Behavioral Effects of Environmental Changes on a Meerkat clan located at The Riverview Park and Zoo

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Abstract

The replication of a natural environment including space, proper enrichment and climate are all key parameters required by zoos to meet for the enclosure of any animal. These animals can have varied responses to being kept in inadequate enclosures, ranging from pacing behavior to self-mutilation and infanticide. In this study a small clan of 4 slender tailed meerkats housed at the Riverview Park and Zoo were studied to determine the behavioral changes the clan might display after being moved to a smaller indoor winter enclosure. The clan consisted of 2 females and 2 males; one of the females was also pregnant and separated from the group. Four main behavioral events were monitored in both the indoor and outdoor exhibits, Bipedal Vigilance, Foraging, Social behavior and pacing. It was found that the meerkats once moved to the indoor enclosure, the clan preformed less bipedal vigilant events. The clan also ceased preforming any social activities such as grooming and playing. The clan also began to pace the perimeters of the exhibit, a classic display of stress in many mammals.

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1) Introduction

Zoos are extremely popular all around the world due to the fact that they feature exotic and native species that visitors can interact with and study up close. These zoos have many crucial responsibilities to both the animals under their care and to the visitors viewing them. One of the most important responsibilities a zoo can have is taking part in breeding programs of critically endangered species in order to preserve global biodiversity (Silber et al, 2013). Another responsibility of these establishments is to educate the public on conservation issues occurring all around the world and let visitors interact with captive animals in such a way that they themselves become aware and passionate about these issues (Powell and Bullock, 2015). Caring for these exotic and domestic animals creates many challenges to zookeeper staff and enclosure design staff alike. In order to provide adequate care to the animals in the zoos collection, the zoo must be able to provide these animals with an enclosure that adequately recreates their natural habitat. If these parameters are not met the resulting behavioral changes can range from repetition such as pacing and unnatural body language to more extreme cases resulting in self-mutilation, aggressiveness and infanticide (Breton and Barrot, 2014).

The Riverview Park and Zoo, located in Peterborough, Ontario, Canada is home to over 50 species of domestic and exotic animals and is also home to Canada's only successful Sulawesi forest turtle (*Leucocephalon yuwonoi*) captive breeding program. One of the many species kept at this zoo is the slender tailed meerkat (*Suricata suricatta*). This species of mongoose live in very close knit social

Groups called clans, they display a number of social interactions including grooming and a very strict social hierarchy including a dominant male and female who control all of the mating opportunities within the clan (Reber et al, 2013). This unique species also have the ability to create a vast number of calls and vocalizations to alert the group of predator threats, often coupled with the act of bipedal vigilance, one of the most recognizable actions preformed by meerkats in order for a sentinel to survey the surrounding area for predators, calls have even been linked to the mitigation of social situations between group members (Townsend et al, 2014).

Due to slender tailed meerkats occupying a very warm climate in the wild they cannot be kept in outdoor exhibits year round in Canada and need to be moved to a strictly indoor climate controlled exhibit in during the harsh winter. This study will be assessing the behavioral characteristics such as bipedal vigilance, foraging, social behavior and pacing in the clan of four meerkats located in the Riverview Park and Zoo. The purpose of this will be to observe behavioral changes, if any that the meerkat clan will express when moved from a larger outdoor exhibit into a smaller indoor exhibit for the winter. This is a very large environmental change for the clan of meerkats and may cause an increase or a decrease of events such as bipedal vigilance, forging behavior, social interaction and pacing events.

2) Materials and Methods

2.1) Subjects

This study received ethics approval for an observational study at the Riverview Parks and Zoo, with no interaction with the subjects or alteration of the enclosure in which the subjects reside, approval was granted by Steve Thexton (Supervisor) and Jim Moloney (Curator). Data was collected by observing the clan of four slender tailed meerkats when they had access to both the indoor (fig1) and outdoor enclosure (fig 2) and then when they only had access to their indoor enclosure (fig1). The clan consists of 2 female and 2 male slender tailed meerkats.

Figure 1: Indoor Enclosure for Slender tailed Meerkats at the Riverview Park and Zoo

Figure 2: Outdoor Enclosure for Slender tailed meerkats at the Riverview Park and Zoo

