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Assessing and managing animal welfare at Australian zoos: A case study of the Spotted Hyena (*Crocuta crocuta*) in Perth, WA

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Assessing and managing animal welfare at Australian zoos: A case study
of the Spotted Hyena (*Crocuta crocuta*) in Perth, WA



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ABSTRACT

Animal welfare at zoos has been a concern since the creation of such collections in the 1800s. There is conflict in what good animal welfare looks like, as well as how to properly measure it. Although achieving “natural” behaviors is often the target of captive animal management, the presence of such behaviors, often done in suboptimal conditions, might not be the best indication of animal welfare. Instead, increasing the animal’s ability to cope with the environment has become the focus of many institution’s plans to improve welfare. Behavioral observations are often used to measure these standards of living due to the non-invasive nature of method. The results of these observations can be used to compare animal well-being, which is crucial to zoos for both social and economic reasons.

An ethogram was used over two weeks at Perth Zoo in Western Australia to collect data on the behaviors of two male spotted hyenas. The aim was to develop a baseline of how the hyenas behaved, as well as how they interacted with each other. It was found that the hyenas exhibited the hierarchal nature of the species, with differences in the sleeping and monitoring patterns of the two animals. Some indications of stress such as disrupted sleep and pacing were noted, which possibly leaves room for management plans to reduce these behaviors. Interactions between the hyenas were mostly limited to chasing, which is an improvement from past incidents. These results also show that animal welfare at institutions such as zoos is often difficult to measure and requires constant revision of management plans, as the motivation behind a behavior can often be unclear.

Key Words: Animal Welfare, Spotted Hyena, Ethogram, Zoo, Animal Enrichment

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1. INTRODUCTION

1. 1 Animal Welfare in Zoos

Thousands of years ago, ancient civilizations in Mesopotamia, Egypt, and China began the practice of collecting animals for exhibition. The idea of these collections, initially called menageries, developed in to the current zoo concept, with the Clifton Zoo in Britain being the first to actually use the term “zoo” in 1847 (Hill & Broom 2000). What began as a hobby for the wealthy and royals has since become a favorite pastime of the general public. This practice of holding exotic animals for exhibition, however, also brought with it concerns about the welfare of the animals involved, as well as the ethics of running such an operation. Zoos in London were noted to have high levels of mortality in their early animal collections (Kisling 2000). Continuing concerns and conflicting research about improving the lives of animals in captivity has led to guidelines for the operation of zoos in the modern day.

There are many ideas of what good animal welfare actually looks like. In the past, animal management was focused on avoiding poor welfare, such as self-injurious behavior and disease (Melfi 2009). Once these needs were met, the goal became to positively enrich the lives of captive animals. Frequently, the goal would be to replicate wild conditions and have an animal behave as similarly as possible to its wild conspecifics (Melfi 2009). The “Gold Standard” of animal welfare was described as the “Five Freedoms” in 1994, which stated an animal should be free from 1) hunger and thirst, 2) discomfort, 3) pain and injury, 4) fear and distress, and be free to 5) express natural behavior (Webster 1994). In this case, “wild” behavior is defined as the “behavior expressed by an animal subject to environmental and evolutionary pressures with minimal intervention” (Veasey et al 1996). However, wild behaviors are often done in sub-

optimal conditions such as starvation and predation, and the expression of such behaviors could indicate stress or fear. As a result, using the exhibition of wild behaviors as the sole indicator of animal welfare fails to properly depict an animal's well-being (Dawkins 2004). It may be possible for zoos to minimize the damage that comes with undesirable "wild" behaviors, while still allowing for the exhibition of positive behaviors (Veasey et al. 1996). The thinking of animal welfare has thus turned to a focus on both the physical and mental wellbeing of the animal. A past study stated the modern definition of welfare being "the state of an animal as regards its attempts to cope with the environment" with coping defined as "having control of mental and body stability" (Hill & Broom 2009).

Even once a definition of welfare is reached, there is dispute over how to actually measure such a concept. In the past, chemical tests have been done to measure stress hormones and other biological factors of captive animals. Behavioral observations, however, are generally regarded as being the preferred study due to their noninvasive and generally nonintrusive nature (Watters & Wielbnowski 2009). An ethogram is a commonly used tool to collect behavioral data, where a set of standard behaviors are recorded as observed in an animal. Ethograms allow for comparison among different individuals, as well as different groups of the same species, and are thus a useful tool for monitoring welfare.

