Using a Timed Feeder to Increase Activity and Exhibit Usage in Captive Giraffes (*Giraffa camelopardalis*)

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Abstract The use of enrichment to simulate a natural environment has become increasingly important in the management of captive animals, especially in large exotic ungulates. Indicators of positive welfare in giraffes are behaviors that mimic those displayed in the wild. This study uses a randomly timed feeder in an exhibit for a herd of seven captive giraffes at the Oakland Zoo in Oakland, California. I hypothesize that the feeder can be used to stimulate more naturalistic behaviors, where the giraffes continuously forage for food. The feeder would cause a decrease in the time spent standing and an increase in the usage of the exhibit. An ethogram was created for this herd of giraffes and a distribution of exhibit usage was complied. Two methods of observations were conducted before and after the feeder was put on exhibit. Approximately 90 minutes worth of observations were done on each giraffe, using an instantaneous scan sampling, to measure the amount of time spent standing. I used an all occurrences sampling to determine the distribution of the giraffes in the exhibit. While the feeder is up in exhibit, the giraffes are predicted to show more movement and activity, as well as show a larger distribution across the exhibit. However, the results showed that the feeder did not have an effect on the movement of the giraffes (2 tailed t-test, $t(5)$, $p=0.47$), nor was there an effect on the exhibit usage. Using a Gini coefficient to determine the distribution across the exhibit, the average before the feeder was 0.67 and after was 0.64, though the results did not prove significant after statistically analyzing them (2 tailed t-test, $t(5)$, $p=0.27$).

Introduction

According to the UK Animal Welfare Codes, one of the basic needs of animals is the "opportunity to exercise the most normal patterns of behavior" (Hughes and Duncan, 1988). It is important to understand the behavior of captive giraffes, *Giraffa camelopardalis,* as a welfare indicator, which may give an indication of the animal's well-being (Veasey et.al. 1996). In general behaviors that are only displayed in captivity are considered negative behaviors (Koene and Visser, 1997). These behaviors are generally called stereotypic and include tongue playing, which is defined by Koene and Visser as "tongue movements free or on substrate," or pacing in an exhibit (Bashaw, Tarou, Maki and Maple, 2001). Stereotypic behavior in captive giraffes is not well documented, however, in a study by Bashaw et. al., it was found that 79.7% of captive giraffes in 71 zoos across the United States displayed at least one stereotypic behavior.

To maintain a population of captive animals, managers use tools called **enrichment** to 1) promote natural behaviors, which are those exhibited in the wild and 2) to decrease stereotypic behavior. Environmental enrichment can include the "social environment (group housing and human-animal interactions), the nutritional environment (how the animal gets its food), the sensory environment, and the physical environment" (Morrow-Tesch, 1997). Examples of enrichment in exhibits are scents, ropes, toys and hanging forage feeders.

One use of enrichment by zookeepers is to prompt captive animals to use the entire exhibit, hoping to increase the amount of daily activity, thereby decreasing time spent displaying non-normal behaviors such as blank staring, lying in a non-sternal position and lolling the head around in circles (Koene and Visser, 1997). Using the time budget of wild animals as reference for captive animals, keepers can determine what kinds of enrichment are needed to promote animal welfare and encourage naturalistic behaviors (Veasey et.al. 1995).

Giraffe research has been minimal compared to other large mammals in the wild and little information has been compiled on stereotypies and daily time budgets of captive giraffes (Bashaw et. al. 2001). I will be observing a herd of seven giraffes at the Oakland Zoo in Oakland, California. This study will use an automatic timed feeder that will dispense food pellets into a bucket at random times during the day. There has been no research done on this herd involving daily activity so this study will precede any other that can be done on the time budgets of these captive giraffes, nor is there any research done on giraffes using a timed feeder. This study will perform a manipulation on the giraffe exhibit aimed to increase their activity and

decrease any stereotypic behaviors. In addition, I hope to provide insight for animal managers in zoos and wildlife parks on providing a more enriching lifestyle for captive giraffes.

