UNIVERSITI PUTRA MALAYSIA

EFFECT OF HUMAN VISITORS ON CAPTIVE SERVAL CATS (*Leptailurus serval*)

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FPV 2017 61

EFFECT OF HUMAN VISITORS ON CAPTIVE SERVAL CATS (*Leptailurus serval*)

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

In partial fulfilment of the requirement for the

DEGREE OF DOCTOR OF VETERINARY MEDICINE

University Putra Malaysia

Serdang, Selangor Darul Ehsan

FEBRUARY 2017

CERTIFICATION

It is hereby certified that we have read this project paper entitled "Effect of Human Visitors on Serval Cats (*Leptailurus serval*)" by Nor Azreen Binti Mohamad and in our opinion it is satisfactory in terms of scope, quality and presentations as partial fulfilment for the course VPD 4999 Project.

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DEDICATION

"We are still young and immature to give up.

If you feel you're going to crash then accelerate more."

To

My beloved family

For your prayers and having me in the family

Meknons

13 years together and we're still strong

Team Rocket

For being amazing friends and helpful study mates

DVM class of 2017

For making the class a little amusing

And,

Furry and non-furry family at home

For making me realise I want to do this

Along with all hard working and respected teachers

ACKNOWLEDGEMENT

In the name of Allah the Most Gracious, the Most Merciful

First and foremost, I would like to thank Allah the Almighty for everything that He has given me; health, family, friends, education, a home, some money, a car, and so on.

In this very special occasion, I would like to express my gratitude and appreciation to Dr. Mokrish Md. Ajat, as my supervisor, who willingly supervise me despite his busy schedule. He has shared his valuable time, criticism, and guidance throughout the thesis preparation and write-up. A special thanks to Dr. Tengku Rinalfi Putra bin Tengku Azizan, as my co-supervisor, for his time, guidance, resources and thoughts to ensure the project can be carried out successfully. Also, thank you to the National Zoo, Ampang, Especially Dr. Mat Naim bin Haji Ramli, Dr. Kavitha Jayaseelan, Dr. Jessie Ho and the staff for helping me throughout this project.

Further thank you to my beloved family for their love, encouragement and support which have made it possible for me to finish my thesis. My thanks are also addressed to my project mate, Norhafizah binte Kamisan for her ideas and time spent together, making the project more memorable.

I also place on record, a gratitude to each and every one who has directly or indirectly been lending their hands in this project.

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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar sebagai memenuhi sebahagian daripada kursus VPD 4999 - Projek Tahun Akhir.

KESAN PENGUNJUNG ZOO TERHADAP KUCING SERVAL *(Leptailurus serval*)

DI DALAM KURUNGAN

Oleh

NOR AZREEN BINTI MOHAMAD

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Penyelia: Dr. Mohd Mokrish Md. Ajat

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Kucing serval atau *Leptailurus serval* boleh ditemui di sepanjang sub-sahara, Afrika, berdekatan punca air. Pada masa kini, kucing serval semakin meraih populariti sebagai kucing peliharaan. Objecktif kajian ini adalah untuk mendokumen tingkah laku serval di dalam kurungan, dan untuk mengetahui samada terdapat apa-apa kesan oleh pengunjung zoo terhadap aktiviti dan tingkah laku serval. Kajian dilakukan di Zoo Negara Malaysia, Jalan Ulu Kelang di Selangor, di kawasan pameran serval. Dua ekor serval: seekor kucing betina dewasa dan seekor kucing betina muda yang terdapat di dalam kawasan pameran yang sama diambil sebagai subjek kajian ini. Kajian ini

dijalankan menggunakan kaedah pemerhatian secara visual menggunakan indeks tingkah laku yang diadaptasi daripada kajian terdahulu dalam keluarga kucing. Persampelan secara langsung dijalankan semasa waktu zoo beroperasi selama enam jam, yang telah dibahagikan kepada dua sesi iaitu dari pukul 9.00 pagi hingga 12.00 tengah hari, dan dari 1.00 petang hingga 4.00 petang. Sejumlah 24 jam pemerhatian dilakukan selama 4 hari, dari 1 Februari hingga 4 Februari 2017. Sementara seorang pemerhati mengawasi tingkah laku serval dan penggunaan kawasan di dalam kurungan, seorang lagi pemerhati merekod jumlah pengunjung zoo yang hadir di kawasan pameran tersebut. Kawasan kurungan serval dibahagikan kepada 4 kawasan iaitu kawasan A untuk berehat, kawasan B yang merupakan kawasan lapang, kawasan C ialah tembok batu untuk serval bersembunyi, dan kawasan D yang berfungsi sebagai tempat makan dan bersembunyi. Analisa statistik dijalankan menggunakan Excel dan SPSS. Ujian bukan parametrik seperti Mann-Whitney U dan korelasi Spearman telah digunakan. Umumnya, kucing serval meluangkan kebanyakan masa tidur, dan berguling adalah tingkah laku paling sedikit diperhatikan. Keputusan kajian ini menunjukkan aktiviti kucing serval semasa waktu operasi di Zoo Negara mempunyai korelasi negatif antara jumlah pengunjung dengan tingkah laku agresif, berguling, berjalan, peka, berehat terjaga, berdandan, dan menguap. Walau bagaimanapun, tingkah laku tidur dan ketidak penampakan kucing mempunyai korelasi positif. Akan tetapi, hanya sifat agresif yang mempunyai data statistik ketara dan menunjukkan korelasi positif yang kuat terhadap jumlah pengunjung. Hal ini boleh dijelaskan melalui respons menyorok yang ditunjukkan oleh serval, menyamai kucing domestik. Berkenaan dengan penggunaan kawasan di dalam kurungan semasa waktu zoo beroperasi, hasil kajian mendapati kedua-dua serval menghabiskan masa sebanyak

85% di kawasan A, diikuti sebanyak 15% di kawasan D, dan hanya 1 pemerhatian di kawasan B. Tiada serval yang menggunakan kawasan C. Tiada korelasi antara jumlah pengunjung dengan penggunaan kawasan di dalam kurungan. Secara kesimpulannya, jumlah pengunjung tidak mempunyai apa-apa kesan terhadap tingkah laku serval di Zoo Negara.