Since the development of zoos, it has become general consensus that the best possible welfare should be provided to all captive animals. The Zoo and Aquarium Association (ZAA), which oversees zoos in Australia, New Zealand, and the South Pacific, states that zoos "have responsibility to ensure a high standards of animal welfare of all animals in their care" (ZAA "AWPS"). For zoos, there are both economic and social factors that motivate maintaining high standards of animal care. Animals with diseases and injuries as the result of poor welfare require

veterinary care, which is costly to the zoo. Furthermore, animals in captivity generally live longer than their wild counterparts. As a result, any problems developed due to welfare issues must be managed over the animal's lifespan, further incurring a financial burden. If an exhibit is not suitable for an animal, they must either be provided with an additional exhibit or be transferred to another zoo, which is a difficult and costly process. In addition to economic factors, the success of zoos is reliant on guests enjoying their visits. Guests enjoy seeing animals that are happy and healthy, so the zoo's reputation and profit will suffer if the animals are not being properly managed.

*1. 2 The Use of *Crocota crocuta**

A species that can be seen in many zoos and demonstrates the conflict between managing animal welfare and allowing for natural behaviors is the Spotted Hyena (*Crocota crocuta*). Hyenas are highly social animals, living in clans of up to 90 animals. These clans are structured in a strict hierarchy, dominated by an alpha female. Hyena cubs are raised in a communal den where they are integrated into the dominance structure of the clan (Holekamp 2007). These dens are often dangerous for cubs, as reflected in a study which showed that when twin cubs are born, there is a high likelihood of the older cub killing the younger one (Maugh 1991). Furthermore, when cubs are born they are equally likely to attack any other cub. As they grow and observe the adults of the clan, they learn that they are only able to attack those of lower social ranking. Hyenas are aggressive by nature, with an animal's ranking being the result of how many fights they win. Conflicts often happen when an animal's ranking is threatened or when hyenas intrude on another clan's territory. A study showed that a vast majority of conflict occurs between unrelated opponents, as kin are more tolerant of opposition and require reconciliation less often

(Holekamp et al 2007). Furthermore, hyenas are very observant of the body posture and vocalizations of others of their species, often using this as a basis for either interaction or avoidance (Holekamp et al 2007). It is routine both in the wild and in captivity for subordinate animals to have bite marks and scars as a result of their ranking (Dulaney & Shoemaker 1997).

Due to the social nature of *Crocuta crocuta*, it can be difficult to manage those living in captivity. In captivity, a subordinate animal is not able to separate geographically from the dominant one, which could potentially stress the animal. In the wild, the clan often has a large territory and animals of different rankings can distance themselves from each other, minimizing conflict. Fights for dominance or displays of dominance can be perceived by the public as poor caretaking, regardless of the fact that these interactions are an innate part of hyena behavior. This leads to zoos having the challenge of minimizing stress for the animals and guests, while at the same time allowing for these natural behaviors to occur.

At Perth Zoo in Western Australia, two male spotted hyena live in the same exhibit where one exhibits dominance over the other. The aim of this study is to use an ethogram in order to develop a baseline of how the pair of hyenas behave and interact. This information can be used to determine if there are noticeable differences in the behaviors of the two hyenas, and if these differences have any implications for the overall welfare of the animals. If major behavioral differences are noted, this study will aim to determine ways the animals could possibly be managed differently and therefore minimize undesirable behaviors.

Past studies of animal welfare and zoos leave gaps that can be filled by studies such as this one. Welfare standards were originally developed using domesticated species as a model, which means that guidelines might not fully address the needs of exotic species. Current recommendations for animal management are usually based on current practice and are not often

backed by empirical data (Melfi 2009). A study of research projects undertaken in British and Irish zoos found that there is a bias in which animals are studied, with the majority of research being done on primates, followed by other charismatic species (Swaisgood 2007). There are few studies done on captive hyenas, so developing a baseline of behaviors could add to the knowledgebase. This study has the potential to assist zoo operations in Perth as well. Using the same methodology, the hyenas can be observed again in the future to determine if anything regarding their behaviors has changed. If enrichment was added or the environment otherwise was altered, the behaviors then could be compared with this study to determine if the change had a positive or negative effect on the animals.

