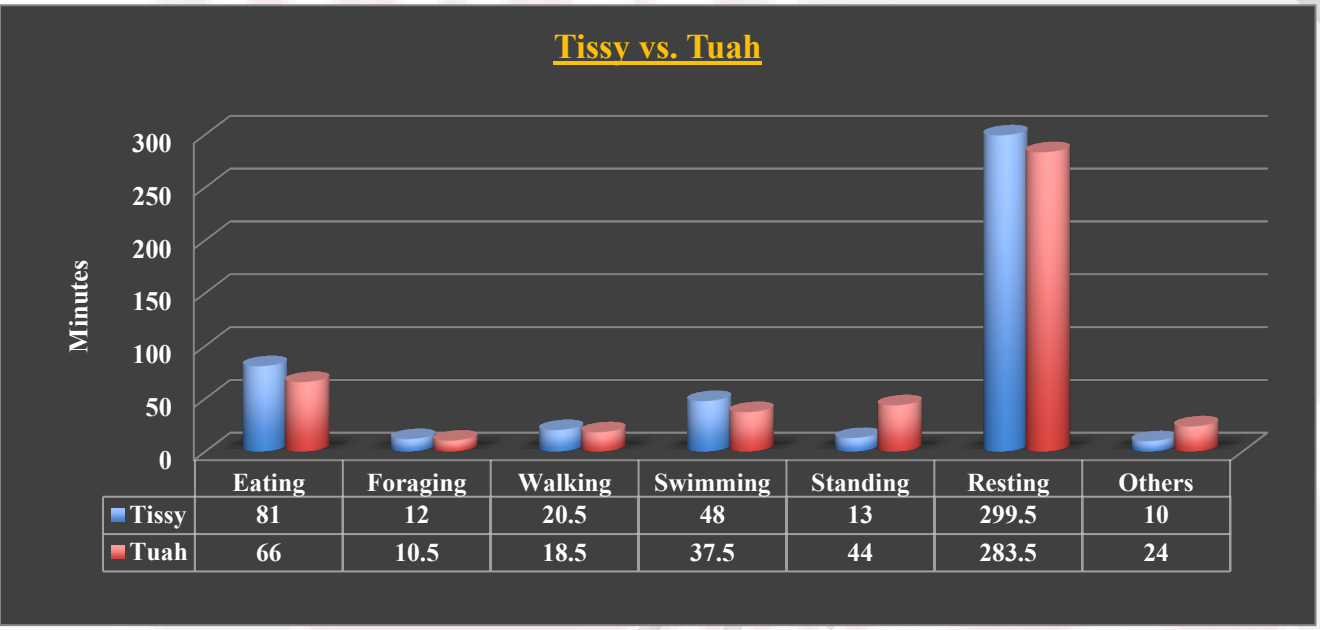
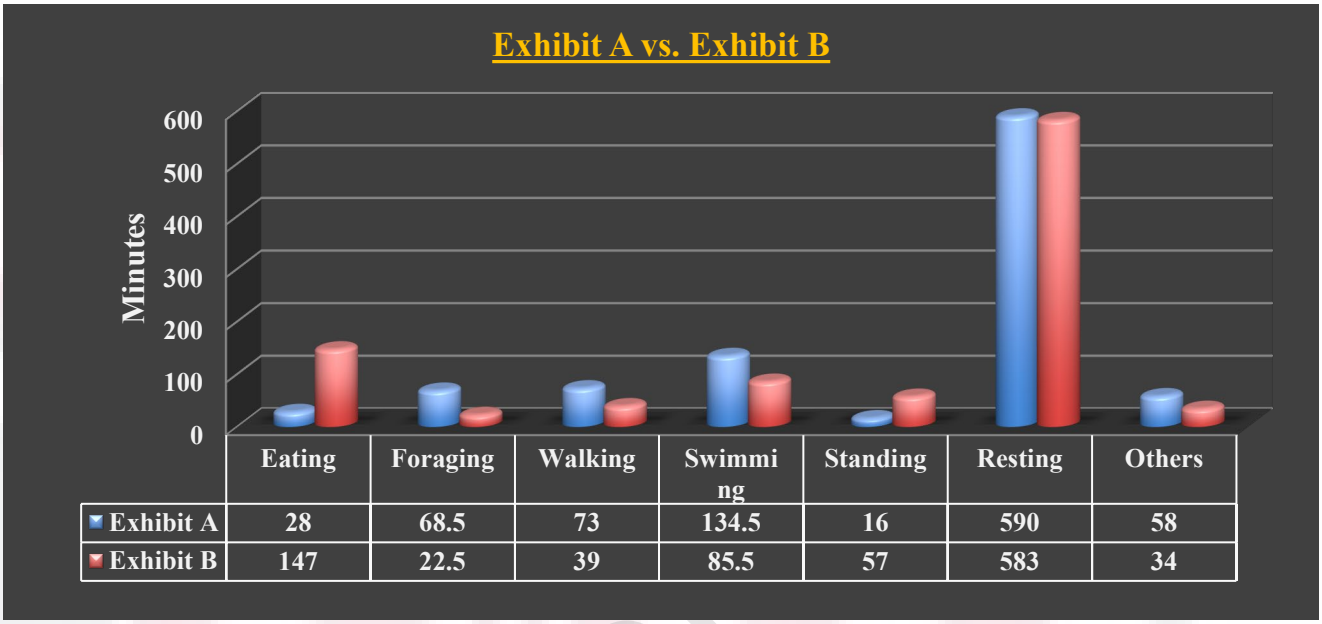


Figure 6: Comparison between diurnal activity budgets in exhibit B

The Malayan tapirs in exhibit B rested (60.23%) the most during the observation period, followed by eating (15.19%), swimming (8.83%), standing (5.89%), walking (4.03%), others (3.5%), and foraging (2.32%) (Figure 5). Likewise with the comparison between the two tapirs in the exhibit, namely Tissy and Tuah, no outstanding differences in activity were seen (Figure 6).

4.1.4 *Diurnal activity budget comparison between exhibits*



	Eating	Foraging	Walking	Swimming	Standing	Resting	Others
Exhibit A	28	68.5	73	134.5	16	590	58
Exhibit B	147	22.5	39	85.5	57	583	34

Figure 7: Diurnal activity budget comparison between exhibits

A comparison was done between both exhibits (Figure 7) by pooling the activities of both tapirs in exhibit A and exhibit B and charting them against each other. No significant differences were identified in this case. In the same fashion as the Malayan tapirs' overall activity in this study, resting was seen to be the most performed activity in both exhibits, with the tapirs in exhibit A spending about 590 minutes in the 48 hours recorded on this activity, with the animals in exhibit B spending about 583 minutes on it.

Between the two exhibits, the tapirs in exhibit A spent more time swimming and foraging than those in exhibit B. On the other hand, the animals in exhibit B spent more time eating compared to those in exhibit A. Other than that, the general pattern of behaviors in all the tapirs appeared to be quite uniform.