Kata kunci: Kucing serval, Kurungan, Tingkah laku, Pengunjung zoo

ABSTRACT

An Abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD 4999 – Final Year Project

EFFECT OF HUMAN VISITORS ON CAPTIVE SERVAL CATS *(Leptailurus serval*)

By

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2017

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Serval cat or *Leptailurus serval* can be found throughout sub-saharan Africa, populating areas near water source. Nowadays, serval cats are gaining popularity to be kept as exotic pets. The objective of the study is to document the behaviour of the serval cats in captivity, and to know whether there is any effect of human visitors on their activities and behaviour. The study was conducted at Zoo Negara Malaysia, Jalan Ulu Kelang in Selangor, at the serval exhibit area. Two serval cats; an adult female and a young female from the same enclosure were taken as the subjects for this study. This study was done by means of visual observation using behavioural index adapted from previous studies of cats' family. An instantaneous sampling was done during the zoo's opening hour for six hours, which was split into two sessions which was from

9.00 a.m. to 12.00 p.m., and from 1.00 p.m. to 4.00 p.m. A total of 24 hours observation was carried out over 4 days, from 1st February to 4th February 2017. While another observer observed the servals behaviour and spatial use, another observer recorded the visitors count on the exhibit. The servals enclosure was divided into 4 areas which were area A for resting, area B which is an open area, area C which is a wall for the servals to hide, and area D which is the feeding and hiding area. Data was analysed using Excel and SPSS. Specifically, non-parametric tests like Mann-Whitney U and Spearman's correlation were used. Generally, the cats spent most of the day sleeping with rolling-over being the least behaviour observed. The result indicated that the diurnal activity of the captive cats during visiting hours at Zoo Negara has a negative correlation between the visitor count, and aggression, rolling, walking, alert, resting awake, grooming, and yawning. A positive correlation though, was indicated by sleeping and with the subjects being out of sight. However, only aggression is statistically significant and shows a strong positive correlation to the visitors count. This could be explained the flight response shown by the servals, which is similar to the behaviour of domestic cats. With regards to the spatial use by the servals in the enclosure during the visiting hour of the insitution, the result shows that both servals spent about 85% of their time in area A, followed by 15% in area D, and area B. None of the servals made use of area C. There was no correlation between the visitors count and the spatial use of the servals. In conclusion, the visitors count do not have any effect towards the behaviour of the servals.

Keyword: Serval Cat, Captivity, Behaviour, Human Visitors

1.0 INTRODUCTION

Serval is classified taxonomically as *Leptailurus serval* (Von Schreber, 1776). *Leptailurus serval* is constructed from Greek roots meaning "slender cat" while "serval" could have been derived from Latin words *Lupus cervalis* which means "deer-like wolf". This explains the morphology of serval cats which are tall and slender.

Based on a DNA study in 2006, it was revealed that serval cats are closely associated to the african golden cat, sharing a common ancestor approximately 5.4 million years ago. Other than the african golden cat, they are also closely related to the caracals and jackals (O'brien & Johnson, 2007).

Their coat is striped and spotted on the neck, shoulders, legs and tails, and is yellow-tan in colour (Shütze, 2002). Additionally, they have large oval-shaped ears, a small muzzle and a shortish tail (Kingdon, 2004). Serval cats have the longest legs among the cat family, relative to its body size ratio. Hence, serval are an exceptional climbers and jumpers (Shütze, 2002). The adults head and body length is approximately 0.67 – 1.00 m, while the shoulder height is 0.54 – 0.62 m. Males are larger than females, and weigh around 8.7 – 18.0 kg (Kingdon 1977 as cited by Nowak, 2005).

In addition to the common yellow-tan-coloured serval, there are also melanistic servals. Melanistic serval are black in colour and they can be found commonly in Africa. In fact in a study conducted in Kenya, about eight out of 21 servals are melanistic, while five others showed varying degrees of melanism. These animals can be found at elevation of more than 2000m (Sunquist & Sunquist, 2002).

The serval is listed as 'least concern' in the IUCN Red List in 2015 (Thiel, 2015). Of the 14 subspecies, 13 of them are listed in CITES Appendix II, meaning the species could become threatened in the near future if no protection programme is enforced (cites.org, 2017). In the wild, their population has been declining steadily, with major threats being hunting and habitat loss (Nowak, 2005). Currently, efforts to conserve the servals revolve around habitat conservation and hunting prohibitions particularly in African countries (Thiel, 2015).

Previous studies tend to revolve around wild servals, looking into landscape use (Ramesh *et al.,* 2015) and also activity levels in response to certain environments (Ramesh & Downs, 2013). However, no previous investigation has been made into the behavior of servals in a zoological park. As solitary animals, servals tend to only interact during mating, nursing and fighting for territory. During a 4-year study in open grassland and marsh by Geertsema, 1984, 7.8% of observations was social interactions which are mostly due to parental care. The adolescent serval claimed ranges by marking behaviour and the adult females and males can be found to occupy the same individual home ranges for several years (Geertsema, 1984).

There are many research which study the effects of presence of visitors towards animal behavior and activities. However, majority of the research are carried out on apes and non-human primate. In papers such as reported by Birke in 2002 shows that there is an effect observed on certain behaviors of the orangutans due to the presence of the visitors. However, there was no paper investigating the effect of visitors on serval cats.

Although there have been numerous studies carried out on serval, published journals on the behaviour of the captive serval are still lacking. With the increasing demand for Serval in Malaysia through pet trade, and a possible lack of good genetic exchange between populations in zoos, ex situ conservation of the species is crucial. Considering the serval is not a local species of Malaysia, it is imperative to monitor and improve their environment in zoological parks in order to allow them to have the highest level of expression of their natural behaviours. This study will provide insight into the behavior of serval in captivity, with respect to the presence of visitors in Malaysia, and may provide baseline data for further studies such as the evaluation of welfare of serval in institutions especially in the local context.

2.0 OBJECTIVE

This study is carried out to identify any effect of presence of human visitors on the activities and behaviour of the captive serval. The aim of this study is to collect the baseline data for the welfare of *Leptailurus serval* in captivity by using the presence of human visitors. Specifically, this study is conducted (1) to observe the behaviour of serval cats in captivity, (2) to study the effect of visitors' count towards general behaviour of captive servals, (3) to study the effect of visitors' count towards spatial use of the captive servals.