2. METHODS

2. 1 *Study Site*

All observations took place during a one month period as a student intern at Perth Zoo, located in South Perth, Western Australia. The hyena exhibit is part of the African Savannah section of the zoo (Figure 3). The exhibit is comprised of a front area that is viewable by zoo guests and a back area where the hyenas are fed and can rest at night. A gate at the back of the exhibit allows for keeper access to the front section of the exhibit. During the day, the hyenas are closed off from the night quarters. In the late afternoon, keepers come by and open the gate to the back section of the exhibit. The hyenas are able to freely move between the front and the back sections of the exhibit during the night. The hyenas are fed once per day, usually sometime in the morning around 9am. However, an attempt is made to vary this in order to keep the hyenas out of a routine.

2. 2 *Study Species*

Hyenas, member of the family Hyaenidae, are characterized by their large, rounded head and strong jaws. Although morphologically similar to canines, hyenas are closer phylogenetically to felines and viverrids. Spotted hyenas are the largest of the three hyena species, with a length between 1.5 and 1.7m and a weight between 62 and 75kg. Spotted hyenas are also identified by their spotted coat, which further distinguishes them from other hyena species.

Two male hyenas live at Perth Zoo. One, “Sabi,” was born at another Australian zoo. After the hyena parents failed to provide care, he was raised by humans before being brought to

Perth to provide company for another male hyena. This hyena was aggressive towards “Sabi” and led to frequent physical interactions and injuries. This led to “Sabi” being put on anti-psychotic medication, although he has since been weaned off.

The second hyena, “Kigana” was brought to Perth in 2011 as company for “Sabi” after the previous male died. After a period of almost no aggression, frequent bouts of physical interactions began, often requiring veterinary intervention. “Sabi” has since taken on the established role as the submissive hyena to “Kigana.” Both have been put on contraceptives in order to lessen this aggression. As result, there have been less frequent interactions that result in injury. “Sabi” can be identified by his short tail and cut ears, which are the results of previous aggression. “Kigana” is larger and has an intact tail and complete ears.

2.3 Behavioral Data Collection

In order to develop a template for data collection, a review of past hyena ethograms was done. From these ethograms, a list of possible behaviors was created. Behaviors that were not relevant to two adult males, such as mating behaviors or those involving cubs, were not included in the list. Observations were then done in one hour periods, either during the hours of 8am-11am or 3pm-5pm. These were the times when the hyenas were most active, which allowed for observance of interactions between the two. Observations were made from the covered viewing platform, although at times observations were made from the viewing area on the left of the exhibit, as required by the hyena’s location.

At the beginning of each observation period, the date and time was recorded. Additionally, other factors such as if keepers were around, if the hyenas had recently been fed, or if there was an unusual environment were recorded. Scan sampling was then used to collect the

behavioral data. Every two minutes, the behavior of each of the hyenas was recorded, using the list of behaviors developed to classify the activities. Effort was made to record the behaviors exactly at the two minute mark, even if the hyena appeared to be changing activities. If anything notable, as deemed by the researcher, happened in the two minute period, it was recorded in the “Comments” section of the observation form. Observations were done for ten days total, over a period of two weeks in November. The days ranged in temperature from 19°C to 36°C.

In order to measure how the two hyenas interacted with each other, a separate data collection sheet was created. Any time the two hyenas interacted more than simply monitoring each other, the interaction was recorded. On this sheet, the behavior of each hyena before the interaction was recorded, and then sequence sampling was used to record the actual interaction. With this method, the behaviors were recorded as they happened, with no attention paid to a certain time interval. After each interaction, the time of the day as well as external factors such as the feeding time were recorded. The behaviors were classified according to the ethogram as the scan sampling method (Table 3).

2.4 Data Analysis

As data was collected during the observation periods, it was compiled in one master spreadsheet. This spreadsheet contained one page for each hyena. On the sheet was a list of behaviors that could be observed, and a tally of the total number of times each behavior was observed during the period, with columns for each individual observation period. At the end of the spreadsheet, the tallies for each day were totaled, giving an overall distribution of the behaviors. These totals were converted to percentages, which allowed for separate graphs to be created. The resting habits of both hyenas were also analyzed. For each time the hyena was

recorded to be resting, the length of time before interruption was noted on a separate data sheet. These durations of rest were totaled to get the overall number of rest bouts for each hyena. In order to determine the average length of uninterrupted rest, the totals were averaged for each animal.

3. RESULTS

Table 1. Total frequency of observed behaviors for both hyenas, listed alphabetically.