Giraffes spend much of their time in the wild walking and looking for food. Koene and Visser (1997) showed that males spend 43% of their daylight hours foraging, which includes walking and eating, and females with young spend some 72% of their time foraging. Overall, they found that wild giraffes spend only 5% of their time standing. In a study by Leuthold and Leuthold, 1978, the percentage of time wild giraffes spent walking was 26%, standing without eating was 14% and eating while standing or walking was 53%.

This study will use a timed forage feeder as enrichment to encourage captive reticulated giraffes (*Giraffa camelopardalis reticulata*) to make full use of their environment, which in this case is the open exhibit they use during the day. This study will be novel because there are no studies on giraffes, in particular, involving a timed feeder. Full usage is defined in this study as spending time in different areas of the exhibit throughout the day, as opposed to staying in one or two areas for most of the time. I hypothesize that the use of a timed forage feeder will increase the usage of the exhibit, and increase the amount of daily activity, such as walking, running, eating and ruminating. Ruminating is an important part of a giraffes' daily activity because it is time spent digesting their food. The addition of a new forage feeder to their exhibit will, in theory, prompt the giraffes to walk around the exhibit more. By increasing their time walking and looking for food, this may imitate the normal behavior in the wild where giraffes are eating and walking for most of the day.

Methods

Subjects and Exhibit The observations will be done at the Oakland Zoo in Oakland, California. The zoo sits on 100 acres in the hills of Knowland Park, a 525-acre stretch of land in the Oakland hills. The herd of giraffes under observation includes 1 intact bull, 3 castrated bulls, 2 cows and 1 pregnant cow. Their ages range from 3 years old to 14 year. During the hours of 10:00am to 4:00pm, the giraffes are in an open enclosure approximately 1 acre large, surrounded by a 66,000 gallon moat which is six feet deep (figure 1). The exhibit contents include five palm trees, several bramble piles, five large rock piles and two waterfalls (refer to Fig. 1). The giraffes share the exhibit with three elands, six gazelles, two vultures, two cranes and eight geese. There is minimal interaction between the species.

Enrichment The enrichment being used in this experiment is an automatic timed feeder (Quick Feed, Shady Point, OK). It dispenses dry acid detergent fiber food pellets, or ADF (Mazuri, Springfield, IL), a fiber supplement. The feeder will dispense 15 cups of ADF three times daily. The times will be determined by randomly choosing times in fifteen minute intervals between 10:00am and 3:00pm. The giraffes are fed acacia browse or alfalfa hay at 11:00am, 12:00pm and 2:00pm from a platform behind the exhibit fence (see point A in Fig 1). The feeder will be placed at the other end of the exhibit, mounted on a chain link fence (see point B in Fig 1).