3.0 LITERATURE REVIEW

3.1 Effect of Human Visitors on Mammals

Most of the studies studying the effect of presence of human visitors in captive animals' behaviour are simulated in mammals. As an example, in a study conducted by Birke in the presence of noisier zoo visitors, the infant orangutans aproached and held onto the adults more. Similar finding was observed in the presence of a larger visitors group. Plus, the adults used available paper sacks to cover their head (Birke, 2002). In addition to the orang-utans, study on two captive jaguars were also done. A study by Sellinger and Ha revealed that the male jaguar exhibited an increased aggression with the increase in visitors' density and intensity. Meanwhile, the female jaguar's pacing were more affected by the visitors' intensity. They concluded that both visitors' density and intensity had a significant effect on the jaguars, with intensity having a stronger effect on the jaguars (Sellinger & Ha, 2005).

3.2 Distribution and Habitat

The serval can be found widely through sub-Saharan Africa from Senegal in the west to Somalia in the east and to Republic of South Africa in the south, except in tropical rainforest and the Saharan dessert (Sunquist & Sunquist, 2002). As they have a specific habitat requirement, they are locally restricted to smaller areas within Africa continent, populating near water source area (Nowell & Jackson, 1996). As reported by Smithers, 1983, cited by Sunquist & Sunquist in 2002, nowadays, their population has dwindled significantly in the northern Africa such as in Morocco, Algeria and Tunisia in which the last sighting was reported over more than 30 years ago. Kowalski

and Rzebik –Kowalska in 1991 believe serval to be extinct in Algeria as the last specimen retrieved was in 1880 (Sunquist & Sunquist, 2002).

Servals can be found in grassland areas which provide them tall grasses as sufficient covers. They can also be found in area with many prey. Even though servals can be found in a wide geographical region of Africa, they cannot be found in the dessert, or in the tropical part of Africa. This is so because they can only be located in near water source (Sunquist & Sunquist, 2002)

3.2 Normal Behaviour in the Wild

3.2.1. Hunting

Their heights contributed by the long metatarsal bones, coupled with large ear pinna and ear bullae reflect their profound hearing ability in hunting for prey in marshy vegetation. These features aid in scanning their prey which consists of small mammals and birds (Sunquist & Sunquist 2002).

3.2.2. Feeding

These animals are a specialised small mammal catcher. Servals are built for heights rather than for speed to enable them to locate rodents underground or in between the tall grasses (Sunquist & Sunquist, 2002). Their diet consist of 98% small mammals (Rodentia and Insectivora) from the fecal analysis carried out by Bowland and Perrin in 1992. Occasionally, grasses and fruits were observed in the fecal sample which can be consumed to aid in digestion or as emetics. The grasses comprised only of 0.67% of the total fecal mass (Bowland & Perrin, 1992).

3.2.3. Social

Similar to many cats, servals also lead a solitary life. Nonetheless, it is not uncommon to find pairs of mother and kitten or mating pairs together in the wild.

Considering they are solitary, their only way of communicating in the wild is through scent marking (Skinner & Chimimba, 2005). The males scent mark the most while the females scent mark about only half of that compared to the males. The juveniles scent mark the least (Sunquist & Sunquist, 2002).

3.2.4. Reproduction

Oestrus lasts for about one to four days (Mellen, 1993, cited by Sunquist & Sunquist, 2002), and the gestation period is a little longer than the domestic cats, which is about 74 days. Commonly, servals give birth to 2 kittens per litter. As a polyoestrus animals, they do not have a specific season for breeding. Generally however, the peak season for breeding is when there is many prey available to feed on (Kingdon, 1977 cited by Sunquist & Sunquist, 2002).

3.3 Behaviour in Captivity

3.3.1. Hunting

Servals in captivity has been demonstrated to cache bigger prey to be eaten for later. They can also be seen to play with their food before eating it, with younger animals play more frequently and for longer duration with their meals (Geertsema, 1981, cited by Sunquist & Sunquist, 2002).

3.3.2. Reproduction

Serval cats breed readily in captivity. In fact, most of servals available in the zoo are captive-bred. According to WAZA, there are about 391 servals being listed in the Species360, formerly known as ISIS: International Species Information System (WAZA, 2017). Species360 maintains an online database of wild animals in captivity within zoological associations. According to Eaton, cited by Sunquist & Sunquist, 2002, sexual maturity is attained by captive servals when they are about over one year

old. Kingdon as cited by Sunquist & Sunquist, 2002 described the first signs of oestrus are characterised by vocalisation and scent-marking.

3.4 Threats

The primary threat for servals is habitat degradation, which is due to the loss of wetlands. Geertsema, 1985 stated that the key to serval conservation is the wetland conservation (Thiel, 2015). Other than that, sport hunting in South Africa also contributed to a reduction in the population of servals. Moreover, due to their beautiful coat pattern, they are also poached. Furthermore, they are also frequently executed for being mistaken to kill livestock. Yet, it is very rare for servals to kill prey weighing more than 4 kg. (Thiel, 2015).

4.0 MATERIALS AND METHOD

4.1 Subjects

Two servals available at Zoo Negara was selected to be the subjects of the study. The two servals are both female and their relationship is that of the queen and

her female kitten. The queen is about 5 years old while the young female serval is about 1 year old. They both are placed within the same enclosure.

4.2 Location and Time

The study was carried out at Zoo Negara, Jalan Ulu Kelang, Selangor, Malaysia. The area involved was the serval exhibition area, located in the Savannah exhibition area. The study was conducted for four days, which was from 1st January to 4th January 2017. The observation was performed during visiting hours of the zoo to study the effect of human visitors count towards the behaviour of the servals. The period of observation was split into two session of 3-hour duration, which was carried out from 9.00 a.m. to 12.00 p.m. and from 1.00 p.m. to 4.00 p.m.

4.3 Behavioural Observation

A series of instantaneous sampling was done within each one-minute time slot for 6 hours by means of visual observation. An ethogram adapted from previous studies of cat family, which is captive tigers were used in the study. The ethogram consists of the behavioural budget and explanation of the tiger, as shown in the Table 1. The behavioural budget was divided into 15 types of behaviours; (1) alert, (2) aggression, (3) clawing, (4) scent marking, (5) playing, (6) smelling, (7) stalking, (8) climbing, (9) walking, (10) grooming, (11) resting awake, (12) rolling over, (13) sleeping, (14) yawning and (15) being out of sight. Not only that, the enclosure of the servals were also divided into four different areas namely; (1) area A for resting, (2) area B which is an open space, (3) area C, a wall of rocks for the servals to hide in, and (4) area D which serves as a feeding as well as a hiding place as the area is secluded from the visitors point of view. This is illustrated in Figure 1. Furthermore,

while an observer took note of the behavioural activity of the servals as well as the spatial use, another observer recorded the visitors' count on the exhibition area.