Behavior	“Kigana”	“Sabi”
Chase	1	0
Drink	2	2
Flee	0	1
Follow	1	0
Greet	1	1
Groom	3	6
Monitor	67	23
Out of Sight	17	22
Open Mouth Appease	0	1
Pace	42	35
Rest	109	140
Roll	0	1
Run	0	1
Smell	19	27
Walk	3	5
Water	1	1

See Table 3 for descriptions of the listed behaviors. Each hyena’s behavior was recorded 266 times over a period of two weeks. The most frequently observed behavior for both was

resting. This is followed by monitoring, smelling, and pacing. During some of the observation periods, one or both of the hyenas was out of sight.

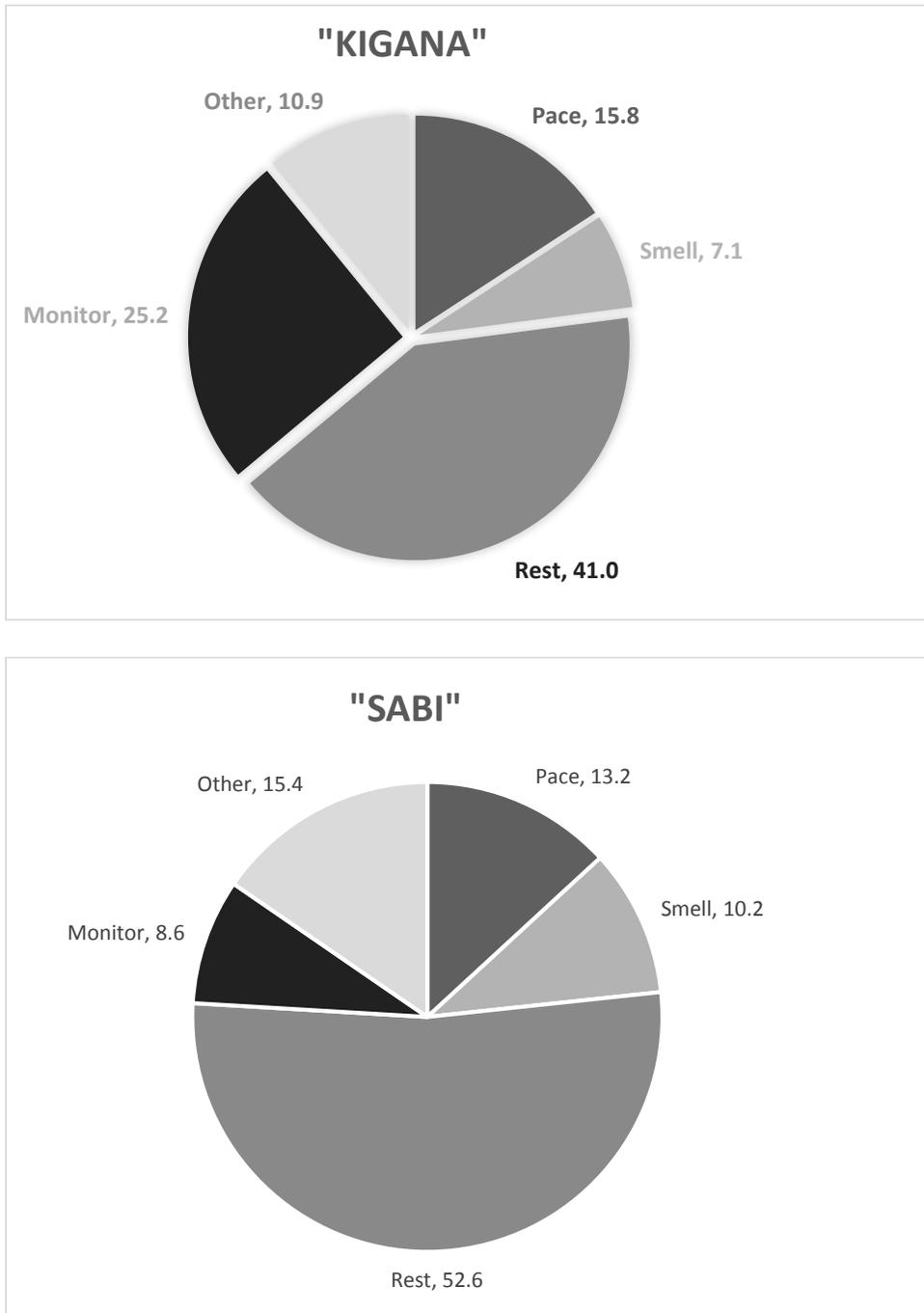


Figure 1. Time spent doing four most frequently observed behaviors, separated by individual hyena. The “other” category includes all additional behaviors not listed on chart.