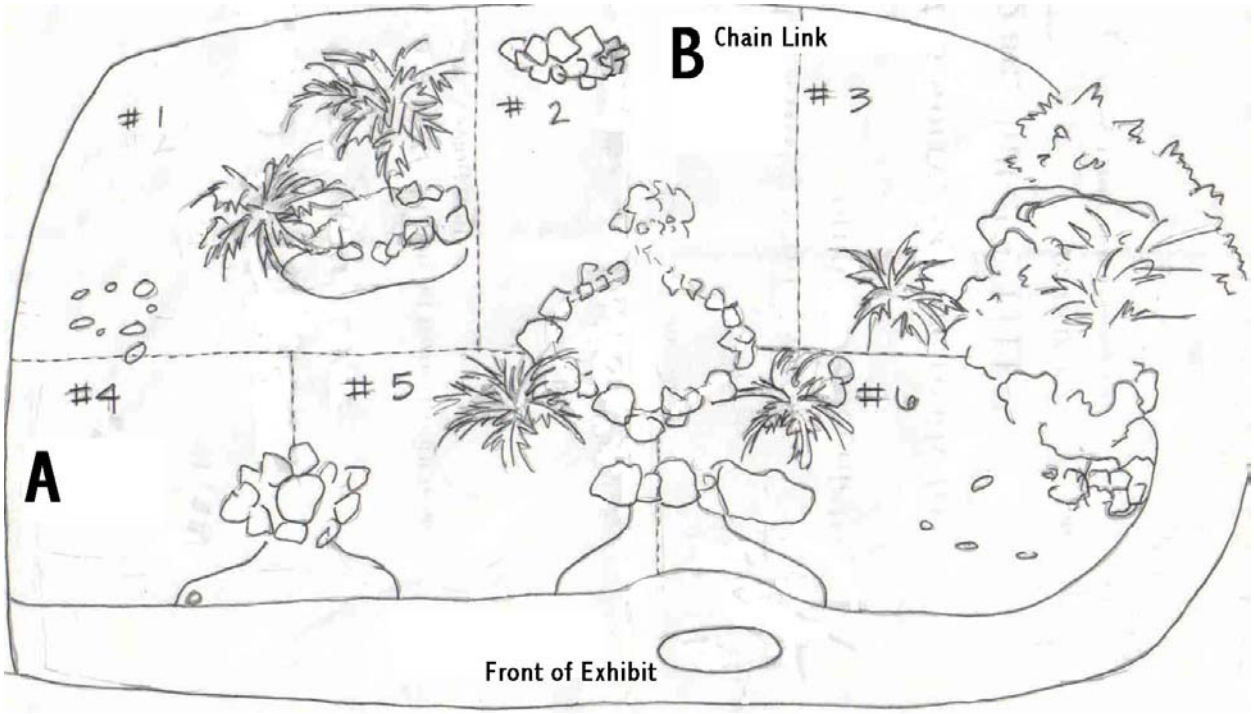

Figure 1 Bird's Eye View of the exhibit showing **A**, the feeding platform and **B**, location of timed feeder, and visual sections of exhibit for data collection denoted by broken lines.

Procedure To conduct this experiment I will observe the giraffes and record a time budget for each individual. This will break down the daily activity of each giraffe into percentages and give an estimate of how much time a giraffe is displaying a particular behavior. I will be focusing on standing. To quantify the behaviors, I will be using two specific types of sampling, a focal animal instantaneous scan-sampling at 10 second intervals and a focal animal all-occurrences sampling (Pellew, 1984) to test my two-part hypothesis, which is to increase exhibit usage and increase daily activity (see below).

To set the variables, the giraffes' feeding regime must be kept constant throughout the experiment. The only variable I will have is the timing of the feeder with the ADF. To thoroughly test my hypotheses I will be conducting observations before the feeder is installed to get a baseline data set. This data will be my control set and contain at least eight hours worth of observations from the entire herd, conducted over a week at different times of the day.

Next, I will put the feeder on exhibit and take observations for a total of 90 minutes per giraffe, broken up into three thirty minute sessions. The 30 minute intervals will be done in between the times that the feeder is scheduled to go off. Since the feeder will be located on the opposite side of the exhibit where the giraffes normally get fed, the experiment will hopefully influence the giraffes to move back and forth between the two ends, looking for food. Ideally this will increase the amount of time spent walking and feeding throughout the exhibit, thus decreasing inactivity and increasing exhibit usage.

Observing Daily Activity The first technique I will employ is all-occurrences sampling using a focal animal (Pellew, 1987). This method will focus on a specific giraffe and what behavior it is displaying. For each giraffe I will observe for 90 minutes, broken up in three 30 minute blocks. Since the main focus is on the amount of time spent standing, I started recording the giraffe when they stood, not eating, noting the start and stop time with a stop watch, rounded to the nearest second. The observation sessions will be done at different times of the day. With this information I will be able to calculate how much time the giraffes stand.

Exhibit Usage The second method of scan-sampling I will be using is instantaneous scan sampling using 10 second intervals (Pellew, 1987). This method will allow me to determine what the giraffes are doing and in what section of the exhibit. This method involves observing for a 5 minute session broken in the following way: observe one giraffe for 10 seconds, mark where it is, then the next giraffe for 10 seconds, so on for the entire herd. I visually divided the exhibit into six sections (see Fig 1), and after each 10 second mark I recorded where the giraffe was in the exhibit.