Behaviour Category	Behaviour	Description
Active	Alert	Standing or lying, open eyes focused on object, conspecies, or human
	Aggression	Threat display or warning motions directed toward visitors
	Clawing	Sharpening nails of paw in trees or wooden log
	Scent marking	Spraying fluid from urinary tract on vegetation, or other structures
	Playing	Nonaggressive interaction with other servals and not grooming
	Smelling	Moving head toward object and sniffing
	Stalking	Slow walking movement, with all legs slightly bent, eyes focused on specific item
	Climb	Climbing tree either alone, or with other servals
	Walking	Ambulatory movement in a specific direction with an apparent goal, a symmetrical gait in which each foot is on the ground more than half the time
Inactive	Grooming	Licking body parts with tongue
	Resting awake	A general inclusive term for lying in a relaxed manner with eye open or partially open

	Roll over	Animal rotates its body on the longitudinal axis coming to rest on the dorsal surface
	Sleeping	immobile: resting with eye closed
	Yawning	A wide gap with deep inhalation. The eyes may be slits or closed and tongue protruded out
	Out of sight	The animal cannot be observed in the observer's eyes
Adapted from Mason 1993, McPhee 2002, Schaller 1967, Taylor 1989, cited by Mohapatra, Panda, Acharya		

Table 1: Behavioural description of the servals from the adapted ethogram

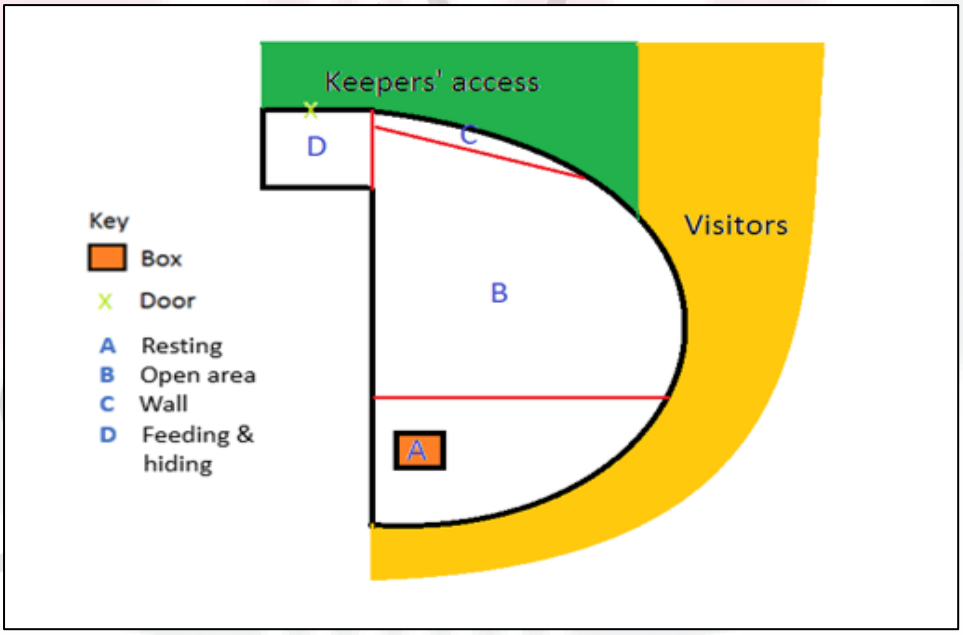

Diagram 1: Serval exhibition area

4.4 Statistical analysis

Statistical analysis using Excel and SPSS were done. A normality test was carried out and non-parametric tests were chosen. Specifically, Mann-Whitney U test

and Spearman's correlation were selected as the non-parametric tests. All types of behaviours displayed by the servals were recorded and analysed. Mann-Whitney U test was used; (1) to see whether there is any difference between the activities of the adult female serval and the young female serval, and (2) to know whether there is any difference between the spatial use of the adult female serval and that of the young female serval. In the meantime, Spearmann's correlation was used; (1) to identify if there is any correlation between the visitors' count and the behaviour of the servals and, (2) to study whether there is any correlation between the visitors' count and the spatial use of the servals.