2.2) Procedure

The observations began on September 27th 2015, on the outdoor enclosure. This enclosure is very large consisting of a sandy sub straight with many drainage tubes buried in the ground, leading to several nest boxes, this allows for the clan to build their own tunnels and use man made ones. The outdoor enclosure also includes several large rocks and other debris (fig 2), the Meerkats have access to the indoor enclosure during the summer months but seem to only go inside when the zookeepers provide them with food inside. The Meerkats were then moved into the indoor enclosure on October 19th 2015 in preparation for the colder winter months. This enclosure is much smaller then the outdoor enclosure (approximately ¼ the size), it is made up of a few centimeters of stony substrate with plywood underneath to prevent burrowing. It is filled with many nest boxes and rock debris as well as pipes and places to climb in an effort to make up for the lack of size (fig 1). During the process of moving the four meerkats it was also discovered that one of the female meerkats was pregnant, and due to litters being rejected in the past, the staff decided to section off this meerkat from the other three individuals. This was done with the use of a clear Plexiglas wall. The meerkats were observed for a total of 8 hours, in each type of enclosure. When this study was proposed, the introduction of two new females was also to be observed to view how the clan would react. The zoo has since made plans to divide the clan into two separate smaller clans at a later date therefor the introduction could not be observed.

2.3) Events

Four main types of events were recorded for this study, firstly the act of bipedal vigilance (individual standing on two hind legs for an extended period of time, >10sec), foraging (the act of digging with two front feet), social behavior (any act that involves playing, grooming or group sunning) and finally pacing (the act of a predicted and repetitive travel path, usually at the perimeter of enclosures. Bipedal vigilance was chosen as a key characteristic to monitor in this study due to the fact that it has been shown when preformed frequently, to be an indicator of clan health and overall communicative cohesion (Santema et al, 2013). Foraging was also selected as it was shown to be characteristic of a healthy clan when preformed frequently (Santema et al, 2013). As described in the work of Townsend et al, it is clear that Meerkats exist in very complex social structures and therefor it was found necessary to record the number of social interactions occurring between clan members. Finally the act of pacing has been shown to be an indicator of stress and is also linked to enclosure size deficiency, and therefore was also recorded (Moberg and Mench 2000).

2.4) Data Analysis

After the observations were completed the total number of event occurrences were totaled for each event. The total time each event occurred was then also totaled up and the average was taken. The data was then analyzed using a student T-test at a 0.5 significance level so the significance could also be reported.

3) Results

3.1) Event Count

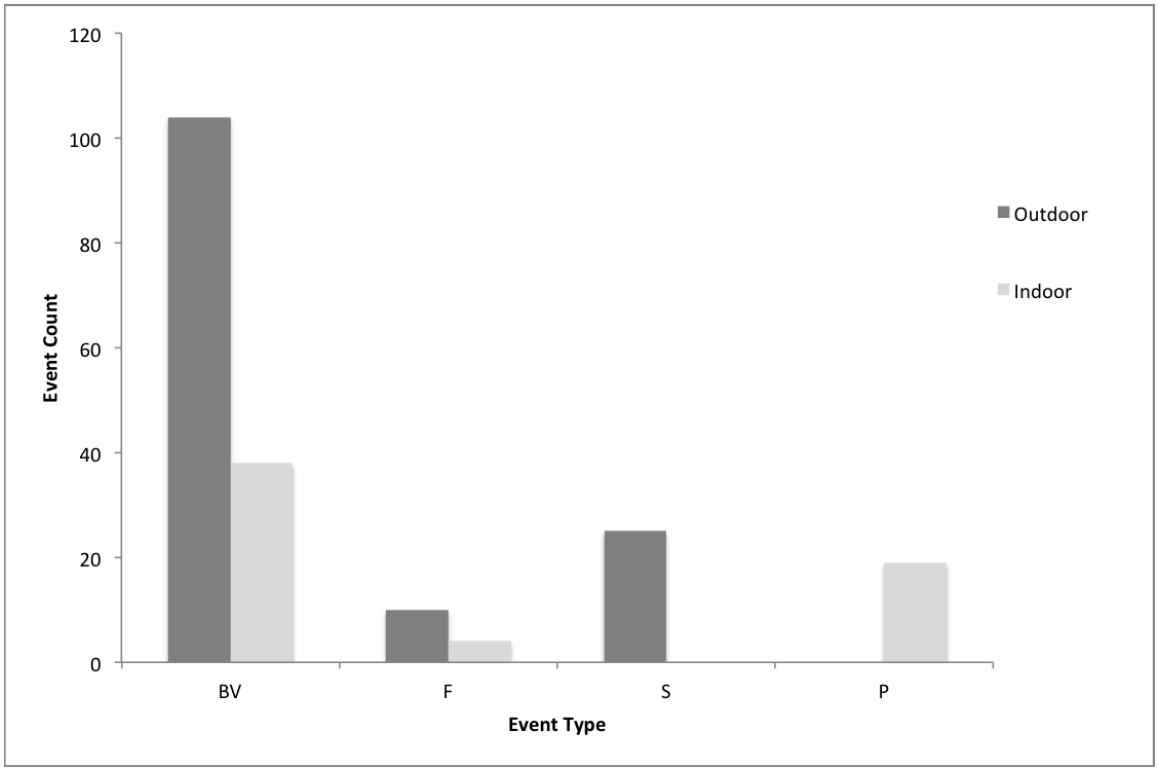

Figure 3: Total counts of each event, Bipedal Vigilance (BV), Foraging (F), Social behavior (S) and Pacing activity (P).