4.1.5 *Diurnal activity budget comparison between sexes*

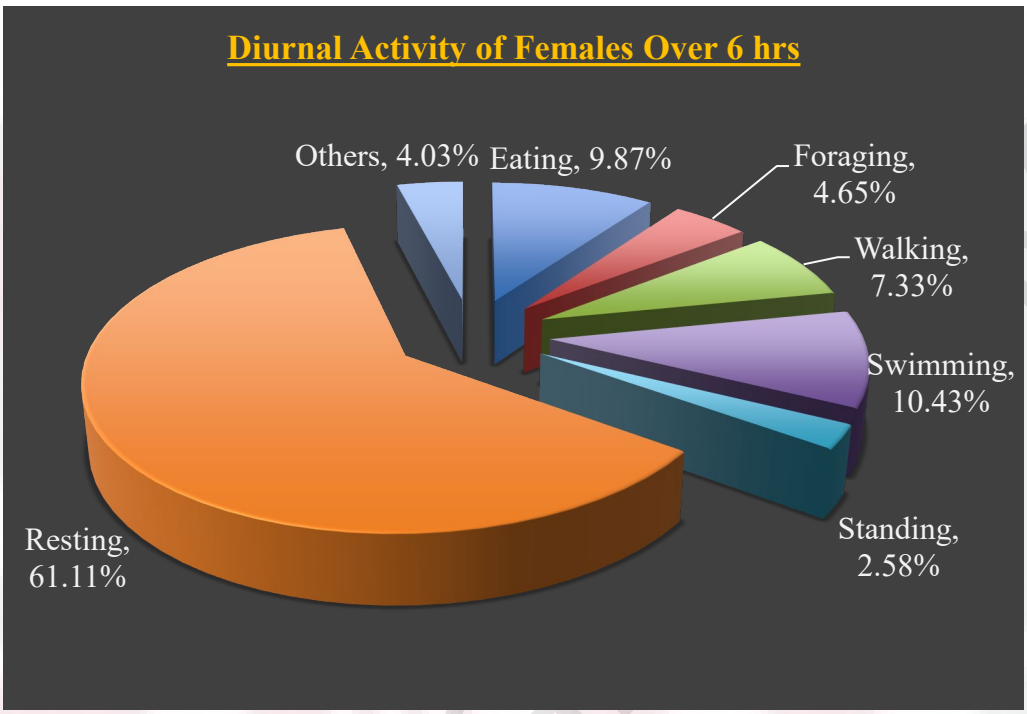


Figure 8: Diurnal activity budget over 6 hours for females (Tuffy, Tissy)

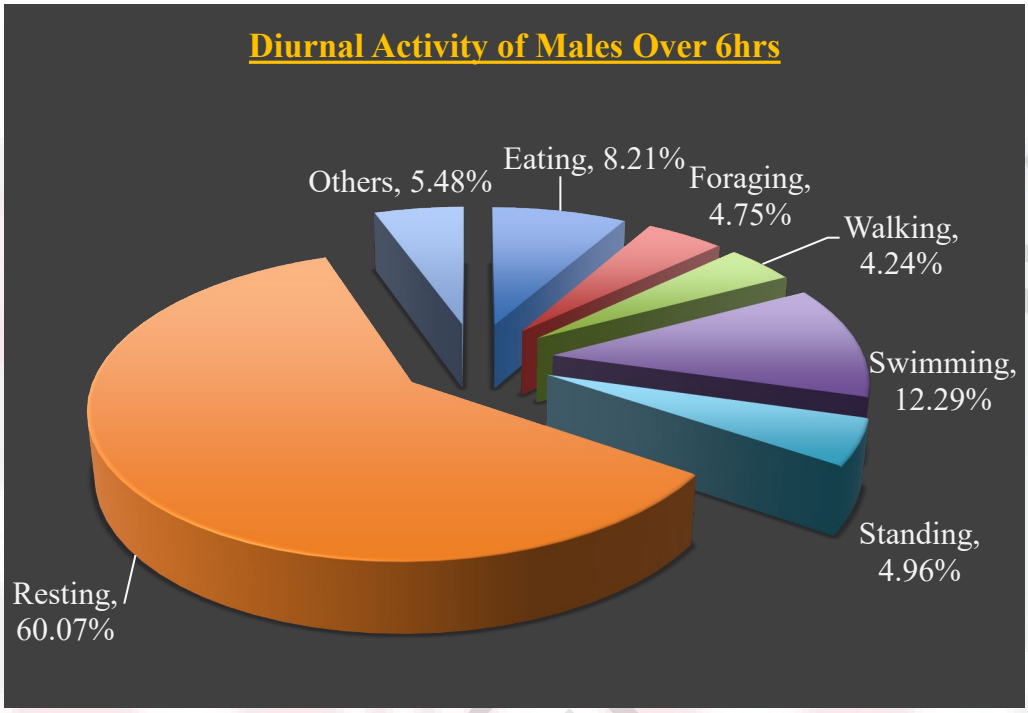
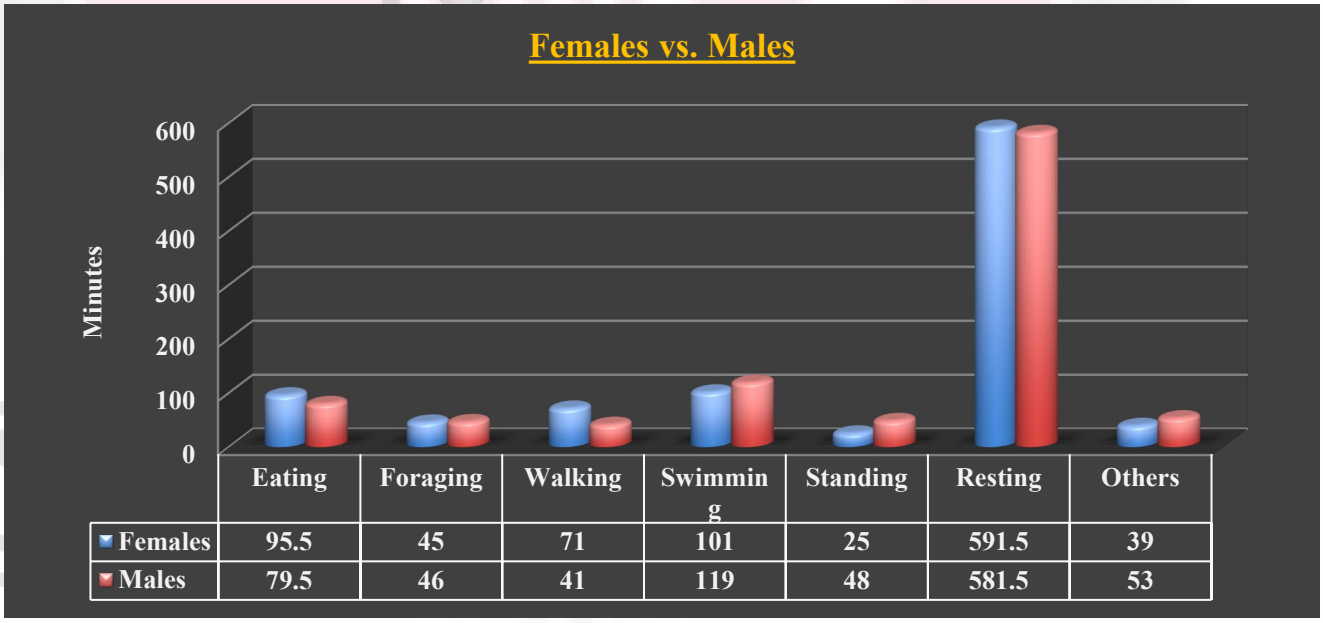