The top four most frequently observed behaviors were resting, monitoring, smelling, and pacing. All other observed behaviors are grouped together in the “other” category. “Sabi” was observed to be resting 52% of the time, compared to “Kigana” who rested about 41% of the time. “Kigana” was observed to monitor the exhibit more (25%) than “Sabi” (9%). “Sabi” spent around 10% of the observation periods smelling the exhibit, compared to “Kigana” who spent 7%. Both were observed doing some pacing, with “Kigana” doing so 15% of the time, and “Sabi” doing so 14% of the time.

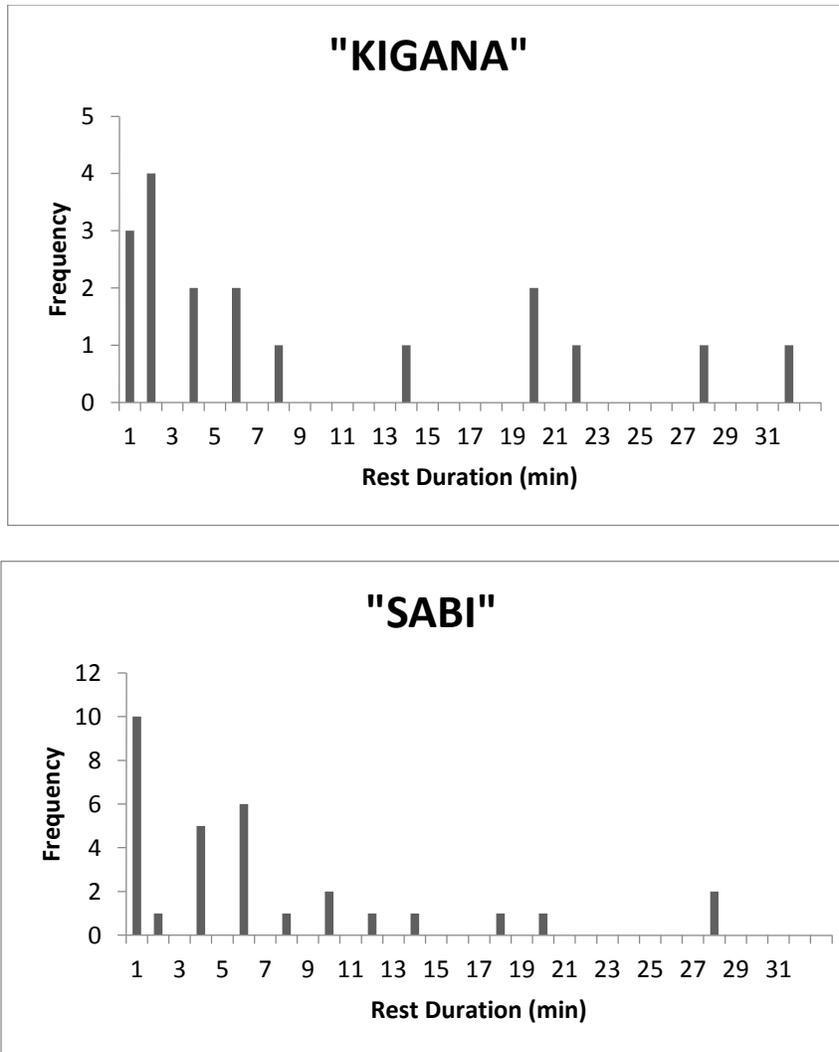


Figure 2. Duration and frequency of uninterrupted periods of rest during the observation periods.

Both hyenas were observed to rest frequently. “Sabi” was observed to rest for 32 separate, uninterrupted periods. Of these periods, 16 (50%) were under five minutes in length, while 13% were over 15 minutes. The average period of uninterrupted rest was seven minutes. “Kigana” was observed to have 18 periods of uninterrupted rest, with 50% being under five minutes and 28% being over 15 minutes. The average period of rest for “Kigana” was 9.7 minutes.

Table 2. Details about observed interactions between the two hyenas.