5.0 RESULT

5.1 Effect on visitors' count on behavioural activity of servals

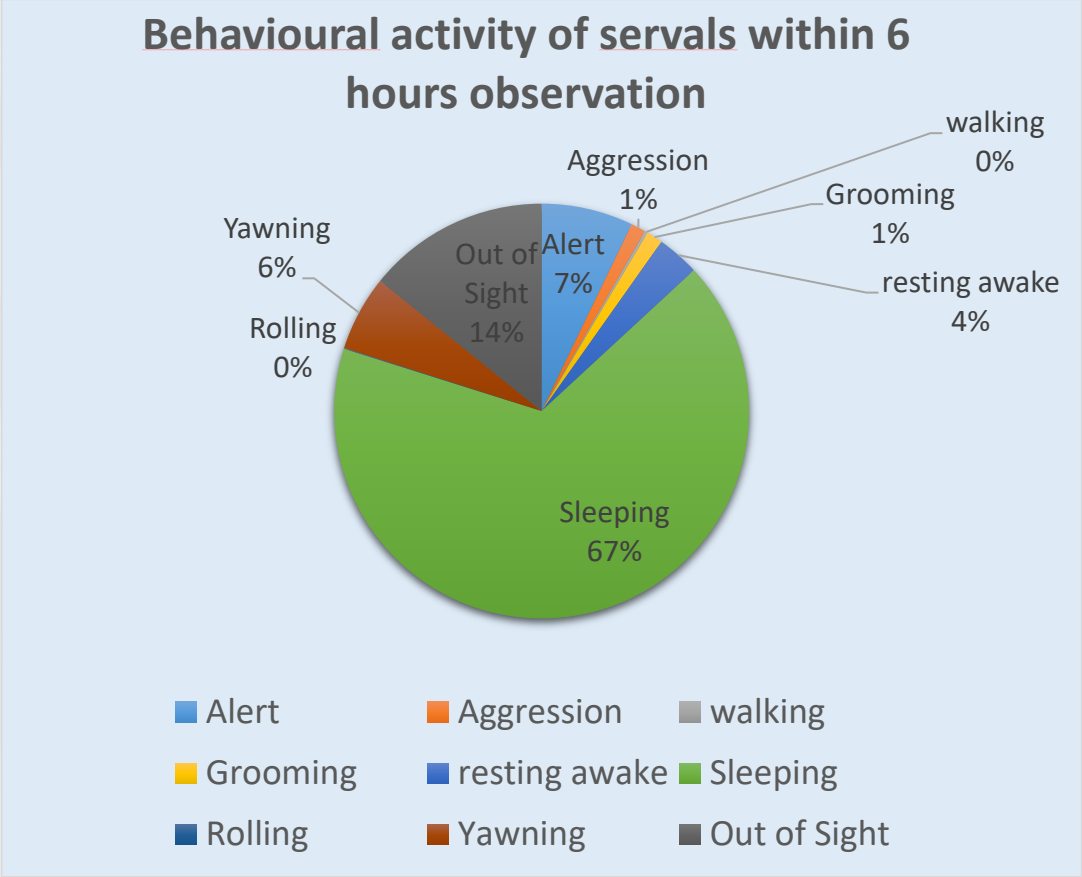

Diagram 2: Behavioural activity of servals within 6 hours observation over four days

In this study, both female servals generally spent most of their day sleeping. This is then followed by being out of sight, alert, yawning, resting awake, grooming, aggression, walking, and rolling. It is assumed that when the animals were being out of sight, they were considered as hiding.

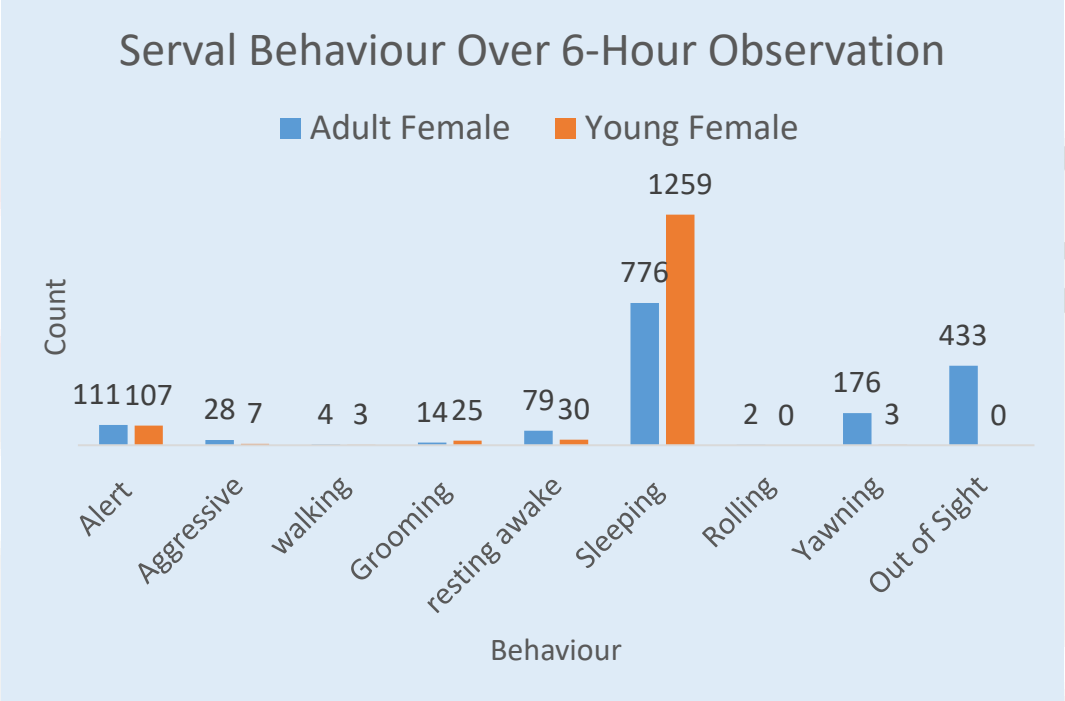

Diagram 3: Serval Behaviour Over 6-Hour Observation over four days

The above diagram reveals that both female servals spent most of their time in the day sleeping. However, the young female participated more in sleeping compared to the adult female. Other than that, the adult female was out of sight quite frequently, while the young serval can be observed throughout the 6-hour observation over four days. Next, both servals were alert at approximately similar frequency. Following that, the adult female can also be seen yawning more often than the young serval. As for resting awake, the young female rested awake approximately half as frequently as the adult female. Subsequently, both servals spent their time in grooming, with the young serval spending more time for grooming than the adult female. As for being aggressive, the adult female seemed to show a lot more aggression towards visitors compared to her kitten. Then, both animals spent minimal time on walking, which was explained by having more time spent on sleeping on the day. Finally, only the adult

female can be seen rolling, while no rolling was observed by the young serval. However, rolling was the least activity the adult serval engaged in.

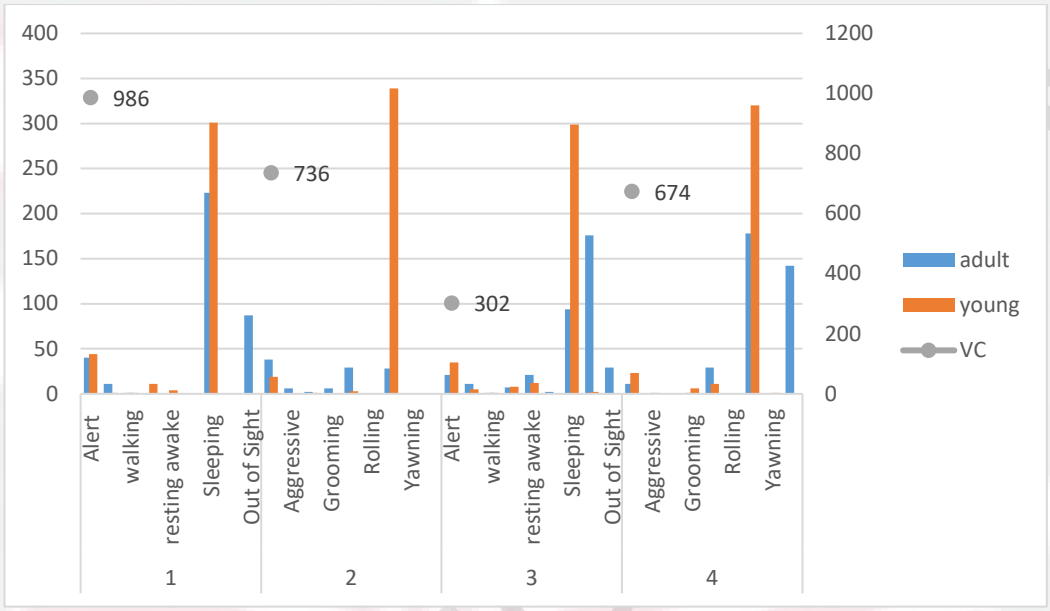

Diagram 4: individual serval's behaviour and the visitors count (VC) over four days