Figure 9: Diurnal activity budget over 6 hours for males (Jessi, Tuah)



	Eating	Foraging	Walking	Swimming	Standing	Resting	Others
Females	95.5	45	71	101	25	591.5	39
Males	79.5	46	41	119	48	581.5	53

Figure 10: Diurnal activity budget comparison between sexes

A comparison between the male Malayan tapirs and the females showed no differences in their activity budget (Figures 8-10). Both sexes showed rested the most during the 6-hour observation period (females: 61.11%, males: 60.07%). This was followed by swimming (females: 12.29%, males: 10.43%), and eating (females: 9.87%, males: 8.21%), in a similar manner as the overall diurnal activity budget of all four tapirs.

4.2 Exhibit use analysis

4.2.1 Exhibit A

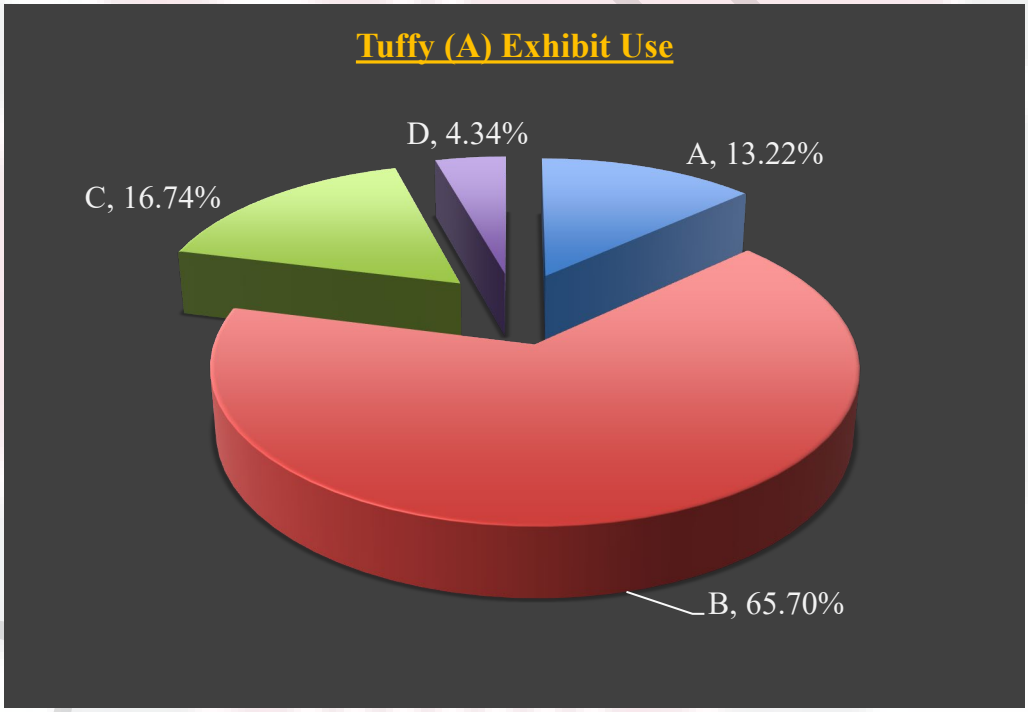


Figure 11: Exhibit use for Tuffy

With regard to exhibit use, both Malayan tapirs in exhibit A (Tuffy and Jessi) used area B (Tuffy: 65.70%, Jessi: 64.46%) the most, and a Mann-Whitney U test showed this was significantly higher ($p < 0.05$) than that of the other areas. This was followed by area C (Tuffy: 16.74%, Jessi: 20.76%), then area A (Tuffy: 13.22%, Jessi:

10.43%), and lastly area D (Tuffy: 4.34%, Jessi: 4.34%) was used the least. (Figures 11 and 12)