Date and Time	Environment Factors	“Kigana” Location and Behavior prior	“Sabi” Location and Behavior prior	Behaviors Observed
9/11/15 10:09	Post morning feeding	Smelling log	Smelling log	“Kigana” chases “Sabi” away. “Sabi” giggle while running.
10/11/15 9:45	Post morning feeding	Smelling exhibit	Laying under tree	“Kigana” walks over and displaces “Sabi”, follows for one minute
11/11/15 9:50	Post morning feeding	Lying down	Smelling exhibit	“Sabi” walks over, both stand and greet each other
12/11/15 9:24	Prior to feeding	Pacing at back gate for 20 minutes.	Pacing at back gate for 20 minutes.	“Kigana” chases “Sabi” away. “Sabi” giggles, returns, and they face each other with open mouths.
12/11/15 10:02	Prior to feeding	Pacing at back gate for 45 minutes.	Pacing at back gate for 45 minutes.	“Kigana” chases “Sabi” away. “Sabi” giggles while running. Both return to pacing.
17/11/15 15:12	Keepers present in other exhibit	Standing at back gate	Standing at back gate	Face each other with open mouths. “Kigana” chases “Sabi” away.
19/11/15 15:36	Keepers present in back area	Standing at back gate	Standing at back gate	“Kigana” chases “Sabi” away. “Sabi” giggles, returns and is chased off.

This table describes the seven instances in which the two hyenas were observed to directly interact with each other. Interactions, in this case, are classified as instances when the

hyenas had behaviors (more than just monitoring) directed at each other. Six out of the seven interactions consisted of “Sabi” being chased off by “Kigana” when both were already in the same location. Five out of the seven observed interactions occurred between the hours of 9:15 and 10:15am.

4. DISCUSSION

4.1 Behavior: Resting

During the observation periods, four behaviors were consistently observed, making up 85-90% of the hyena's total activity. The most prominent behavior was "resting" which was observed 40% of the time for "Kigana" and 53% of the time for "Sabi" (Figure 1). A study of wild hyena behavior showed that approximately 70% of a hyena's time was spent resting (Kolowski et al 2007). Observations were done in the morning and late afternoon, with the goal being to see the hyenas being active. Between the hours of approximately 11:00 and 15:00, the hyenas were observed to almost solely be resting. These observations are similar to the same study of wild hyenas which found that the majority of activity occurs early in the morning and at sunset or later (Kolowski et al 2007). This lack of activity during the day is also likely the result of the warm temperatures, which reached 37°C during peak hours. It is likely that if behaviors were recorded 24 hours a day, the percent of time the hyenas at the zoo spent resting would be greater, and closer to their wild conspecifics. From brief observances, much of the afternoon and night is spent resting in captivity.

While both hyenas were observed to spend much of their time resting, the length and frequency of these rests differed slightly. "Kigana," the more dominant hyena, was observed to have fewer instances of uninterrupted rest, yet the periods were longer than those of "Sabi." "Kigana" averaged ten minutes of uninterrupted sleep at a time, with close to 30% being over 15 minutes in length. Comparatively, "Sabi" had rest periods on average of 7 minutes, with only 13% being over 15 minutes in length. However, "Sabi" overall rested for a greater amount of time than "Kigana" (Figure 1). Generally, the periods of rest were interrupted when the hyena

would pick its head up and monitor some aspect of the exhibit. Frequently, this aspect was either the other hyena or the back gate where keepers have access to the exhibit.

Generally, the presence or absence of sleep can be an indicator of the amount of stress facing an animal. A study of African ungulates found that animals exposed to stressors, such as the presence of predators, had increased vigilance and decreased rest (Creel et al 2014). If an animal were to sleep for extended periods of time, they may miss the signs of an impending threat. As a result, it is advantageous for the animal to remain relatively alert, even during periods of rest. This sleeping pattern is similar to that observed in “Sabi,” who slept for short periods of time, interrupted by periods of monitoring. A submissive hyena is more susceptible to threats from other hyenas, and thus would likely experience more stress than a dominant hyena, such as “Kigana.” In one interaction, “Kigana” was observed to walk close to “Sabi” who was resting at the time. When they came within one meter of each other, “Sabi” immediately got up and ran to the other side of the exhibit. (Table 2). This interaction shows that the presence of the dominant hyena is a stressor to the submissive one, causing the need for vigilance. “Kigana” was observed to rest for longer periods of time, with less monitoring in between. This could possibly indicate lower levels of stress, due to the fact that he is the dominant animal.