From the diagram above, a pattern can be visualised in which the top peaks are the sleeping behaviour, while the rest are groups of shorter peaks which consist of different minority behaviours. Generally, both servals spent most of their time sleeping on the day, regardless of the visitors' vount. On the first day which had 986 visitors, the servals can be seen to sleep most of the time. As compared to the third day, which had the least visitors, the servals still spent a lot of time sleeping. However, for the adult serval, the pattern is varied. Even though she still spent most of the time sleeping, she was out of sight for a significant amount of time too.

As for the statistical analysis, there was no difference between the activities of the adult female and the young female (U: 2392.5, p: 0.394). In addition, there was a weak, negative correlation between the visitors' count and the behaviour of the servals.

The result is as follows; alertness (r_s= -0.385, p=0.141), walking (r_s= -0.375, p=0.153), grooming (r_s= -0.114, p=0.675), resting awake (r_s= -0.033, p=0.903), rolling (r_s= -0.394, p=0.131), and yawning (r_s= -0.249, p=0.352). On the contrary, sleeping (r_s= 0.083, p=0.760) and being out of sight (r_s= 0.062, p=0.819) had a weak positive correlation to the visitors count. However, only aggression had a strong, negative correlation to the visitors count, which was statistically significant (r_s= -0.665, p=0.05).

5.2 Effect on visitors' count on spatial use of the enclosure by the servals

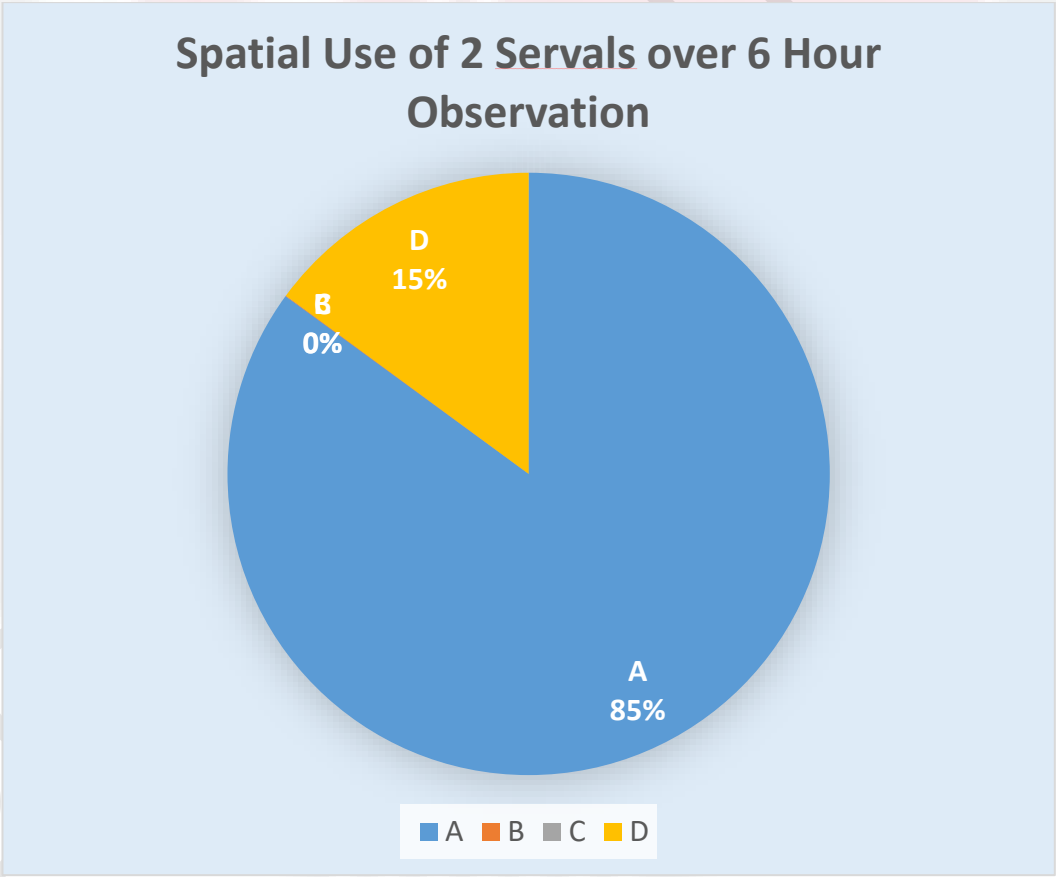

Diagram 5: Spatial Use of 2 Servals over 6 Hour Observation over 4 days

According to the diagram illustrated above, both servals generally spent most time in area A. Next, area D was visited by the adult female as few as only 15% of the

time. This is mainly contributed by the adult female as the young female only stayed at area A throughout our observation over the four-day study. Conversely, neither of the servals visited area C.