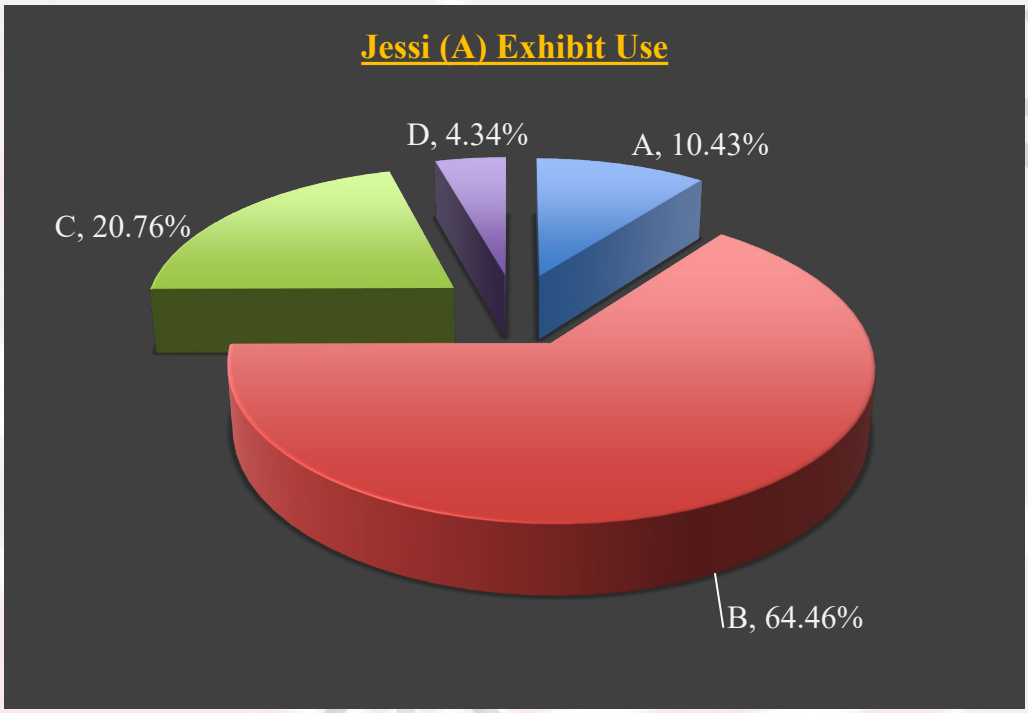


Figure 12: Exhibit use for Jessi

4.2.2 Exhibit B

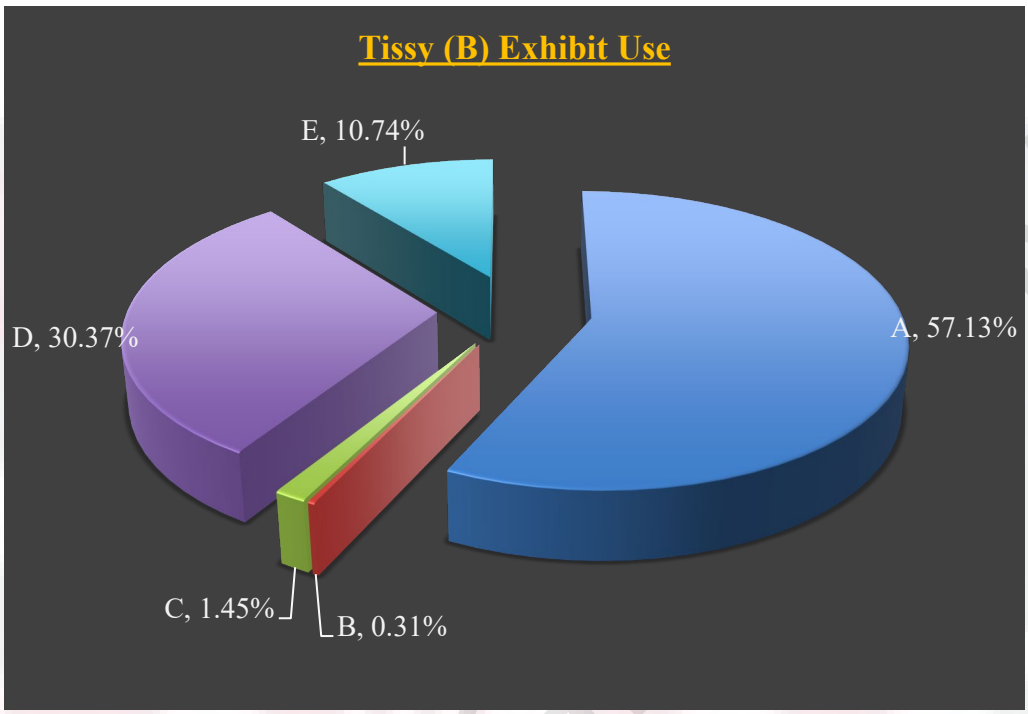


Figure 13: Exhibit use for Tissy

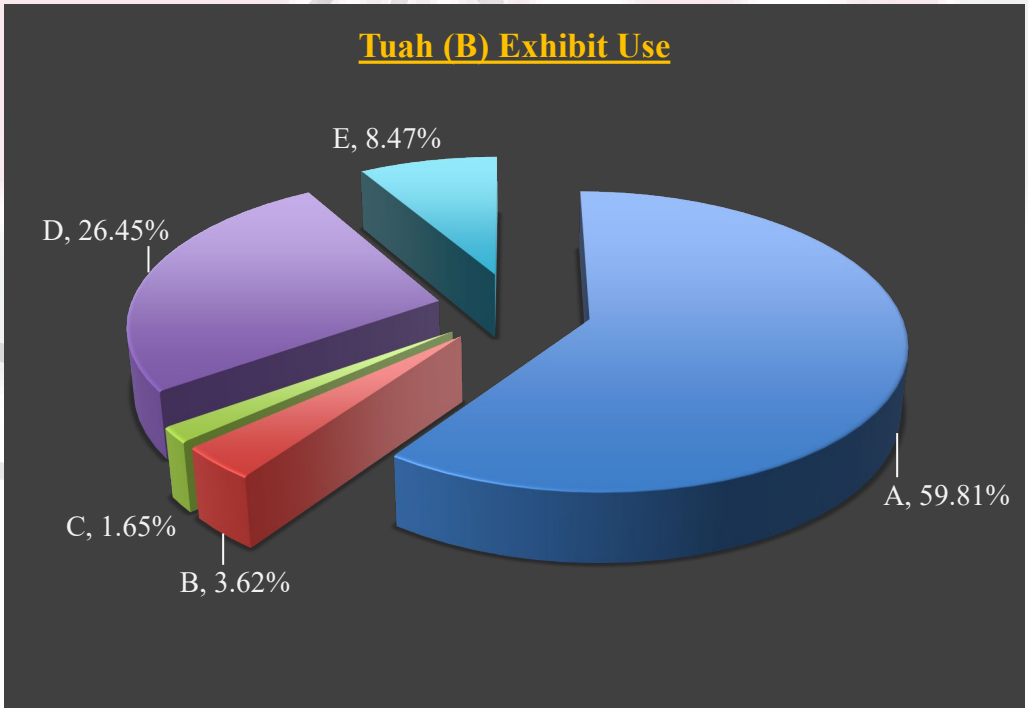
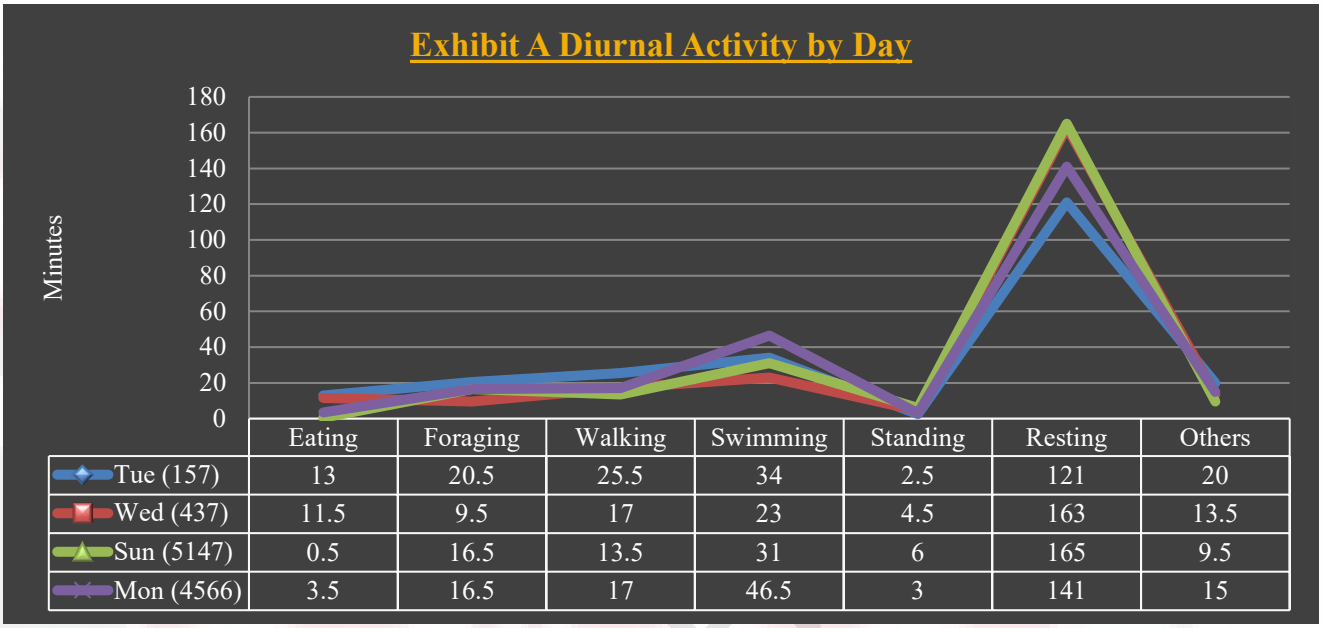