The difference in observed behaviors however, does not necessarily indicate a place where management of the two hyenas could be improved. Any set of hyenas in captivity are going to have a hierarchal structure, resulting in one hyena being the most submissive and one being the most dominant. The submissive hyena is going to experience higher levels of stress, solely based on their place in the hierarchy. Therefore, it is not likely that such stress can be avoided, if a zoo has the desire to continue displaying the hyenas.

4.2 Behavior: Smelling

One behavior observed frequently was smelling, as defined by the hyena having their nose to the ground. “Kigana” was observed to be smelling around 7% of the time, while “Sabi” was smelling approximately 10% of the time. Generally smelling would occur in the mornings, after keepers had placed various enrichment objects in the exhibit. The presence of this behavior indicates that the hyenas are engaged in their exhibit. This action is preferable to behaviors that reflect boredom and obsession. In the wild, hyenas would use their sense of smell to watch for predators, prey, or other hyenas.

4.3 Behavior: Monitoring

Both hyenas were observed to spend time monitoring the exhibit, generally for the other hyena or a keeper. “Kigana” was observed to spend 25% of the observation periods monitoring, while “Sabi” only spent approximately 9% of the periods doing so. It is possible that as the dominant hyena, “Kigana” is looking for threats to the clan, as a wild hyena alpha would do. Wild hyenas in the African Savannah face a variety of threats such as hunters and lions, which means that vigilance is key to the survival of the species. As a submissive, “Sabi” would not be as responsible for the protection of the overall clan, which could explain his lack of monitoring (Holekamp 2007). Hyenas in the wild spend about 20% of their time traveling, which requires almost constant vigilance (Kolowski et al 2007). Being in a captive environment, the hyenas do not have the ability to travel and are not exposed to threats that they would be in the wild. This means that vigilance is less necessary for the clan (or pair) as a whole, and there is time that needs to be occupied.

The observed behaviors of the hyenas in this study, however, indicate that vigilance for threats to the clan is not a key focus of the day. Much of the time “Kigana” spent monitoring was at the back gate of the exhibit. From this vantage point, the hyena is able to see the back area of the exhibit and those nearby, which is where keepers enter for feeding and other training exercises. The frequent presence of “Kigana” at this location could possibly indicate obsession or boredom. Much of the time, there were not keepers visible from the gate, so it is assumed “Kigana” was waiting for one to appear. The hyena exhibit is located near a guinea fowl exhibit, so it is possible that the noise and activity in that exhibit was attracting his attention. It is difficult to make a distinction between watching the gate out of obsession and watching the gate out of curiosity, however, so action is not necessarily needed. It is possible that more enrichment objects and an increasingly varied routine could minimize this behavior, if there is a desire to do so.

4.4 Behavior: Pacing

Both hyenas were observed to spend approximately 15% of the observation periods pacing. This generally happened in the late afternoon, starting around 15:30. Within the hour, usually, the gate to their night quarters would be opened by a keeper, which is likely what the hyenas were anticipating. However, some pacing was also observed in the mornings when the hyenas were active after their morning feeding.

Pacing in captive animals is generally seen as an undesirable behavior, as it can indicate obsession and boredom. Furthermore, most of the interactions between the hyenas happened after they had both been pacing at the back gate for some period of time. If the pacing behavior were to be reduced, it is possible that there would be fewer instances of “Kigana” chasing “Sabi”

away from the gate, potentially putting less stress on “Sabi.” The presence of pacing has possibly created a negative association between the back gate and “Sabi” which could be problematic for care in the future. If more enrichment were to be introduced prior to the later afternoon when pacing begins, it is possible that the behavior will be reduced. It may also help for there to be increased randomness in the hyenas’ routines. It is difficult to actually achieve this, as the nature of zoo animal management means that a routine is necessary. However, in the best case scenario, a completely randomized schedule could help break the hyenas of these behaviors that possibly reflect obsession.

4.5 Interactions Between Hyenas

The dominant-submissive relationship between the two hyenas was clearly evident during the observation periods. Most interactions consisted of “Kigana” chasing “Sabi” away from an area, usually the back gate of the exhibit. However, this was observed at a relatively low frequency, which indicates that their relationship is relatively stable. There was no observed physical contact, such as biting, which shows an improvement from the past when such behavior was more frequent.

Furthermore, the physical location of both hyenas during the observation period was representative of their hierarchy. As the dominant male, “Kigana” spent most of the time, including rest periods, within a couple of meters of the back gate, while “Sabi” was located in the front or sides of the exhibit. The majority of interactions when “Sabi” was chased off by “Kigana” occurred when both were at this back gate. It is important for both hyenas to be able to access the gate, as this is where they can be reached by the keepers for training and other medical care.