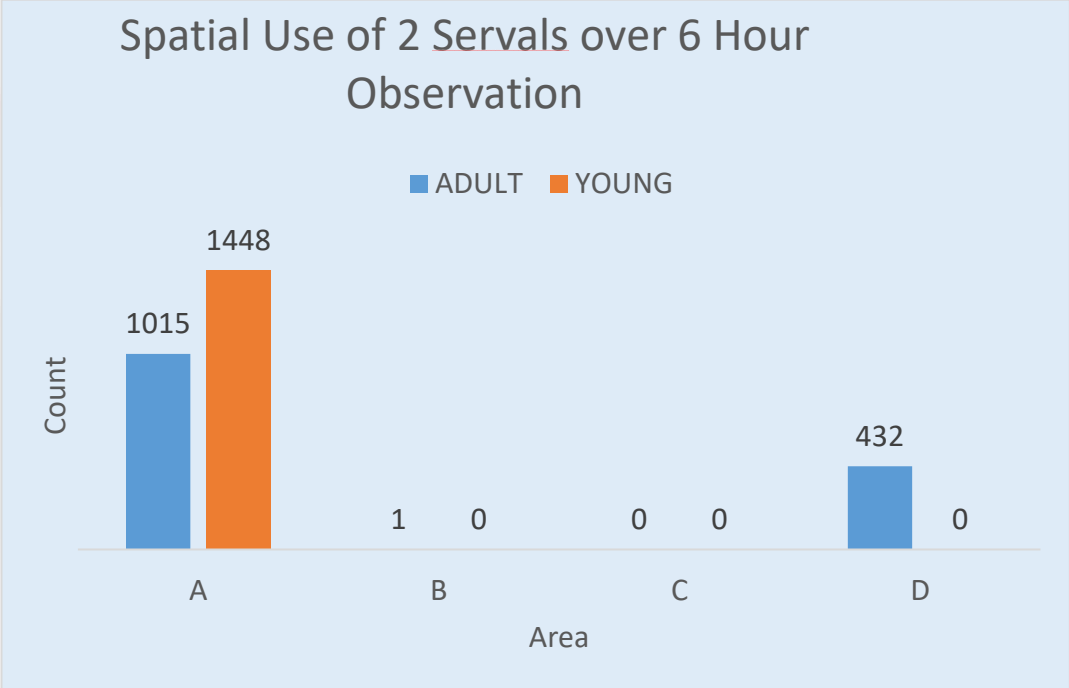

Diagram 6: Individual Spatial Use of 2 Servals over 6 Hour Observation

During the course of four days study, it was found that the young female serval spent her time in area A for resting. As for the adult female, she spent her time the most in area A, followed by area D which is a room for feeding and hiding, and area B which is an open area. None of the servals frequent area C, which is a wall of rock serving as a hiding place.

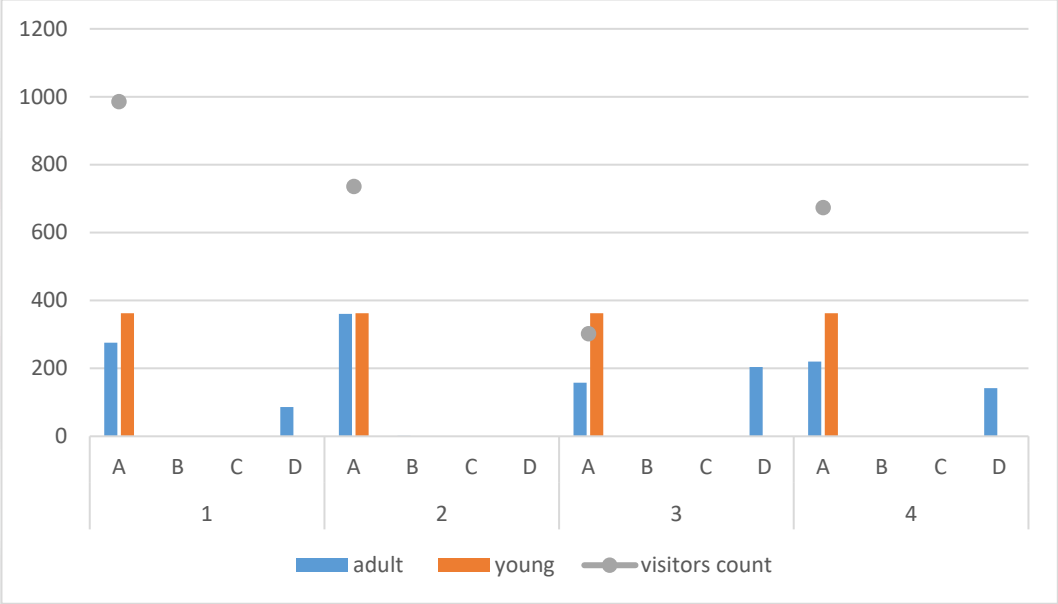

Diagram 7: individual serval's spatial use and the visitors count over four days

From the diagram above, it can be seen that regardless of the visitors' count, the servals still spent most of the time in area A. for the adult serval, she also spent some time in area D every day, except on the second day.

As for the statistical analysis, there was no difference between the spatial use of the adult female and the young female (U: 112, p: 0.488). Non-parametric correlation revealed that there was a weak positive correlation but they were not statistically significant between spatial use of area and the visitors count. The result was: area A (r_s= 0.208, p=0.621), and area B (r_s= 0.169, p=0.689). In contrast, area D (r_s= -0.280, p=0.503) had a weak negative correlation. Area C was not used by both servals.

6.0 DISCUSSION

6.1 Aggression

With regards to aggression, as the number of visitors increases, the aggression behaviour observed was reduced. This could be explained by the flight response of the cats. Fraser in 2012 identified that a cat's usual reflex is negative to a sudden loud sound. This is done to avoid threatening situations. Many cats would still react the same way even if they have been exposed to the sudden loud noise periodically.

6.2 Other behaviours

Other behaviours such as rolling, walking, alertness, resting awake, grooming and yawning had a weak negative correlation to that of the visitors' count. This means that as the visitors' count increases, the behaviour specified decreases in frequency. The findings could be attributed to the fact that both servals spent majority of their time in sleeping and being out of sight during the visiting hours. However, these results were not statistically significant.

Behaviours such as sleeping and being out of sight had a weak positive correlation to that of visitors' count. This means that as the visitors' count increases, bouts of behaviour specified also increases. The findings may also be suggestive of the flight response of the servals. However, the correlation findings were also not statistically significant. The reason why the results were not statistically significant could be attributed to the fact that the parameters were not normally distributed. Other than that, low number of subjects employed in the study (only two servals) could contribute to the statistically insignificant result.