Figure 14: Exhibit use for Tuah

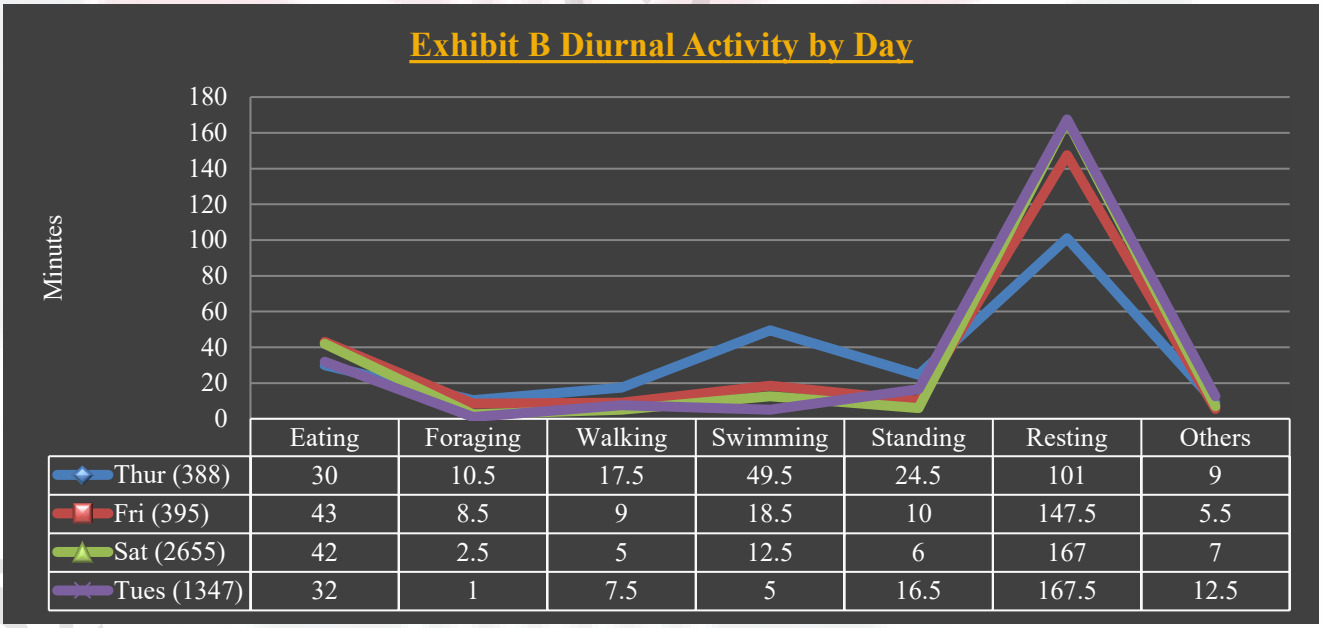
In the case of exhibit B, both Tissy and Tuah utilized area A the most (Tissy: 57.13%, Tuah: 59.81%), also shown to be significantly ($p < 0.05$) higher than the rest by a Mann-Whitney U test. Additionally, area D was the second most utilized area of the exhibit (Tissy: 30.37%, Tuah: 26.45%), followed by area E (Tissy: 10.74%, Tuah: 8.47%), then areas B and C. (Figures 13 and 14)

4.3 Visitor effects analysis



	Eating	Foraging	Walking	Swimming	Standing	Resting	Others
Tue (157)	13	20.5	25.5	34	2.5	121	20
Wed (437)	11.5	9.5	17	23	4.5	163	13.5
Sun (5147)	0.5	16.5	13.5	31	6	165	9.5
Mon (4566)	3.5	16.5	17	46.5	3	141	15

Figure 15: Exhibit A diurnal activity budget of individual activities by day



	Eating	Foraging	Walking	Swimming	Standing	Resting	Others
Thur (388)	30	10.5	17.5	49.5	24.5	101	9
Fri (395)	43	8.5	9	18.5	10	147.5	5.5
Sat (2655)	42	2.5	5	12.5	6	167	7
Tues (1347)	32	1	7.5	5	16.5	167.5	12.5

Figure 16: Exhibit B diurnal activity budget of individual activities by day

Figures 15 and 16 above show the levels of the individual activities each day by their exhibits. Visitor numbers indicated at the labels in brackets show the changes in visitors over the four-recorded days at each exhibit. Generally, across both exhibits,

the levels of all activities did not fluctuate very much. However, it could be seen that the amount of resting done by both exhibits was increased with an increase in the number of visitors. Overall, following a Spearman's *rho*, there appears to be a weak negative correlation between the activity levels and the number of visitors present (r_s = -0.229, p <0.05). When individual activities were correlated against the visitor number, a moderate positive correlation was seen between the levels of resting and the number of visitors (r_s = 0.431, p<0.05).

5.0 DISCUSSION

5.1 Activity budget

Similar to Mahler (1984), and Gilmore (2001), a great portion of the Malayan tapirs' activities in Zoo Negara consisted of maintenance behaviors such as resting and eating. Differences were seen between the current study and those done by Mahler (1984) and Gilmore (2001) as well, with an increased level of swimming in this study, especially. It was suggested that different zoo regimes and daily practices could affect the behaviors performed by these animals (Mahler, 1984). Additionally, the earlier studies were carried out in temperate countries, whereby the temperatures tend to be cooler as compared to Malaysia, which experiences an "all-year summer". The climate and weather may have played a role in these differences as well.

Seeing as the tapirs are more nocturnal and crepuscular (Downer, 2003; Huffman, TSG, 2008), a diurnal activity budget as the one seen in this study is logical, with the majority of the time spent on resting and maintenance behaviors. On the downside, because the study only took place over 6 hours in the day, no confirmation can be made as to whether the behaviors seen were in line with their normal behaviors in captivity or in the wild.

When the behaviors were compared across the two exhibits, it could be seen that the animals in exhibit A foraged and swam more than those in exhibit B. This could be attributed to individual variances, as well as exhibit variances. Exhibit A seemed to have an increase in the presence of scavengers such as monkeys and birds, which had a tendency to steal the feed provided for the animals. This behavior by the scavengers may have led the tapirs in exhibit A to forage to supplement what was taken. Additionally, exhibit A used to house the elephants, and although the area of the exhibit was not measured, it could clearly be appreciated that the exhibit was much larger than exhibit B, and the pool was also deeper. A deeper pool may have contributed to the increased swimming behavior seen in Tuffy and Jessi of exhibit A, as suggested by Gilmore (2001), who found a similar finding in her study.