Based on Figure 3 we can clearly see the number of times each event occurred in both the outdoor (dark grey) and indoor (light grey) exhibits. Across all the event types observed, the act of bipedal vigilance was clearly preformed the most both in the outdoors and indoor exhibits. It was preformed in the outdoor exhibit a great deal more then in the indoor exhibit with 104 counts in the outdoor and only 38 counts in the indoor exhibit. It was also found that the clan preformed foraging activities more often in the outdoor exhibit with 10 counts, than the indoor exhibit with only 4 counts. The next parameter, social events was found to be

completely one sided by only being preformed in the outdoor exhibit, 25 times and 0 times in the indoor exhibit. Pacing activities were found to be exclusive to the indoor exhibit and were preformed on 19 occasions.

3.2) Event time

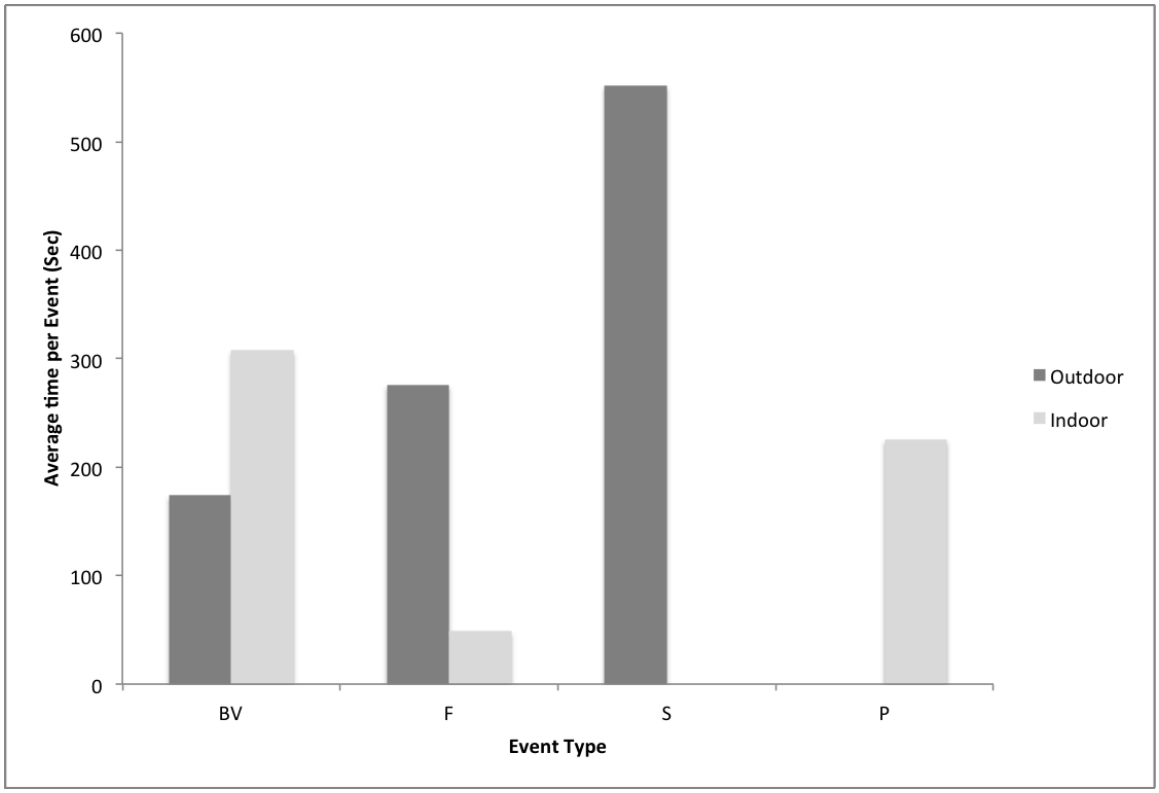

Figure 4: The average time each meerkat preformed each type of event, in seconds. Bipedal vigilance (BV), Foraging (F), Social (S), and Pacing activities (P).

Out of all the events observed it is clear based on Figure 4 that the clan spent the most time preforming social events with an average of 552 sec per event. It is also notable that the clan did not preform social events in the indoor exhibit. Bipedal vigilance was preformed more in the outdoor exhibit (figure 3) but based on figure 4 one can see that although there were less events of BV recorded indoors, they were on average preformed for a longer duration of time, 307 seconds on average

indoors and only 174 seconds outdoors. Foraging events were both more frequent (figure 3) and on average preformed for longer per event (figure 4) in the outdoor exhibit (276 sec), then the indoor exhibit with only 48 seconds on average per event. Pacing events were also found to have a duration of 225 seconds on average in the indoor enclosure.