6.3 Resting and sleeping

The result from this study conforms to the nature of the cat, in which they are nocturnal and crepuscular. Sleeping is a principle feature in a cat's manner of living. As area A has a box in a raised platform (refer to Figure 1) for the cats to rest in, the servals can be seen to spent majority of their time here during the day. This shows that the servals are much like our domestic cats which like to rest or sleep in a close containment and in an elevated hideout. Cats are tree-climbing mammals who equate safety and elevated area, and they like to feel safe before dozing off (Tabor, 2003). Domestic cats on average, spend 18-20 hours per day to sleep. However, this period include resting, light sleeping and deep sleeping since it is very difficult to determine in which sleep phase the cats are having by visual observation (Fraser, 2012). So this could also be demonstrated in these serval cats. A cat in a light sleep period can be woken up easily as compared to the period of a deep sleep. In total, a cat spends approximately 30% of its sleep in deep sleep mode (Tabor, 2003).

Figure 1: An elevated box for the servals to rest in area A

6.4 Feeding

As for feeding, the wild serval usually feed at night. However, the adult female usually went out to area D at 9 – 10 am & 1-3pm because the food was given by the caretaker around 8 am. The young female though, was not observed to be moving into area D as it was always in area A. As these servals are in captivity, they do not have a privilege to hunt and depend on the food given. Fraser, 2012 stated that many wild cats are nocturnal and crepuscular in nature, and that they have two peaks of eating period (morning and evening). In the wild, animals depend on the availability of food, and hence they do not have a set time for meals (Bell, 2010).

6.5 Hiding

As for hiding, Fraser once again states that it is in the nature of all wild cats to hide. Without it, welfare is compromised. In this study, area D also serves as a room for the cats to hide in as the room is secluded from the visitors' view. There is also a

possibility that the servals rested in area D considering that their actual behaviour could not be observed here.

7.0 CONCLUSION

In conclusion, there was no effect of visitors' count on the behaviour and activity of the servals. There was no visitors' effect on their activity and on their spatial use. The 2 servals were mostly inactive during the day. From the study, sleeping and being out of sight are the highest activity they engaged in.

The findings of this study may be used as a baseline data that would help future researchers to further determine the effect of visitors on the behaviour of servals in captivity.

8.0 RECOMMENDATION

For future study, it is recommended to do a baseline data to identify the behaviour of the servals in captivity during the day without the presence of visitors. This data can then be used to compare with the data obtained from the servals' behaviour when there is presence of human visitors.

Moreover, longer hour of observation should be incorporated in this study. In this case, the study was carried out over four days, which was too short of a time. Longer period of study can deliver a more accurate result.

Furthermore, larger sample size can be used in the study. Multiple zoo institutions which have servals exhibit can also be incorporated into the study to get a more accurate result.

Additionally, the application of camera trapping can be beneficial to the study. The current study was conducted purely via visual observation. The utilisation of camera traps can eliminate the effect of observer.

Moreover, as the servals have sharp hearing, the effect of noise level elicited by the visitors can also be studied. The noise level can be grouped into quiet, and loud to see the effect on the servals.

Lastly, the group effect of visitors on the servals behaviour can also be experimented. The visitors can be grouped into a larger group consisting of more than 5 people, and smaller group consisting of less than 5 people.

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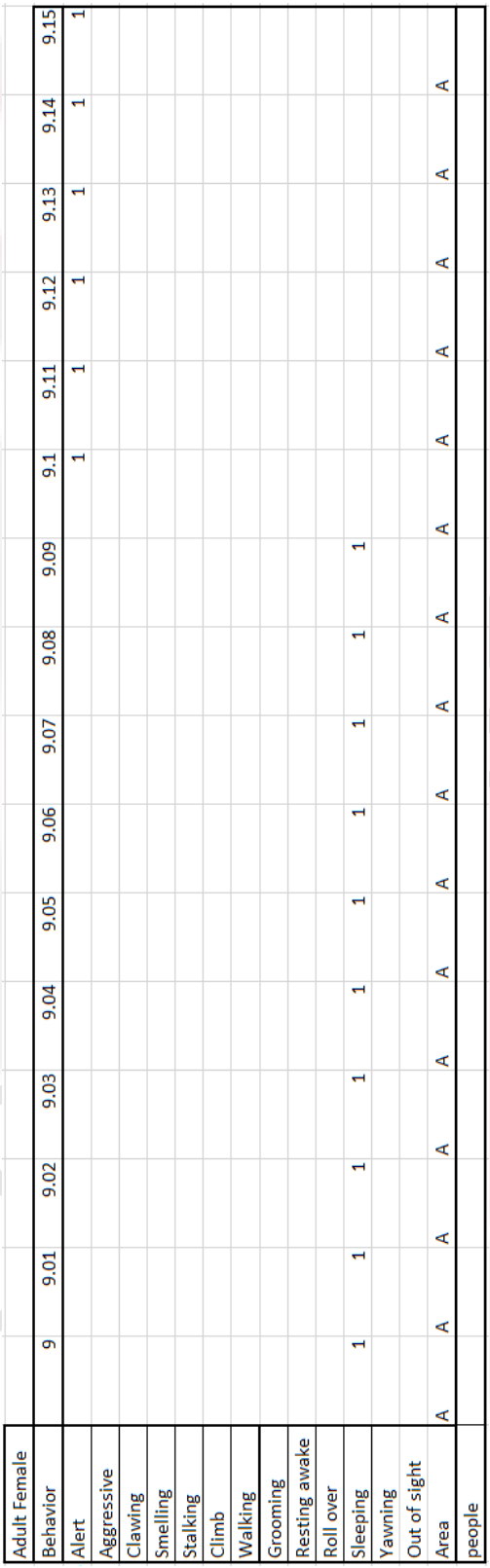
APPENDICES



Adult Female																
Behavior	9	9.01	9.02	9.03	9.04	9.05	9.06	9.07	9.08	9.09	9.1	9.11	9.12	9.13	9.14	9.15
Alert											1	1	1	1	1	1
Aggressive																
Clawing																
Smelling																
Stalking																
Climb																
Walking																
Grooming																
Resting awake																
Roll over																
Sleeping	1	1	1	1	1	1	1	1	1	1						
Yawning																
Out of sight																
Area	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
people																

Young female																
Behavior	9	9.01	9.02	9.03	9.04	9.05	9.06	9.07	9.08	9.09	9.1	9.11	9.12	9.13	9.14	9.15
Alert											1	1	1	1	1	1
Aggressive																
Clawing																
Smelling																
Stalking																
Climb																
Walking																
Grooming																
Resting awake																
Roll over																
Sleeping	1	1	1	1	1	1	1	1	1	1						
Yawning																
Out of sight																
area	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
people																