On the other hand, unlike the results of Gilmore (2001), which showed the females to be more inactive, this study found no significant differences between the activity levels of the male Malayan tapirs and the female Malayan tapirs.

Lastly, a lack of stereotypic behavior as well as a good body condition score indicates that the animals have adequate welfare, or they are able to cope with the stresses of living in captivity. In terms of adequate welfare, this can refer to the amount of nutrition the tapirs are getting, or even the ability for them to do things like forage or even soak in the pool.

5.2 Exhibit use

The exhibit use results in this study correlated well with the daily activity budget of all four Malayan tapirs. This means the percentage of time spent doing a certain activity was in comparison with the facilities within a certain area. For example, the

amount of time spent eating corresponded with the amount of time spent by the tapir in an area that had a feeding site.

All the tapirs in this study showed preferences for their resting areas. The preferred area in exhibit A was area B and that in exhibit B was area A. Alger (1998) did a study on the microhabitats of the resting areas of tapirs, and found that these animals preferred areas, which allowed them to cool down during hot days. This was supported by the findings of Gilmore (2001), whereby the animals in her study also preferred areas with cooler substrates.

In the current study, the preferred resting area for the tapirs in exhibit A was a roofed area, with cement as the floor substrate. On top of that, this area was also the furthest away from the visitors. Similarly in exhibit B, the preferred resting area was the only area in the exhibit with pure earth or soil as the substrate. Earth or soil is expected to be much cooler as compared to grass out in the open sun. In addition to that, not only was this particular site the furthest away from the visitors like in exhibit A, it was also visually blocked by trees. In contrast, the areas that were least used by the tapirs in both exhibits were those that were open spaces, and had no trees to provide shade or shelter.

5.3 Visitor effects

The findings in this study differed from those of another study done by Burrell, Wehneit, & Waran (2004) in the black rhinoceroses. In the study, the black rhinoceroses exhibited increased stress-related behavior of pacing with an increase in the density of visitors present. Rajagopal, Archunan, & Sekar (2010) also found a similar finding in the Indian blackbucks, whereby increased visitor numbers the animals showed increased stress-related behavior. In the blackbucks, however, this

type of behavior manifested itself in the form of aggression. On the other hand, a different study recently showed that zebras actually had no signs of being disturbed with increasing visitor numbers (Conte, 2014). Instead, these animals showed increases in maintenance behaviors such as feeding.

In this study, the activity levels of the tapirs were significantly negatively correlated to the number of visitors to their exhibits. However, this correlation was weak. An explanation as to why this relationship was weak could have been the fact that all four tapirs involved were born and bred in captivity. Specifically, Tuffy was from Zoo Johor in Southern Malaysia, and Tuah was from the tapir conservation center in Sungai Dusun, Malaysia. Additionally, Tissy and Jessi were both from Zoo Negara. All four animals have been with Zoo Negara for at least five years. With this in mind, and knowing that the keepers need to enter their exhibits each day during feeding times, there is a very high chance that these animals may have adapted to the presence of human beings, and do not actually perceive them as a threat.

On the other hand, tapirs have very acute audition and olfaction (Downer, 2003). Naturally, an increase in the number of visitors would increase the noise level. In addition to that, with an increase in the number of visitors, there would also be an increase in scents. Higher levels of sitting and lying down in areas furthest away from the visitors could actually be an evasive technique by the tapirs to avoid the excessive noise and smells. Based on the observation, however, the tapirs appeared to pay no heed to the visitors over all the days in the study, similar to the study by Conte (2014) on the zebras.

6.0 CONCLUSION

The Malayan tapirs observed in this study showed activity budgets that were related to their expected natural crepuscular pattern. Most of their diurnal behavior consisted of inactivity with resting, consisting of behaviors like sitting and laying down. Over the observation period, no stereotypical behaviors were exhibited by all tapirs, indicating that the animals were in an environment with adequate welfare.

Exhibit use was also associated with major activities performed, namely resting. These behaviors were also done at very specific locations within each exhibit.

Additionally, a negative relationship between the activity levels of the tapirs and the number of visitors to the exhibits were observed. When a higher number of visitors were present, the tapirs had a reduced amount of activity, which translated to an increase in inactive behavior.

7.0 RECOMMENDATIONS

Seeing as the study was performed over a short period of time and on a small number of animals, a larger sample size should be studied. Doing this, and including other local zoological institutions such as Zoo Melaka, or even Zoo Taiping would give a better representation of the captive Malayan tapir population in Malaysia.

Apart from that, because this study only comprised of behaviors observed over a period of six hours in a day, the data lacks comprehensiveness. As such, 24-hour data collection would be preferable, with the aid of camera traps. This would also allow for better comparison against other studies done on captive tapirs with data collected over a period of 24 hours.

Pertaining to the effects of visitors on the activity levels of the tapirs, it would be appropriate to expand this study to look at visitor effects in night safaris as well. Tapirs are expected to be more active at night, and thus, differences may be seen when compared to the current study, which was carried out during the day, when these animals are supposedly most inactive.

According to the keepers caring for the Malayan tapirs in this study, enrichment is not commonly done. A suggestion would be to introduce enrichment more often, such as in the form of olfactory stimuli to engage the tapirs in more investigative behavior.

Besides that, it could be beneficial for the animals if more vegetation were provided as cover in their exhibits. These covers should be strategically placed to allow visitors to view the tapirs, while at the same time, giving the tapirs freedom to hide if they desire. Tapirs are elusive animals, and allowing them to do this may help to increase their activity levels during the day.

REFERENCES

Alger, S.J. (1998). Resting site microhabitat selection of *Tapirus bairdii* during the dry season in Corcovado National Park, Costa Rica. *Winchell Posters*, 62(2), 7.

Bergeron, R., Badnell-Waters, A.J., Lambton, S., Mason, G. (2006). Stereotypic oral behavior in captive ungulates: Foraging, diet and gastrointestinal function. In G. Mason & J. Rushen (Eds.), *Stereotypic animal behavior: Fundamentals and Applications to welfare* (2nd ed) (pp. 1-18). UK: Cromwell Press, Trowbridge.

Birke, L. (2002). Effects of browse, human visitors and noise on the behavior of captive orang utans. *Animal Welfare*, *11*, 189-202.

Burrell, ., Wehneit, S., & Waran, N. (2004). Olfactory enrichment and visitor effects in black rhinoceroses (*Diceros bicornis*) at two UK zoos. *Proceedings of the Sixth Annual Symposium on Zoo Rescues.*

Clauss, M., Wilkins, T., Hartley, A., & Hatt, J.M. (2009). Diet composition, food intake, body condition, and fecal consistency in captive tapirs (*Tapirus spp.)* in UK collections. *Zoo Biology, 28,* 279-291.

Clubb, R. & Vickery, S. (2006). Locomotor stereotypies in carnivores: Does pacing stem from hunting, ranging or frustrated escape? In G. Mason & J. Rushen (Eds.), *Stereotypic animal behavior: Fundamentals and Applications to welfare* (2nd ed) (pp. 1-18). UK: Cromwell Press, Trowbridge.