3.3) Student T- test

	Outdoor	Indoor	P	T-Value
BV Events	104	38		
Av Time(s)	174	307.8	0.27977	1.946
Stdev	8.924	7.071		
Forage Ev	10	4		
Av Time(s)	276	48.6	0.000505	4.31243
Stdev	1.64	0.82		
Social Ev	25	0		
Av Time(s)	552	0	0.00082	4.732
Stdev	6.142	0		
Pacing Ev	0	19		
Av Time(s)	0	225.6	0.0001	6.003744
Stdev	0	3.76		

Table 1: All of the event types totaled with Standard Deviation (StDev) and the average time they were preformed per event. The resulting T-value and P value is also shown.

In table 1 the resulting T- value is shown from preforming a student T-test on the event data collected, this allowed for a P value to test for significance to be found. One can clearly see that for all sets of data the P value was found to be significant at a significance level of 0.5.

4) Discussion

Based on the results shown on Figures 3 and 4 it is clear that changes to the slender tailed meerkat clan's environment led to quantifiable behavioral changes.

The results have also shown that this environmental change has led to certain behaviors being shown exclusively in a particular enclosure. When observing the results in figure 3, the most prominent change in behavior observed in the clan was the absence of any social behavior when moved to the indoor enclosure accompanied by the presence of a large amount of pacing behavior.

In Meerkat clans and many other species of mammals, one of the most important social interaction is the act of grooming, this is for several reasons; the most important being hygienic, grooming removes ticks and other potential parasites (Kuttusake and Brock, 2009). The act of grooming is also very important to the clan as it increases social bonds between members, it has also been shown to trigger endorphin release in the individual being groomed; this in turn leads to lower aggression levels within the group (Kuttusake and Brock, 2009). Meerkats engage in cooperative breeding, in which a dominant pair monopolizes the breeding but still rely on the rest of the clan to help raise their young (Santema and Clutton-Brock, 2013). The lack of social interaction could therefor have an adverse effect on the young meerkats and prevent them from engaging in social learning with other members of the clan (Thorton and Clutton-Brock, 2011). Due to the pregnant female being physically separated from the clan we were able to get a glimpse to how a solitary lifestyle might have an effect on the individual. It was observed that out of all 19 pacing events, the pregnant female preformed 6 of those events; pacing was always preformed along the wall separating her from the rest of the clan. When she was not pacing she remained out of sight from the observer. In the work of Sharp and Clutton-Brock, it is clear that prolonged stress in breeding females can

cause lowered reproductive success and even heightened rates of reproductive senescence (2011). The sudden appearance of pacing behavior once the meerkats entered the indoor enclosure is indicative of zoo animals that are being subjected to enclosures that do not meet adequate size in order to replicate the individual's natural habitat (Bretton and Barrot, 2014).

There was also a large drop in the total amount of bipedal vigilance events when the meerkats were moved to the indoor enclosure, frequent and short vigilant events are shown to be indicative of socially strong and healthy clans in the wild (Santema and Clutton-Brock, 2013). Therefor the drop in BV events could be due to the change in environments causing social disruption in the clan. It was also found that the meerkat clan preformed over twice as many foraging activities in the outdoor enclosure then in the indoor enclosure, these events also lasted substantially longer outside then inside. In the wild meerkats forage for food for over 8 hours a day and although they are provided with food in the zoo environment, frequent foraging activities are indicative of an enriched and active animal (Santema and Clutton-Brock, 2012).

Due to the work of Sherwen et al, and observations from this study it was clear that meerkats are not effected by the presence of visitors; in some instances the meerkats were less then a meter away from a visitor and did not move or appear to be in distress (2014). Therefore the number and proximity of visitors was not taken into account when preforming this study.

Based on the above data it is clear that when the meerkat clan at the Riverview Park and Zoo were subjected to large environmental changes,

quantifiable behavioral alterations ensued. When the meerkats were moved to a smaller winter enclosure (fig 1) bipedal vigilance events decreased and lasted on average longer, social events ceased completely, foraging events and average time spent foraging decreased and pacing behavior began. More research should be done to determine the minimum space requirements of slender tailed meerkats in order to prevent behaviors such as pacing from occurring. The Riverview Park and Zoo has several renovation plans in effect to both expand the meerkat holdings and divide the clan into 2 smaller clans in order to better accommodate them with limited space. A follow up study should be done on these meerkats in order to determine their behavioral patterns in the new enclosures with the new smaller clans. This follow up study should also monitor negative behaviors within the clan such as pacing and reduced social activities.

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Raw Data Attached