While some implications can be noted about the observations made in this study, there are limitations to the results. Observations took place over a period of two weeks, which is a relatively short period of time to accurately depict the daily behaviors of the hyenas. Furthermore, the classification of the behaviors is done at the discretion of the researcher, which means that if repeated there may be some variation in how certain behaviors are classified. By recording behavior every two minutes, some behaviors that are done a short period of time could be missed. However, the main aim of the study was to develop a baseline for the behaviors of the two animals, and potentially point to areas that the welfare of the animals could be improved. In that sense, the goals were accomplished as this record of behaviors can now be referenced in the future.

5. CONCLUSION

The aim of this study was to record the daily activities of two Spotted Hyenas at Perth Zoo, as well as detail how the pair interact. The observations depict approximately how the hyenas allocate time during the day, so a similar methodology can be used in the future to compare the behaviors. The most common behaviors observed were resting, monitoring, smelling, and pacing. Past research on hyenas have recorded strong hierarchies that guide the clan. Evidence of such hierarchy was observed in the captive hyenas as well, with differences in where the hyenas spend their time, as well as how they sleep.

Some of the behaviors observed may indicate places where different management could improve the welfare of the hyenas. Pacing, which is generally a sign of obsession or boredom, was observed approximately 15% of the time, particularly in the hours surrounding when a keeper is usually present at the exhibit. An increased randomness in the times when the keepers are present could change the routine nature of the hyena's day. Furthermore, the hyenas were observed to spend time smelling the enrichment objects which were placed in the exhibit. It is possible that introduced enrichment could minimize pacing, as it is shown to be effective at other times during the day. Further studies could be done to determine the behaviors of the hyenas across a 24 hour period. It could be useful to test different enrichment objects, as well as vary their placement to areas far from the back gate of the exhibit, trying to determine if this can lessen the focus on the gate. Additionally, it would be beneficial to study hyenas in other zoos, particularly those with a more traditional clan consisting of males and females. It is possible that the behaviors of these hyenas would be different, allowing for conclusions to be drawn about the effect of clan structure on such gregarious creatures.

APPENDIX

Table 3. List of possible behaviors that could be observed, with codes and definitions.

Category	Behavior	Code	Description
Individual Activity	Feed	feed	Hyena is consuming food item
	Drink	dri	Hyena is actively drinking
	Smell	sme	Hyena is actively smelling with nose to ground
	Groom	groo	Hyena licks own body
	Water	siw	Hyena is using water tub or pool
Locomotion	Rest	rest	Lying in absence of food, with neck on ground (eyes may be open or shut)
	Walk	walk	
	Run	run	
	Pace	pace	Walking or running short laps repeatedly
	Monitor	mon	Hyena is alert and watching some element inside or outside exhibit
	Roll	roll	Hyena rolls on ground
Vocalization	Giggle	gig	High-pitched vocalization, usually emitted when threatened or chased
	Growl	gro	A low pitched sound
Interactions	Approach	app	One hyena comes within 1 m of other
	Greet	grt	Two hyenas stand head to tail, lift legs and smell each other
	Displace	disp	Approach of one animal causes avoidance in other
	Chase	chs	Running pursuit
	Follow	flw	One hyena walks closely behind another
	Aggressive Posture	ap	Hyena stands with ears cocked forward and tail bristled and raised
	Lunge	lun	Hyena moves toward other hyena quickly with mouth open
	Head Wave	hw	Hyena moves head with intention to bite
	Push	push	One hyena pushes another
	Bite	bite	One animal bites another
	Stand Over	st ov	One animal stands over the other with muzzle pointed down at shoulders
	Flee	bo	Threatened hyena withdraws
	Defensive parry	dp	Threatened hyena blocks aggressor by orientating open jaws
Counterattack	ct	threatened hyena lunges back at aggressor	

	Submissive Posture	sp	Threatened hyena stands/walks with head lowered, ears back, and lips retracted
	Open Mouth Appease	oma	One animal approaches other with ears back and puts open mouth up to other animals mouth. Occurs spontaneously
	Carpal crawl	cc	Threatened hyena crawls on carpal joints with hind legs bent
Miscellaneous	Out of Sight	oos	Hyena is not visible to observer, generally in night quarters



Figure 3. Map of Perth Zoo with hyena exhibit indicated.

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