Conte, C. (2014). *Do visitors affect zebra behavior in zoos?* (Honors Scholar Thesis). Available from University of Connecticut DigitalCommons@Uconn. (337).

Downer, C. C. (2003). Tapirs (Tapiridae). In Hutchins, M., Kleiman, D. G., Geist, V., McDade, M. C. (Eds.), *Grzimek's Animal Life Encyclopedia* (2nd ed.). Farmington Hills, MI: Gale Group.

Farrand, A., Hosey, G., Buchanan-Smith, H. M. (2014). The visitor effect in petting zoo-housed animals: aversive or enriching? *Applied Animal Behaviour Science, 151*, 117 – 127.

Ferguson, S. (1997). *Order Perissodactyla*. Retrieved February 11, 2017, from http://www.nhc.ed.ac.uk/index.php?page=493.170.280.

Garcìa, M., Jordan, C., O'Farril, G., Poot, C., Meyer, N., Estrada, N., Leonardo, R., Naranjo, E., Simons, Á., Herrera, A., Urgilés, C., Schank, C., Boshoff, L. & Ruiz-Galeano, M. (2016). *Tapirus bairdii*. The IUCN Red List of Threatened Species 2016:e.T21471A45173340. http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T21471A45173340.en. Downloaded on January 12, 2017.

Gearty, W. (2012). *Tapirus indicus*: Malayan tapir. In *Animal diversity web*. Retrieved February 28, 2017, from http://animaldiversity.org/accounts/Tapirus_indicus/.

Gilmore, M. (2001). *Tapir behavior – An examination of activity patterns, mother young interactions, spatial use, and environmental effects in captivity on two species (Tapirus indicus & Tapirus bairdii)* (Unpublished masters thesis). Oklahoma State University, Oklahoma, United States of America.

Huffman, B. (2004). *Tapirus indicus: Malayan Tapir.* Retrieved February 15, 2017 from www.ultimateungulate.com/Perissodactyla/Tapirus_indicus.html.

IUCN/SSC Tapir Specialist Group (TSG) (2008). *Tapirs of the world*. Retrieved January 31, 2017, from http://tapirs.org/tapirs/.

Lizcano, D.J., Amanzo, J., Castellanos, A., Tapia, A. & Lopez-Malaga, C.M. (2016). *Tapirus pinchaque*. The IUCN Red List of Threatened Species 2016: e.T21473A45173922. http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T21473A45173922.en. Downloaded on January 12, 2017.

Mahler, A.E. (1984). Activity budgets and use of exhibit space by South American tapir (*Tapirus terrestris*) in a Zoological Park setting. *Zoo Biology*, 3 (1), 35-46. Abstract retrieved from Wiley Online Library. http://dx.doi.org/10.1002/zoo.1430030105.

Malay Tapir Conservation Project. (n.d). Retrieved from http://www.malaytapir.org/index.html.

Mangini, P. R., Medici, E. P., Fernandes-Santos, R. C. (2012). Tapir health and conservation medicine. *Integrative Zoology, 7*, 331 – 345.

Manteca, X. & Salas, M. (2015). Stereotypies as animal welfare indicators. *Zoo Animal Welfare Education Centre: Zoo Animal Welfare Fact Sheet.*

Medici, E.P., A. Lynam, R. Boonratana, K. Kawanishi, S. Hawa Yatim, C. Traeholt, B. Holst, and P.S. Miller (eds.) (2003). Malay Tapir Conservation Workshop. Final Report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN, USA.

Naveda, A., de Thoisy, B., Richard-Hansen, C., Torres, D.A., Salas, L., Wallance, R., Chalukian, S. & de Bustos, S. (2008). *Tapirus terrestris*. The IUCN Red List of Threatened Species 2008: e.T21474A9285933. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T21474A9285933.en. Downloaded on January 12, 2017.

Nimon, A.J. & Dalziel, F. R. (1992). Cross-species interaction and communication: a study method applied to captive siamang (*Hylobates syndactylus*) and long-billed corella (*Cacatua tenuirostris*) contacts with humans. *Applied Animal Behavior Science*, 33(2), 261 – 272. DOI: 10.1016/S0168-159(05)80013-9.

O'Farrill, G., Galetti, M., Campos-Arceiz, A. (2013). Frugivory and seed dispersal by tapirs: an insight on their ecological role. *Integrative Zoology*, 8 (1), 4-17. doi:10.1111/j.1749-4877.2012.00316.x.

Pedraza, C. (2008). Malayan tapir habitat range. In *The world's tapirs – The Malayan tapir (Tapirus indicus)*. Retrieved February 16, 2017, from http://www.tapirs.org/tapirs/tapir-range-maps/t_indicus/t_indicus-poster.jpg

Rajagopal, T., Archunan, G., Sekar, M. (2010). Impact of zoo visitors on the fecal cortisol levels and behavior of an endangered species: Indian blackbuck (*Antelope cervicapra L.*). *Journal of Applied Animal Welfare Science*, 14 (1), 18 – 32. http://dx.doi.org/10.1080/10888705.2011.527598.

Rose, P.E. & Roffe, S.M. (2012). A case study of Malayan tapir (*Tapirus indicus*) husbandry practice across 10 zoological collections. *Zoo Biology*, 32 (3), 347-356. http://dx.doi.org/10.1002/zoo.21018.

Rushen, J. & Mason, G. (2006). A decade-or-more's progress in understanding stereotypic behavior. In G. Mason & J. Rushen (Eds.), *Stereotypic animal behavior: Fundamentals and Applications to welfare* (2nd ed) (pp. 1-18). UK: Cromwell Press, Trowbridge.

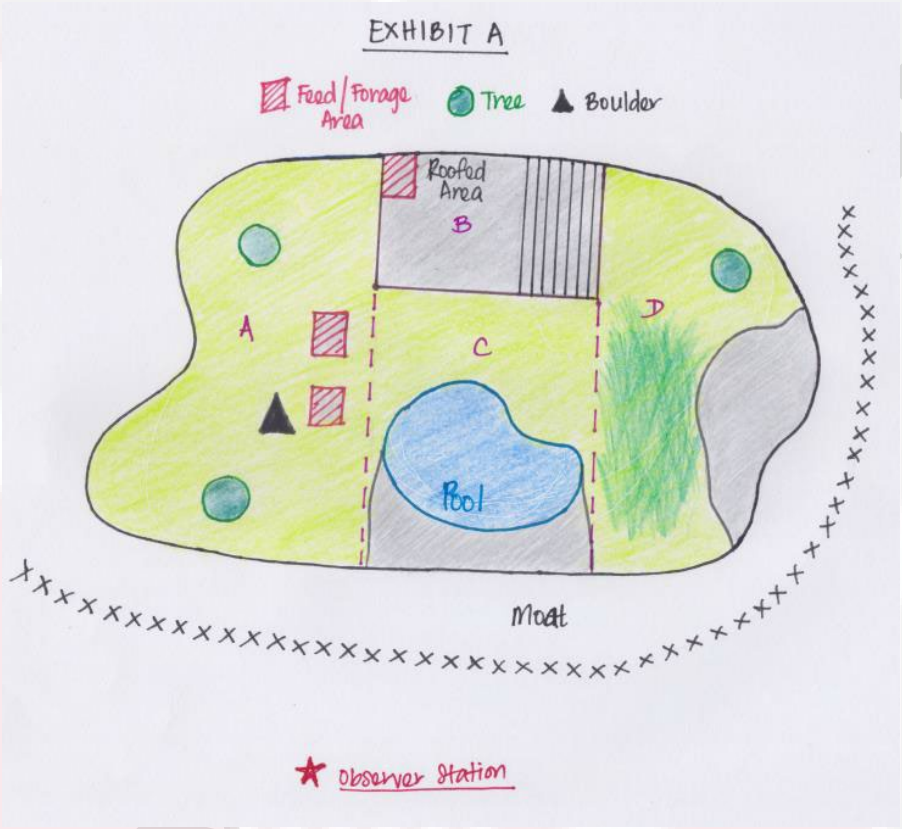
Shoemaker, A.H., Barongi, R., Flanagan, J., Janssen, D., Hernandez-Divers, S. (2003). *Husbandry guidelines for keeping tapirs in captivity* (Unpublished report). IUCN/SSC Tapirs Specialist Group (TSG). Retrieved October 9, 2016, from http://www.tapirs.org/Downloads/.

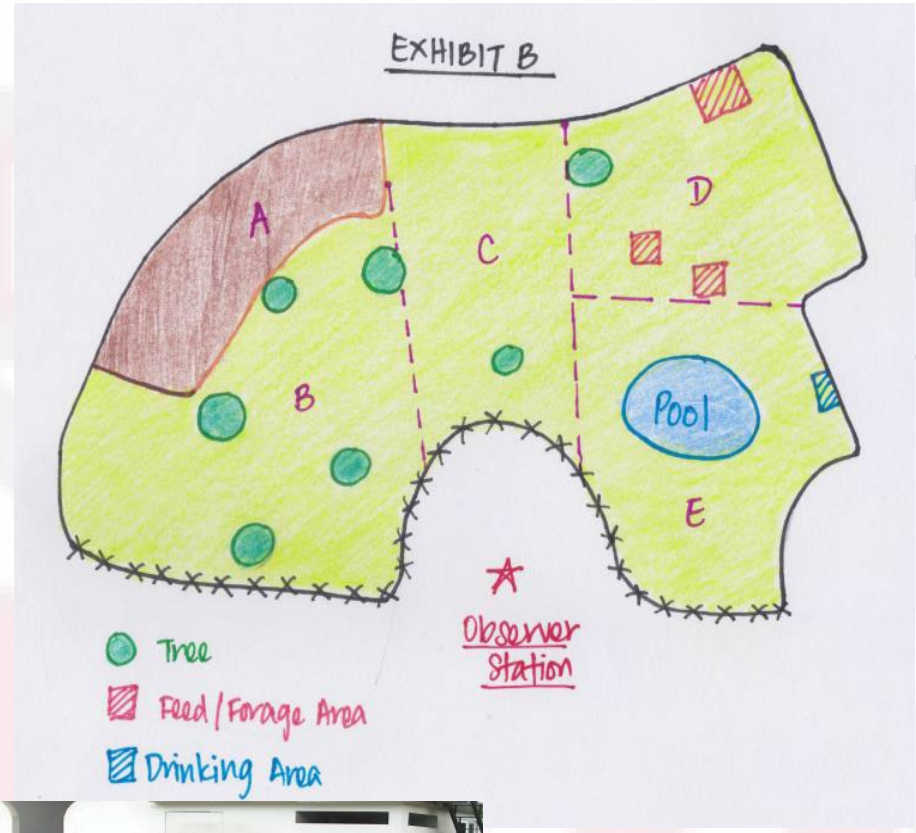
Traeholt, C., Novarino, W., bin Saaban, S., Shwe, N.M., Lynam, A., Zainuddin, Z., Simpson, B. & bin Mohd, S. (2016). *Tapirus indicus*. The IUCN Red List of Threatened Species 2016: e.T21472A45173636.http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T21472A45173636.en. Downloaded on October 8, 2016.

Williams, K. (2008). *The world's tapirs – The Malayan tapir (Tapirus indicus)*. Retrieved February 16, 2017, from http://www.tapirs.org/tapirs/malay.html.

APPENDICES

Appendix I: Layout of Exhibits





Appendix II: Animals

Tapirs in exhibit A: Tuffy the female (left), and Jessi the male (right) distinguishable by the ear notch on Jessi's left ear

Appendix III: Behavior Index

Tapirs in exhibit B: Tissy the female (left), and Tuah the male (right) distinguishable by the wound on Tuah's dorsum

Behavior Index: Malayan tapir (*Tapirus indicus)*

Behavior	Behavior Code	Definition
Eating	E	Animal ingesting feed from the offered feed
Drinking	Dr	Animal taking in water - using its snout to suck the water
Urinating	U	Animal expelling urine
Defecating	De	Animal expelling feces in the pool or on the ground
Grooming	G	Animal performing self-cleaning activities, including scratching, rolling, shaking
Rubbing	Rb	Animal moving back and forth against an object or a conspecific
Foraging	Fo	Animal walking and investigating, in search of food with its proboscis, and occasionally ingesting feed items from ground or low hanging plants
Touching	T	Animal touching objects or conspecifics with its proboscis
Walking	W	Animal moving around exhibit at a slow pace

Running	R	Animal moving inside exhibit at a fast pace
Swimming	Sw	Animal inside pool fully or partially submerged
Following	Fl	Animal travelling in the same direction behind conspecific or another species
Sitting	Si	Animal has its rear on the ground and supports itself upright with the forelimbs, or on sternal position with its head upright and alert
Standing	St	Animal on all four limbs unmoving in an upright position and appears alert
Lying down	Ld	Animal resting on lateral or sternal recumbency with its head down on the ground
Watching	Wa	Animal staring at a stimuli or potential stimuli
Aggression	Ag	Animal showing threatening or violent actions to conspecific or another species
Reproductive	Re	Animal showing behavior related to reproduction; Male sniffing female's genitalia and biting the female, mounting, compliance by the female to the male's advances, chasing
Spraying	Sp	Animal focusing a short burst of urine in a specific place
Vocalizing	V	Animal producing sounds via nasal or oral cavity
Flehmen	Fle	Animal curls up its upper lip exposing the teeth and gums with its neck extended and head up with eyes rolled back
Pacing	P	Animal moving in a repetitive path continuously for at least 5 minutes with no evident purpose
Out of Sight	O	Animal not seen

Behavior index for Malayan tapir *(Tapirus indicus)* adapted from Gilmore (2001), and Mahler (1984)