Statistics To test the first part of my hypothesis, increasing daily activity, I will quantify my data by adding up the amount of time, in seconds, that each giraffe was observed standing. I will be using a paired t-test on the total times for each giraffe(table 1) to find any differences in activity between the time frames: before and during the feeder usage. To determine the exhibit usage I will use a Gini coefficient to determine the relative distribution of giraffes in the exhibit.

Each time I mark where the giraffe was after the 10 second interval is a datum point. The points will be tallied up in each section and the Gini coefficient will be found. This will let me determine the degree of variance the giraffes are displaying before and during the feeder. A higher Gini coefficient will indicate a lower distribution of exhibit usage. The Gini coefficient for each giraffe was put through a paired t-test to determine the significance.

Results

The total amount of time spent standing for each giraffe is summarized in table 1, along with average amount of time spent standing for the entire herd. Before the feeder was placed the average time for the herd totaled 31.94 minutes. The average amount of time spent standing after the feeder was 31.6 minutes.

Standing:	Before(sec)	After	Diff
Kodjoe	1935	1920	-15
Benghazi	1415	1536	121
Sudi	1421	1396	-25
Tiki	1456	1620	164
Twiga	2067	1996	-71
Mosi	1011	1234	223
Balthazar	2192	1671	-521
Average:	1916.17	1895.5	

Table 1. Summary of the individual giraffes' data, including amount of time spent standing (totaled over the three thirty minute interval).

The numbers for each giraffe was put into a paired t-test (2 sided paired t-test, $t(5)$, $p=0.43$). Before the feeder the distribution of the giraffes across the exhibit had an average Gini coefficient of 0.67. After the feeder the herd had an average of 0.64. The data on the individual giraffes is summarized in Table 2.

Before Sections	Giraffe:	G1	G2	G3	G4	G5	G6	G7
1		20	19	16	21	22	18	24
2		10	2	3	3	7	5	5
3		0	0	0	2	1	4	1
4		0	11	9	4	0	3	0
5		0	0	2	1	0	0	0
6		0	0	0	0	0	0	0
Total:		30	30	30	30	30	30	30
	Gini # *	**0.72**	**0.68**	**0.6**	**0.64**	**0.73**	**0.59**	**0.75**

After Sections	Giraffe:	G1	G2	G3	G4	G5	G6	G7
1		18	22	15	21	16	20	17
2		0	5	8	0	7	4	8
3		11	0	3	0	0	4	4
4		1	0	3	5	6	0	0
5		0	3	0	0	0	2	0
6		0	0	0	4	1	0	1
Total:		30	30	30	30	30	30	30
	Gini #	**0.68**	**0.71**	**0.57**	**0.69**	**0.59**	**0.63**	**0.62**

Table 2. Summary of the giraffes' distribution in the exhibit. Gini coefficients were obtained from http://www.economics.pomona.edu/cconrad/GiniA.xls

The results of the Gini coefficient for 'Before' and 'After' were also put into a paired t-test (2 sided t-test, t(5), p=0.27).

At the conclude of the study, the results would indicate a decrease in the average amount of time spent standing across the herd. Upon further analysis of the data by using a paired t-test, the results prove to be extremely insignificant. The mean time spent for the herd after the feeder can not be determined significantly smaller than the mean time spent after the feeder. Therefore the null hypothesis can not be rejected, and the feeder can not be proven to have an effect on the amount of time spent standing.

The distribution of the giraffes in the exhibit also proved to be insignificant. Though the average Gini coefficient was lower, indicating that the giraffes are more evenly distributed in the exhibit, the null hypothesis can not be rejected. Therefore, the feeder has not been proven to have any effect in this study.

Discussion

There are several reasons why the data proved insignificant. The lack of experience could have had an effect, because there may have been inconsistencies when I collected data. The seasons also have an effect on the data. As the project schedule entered the wet season, the giraffes behavior was very erratic and the schedule was not kept consistent, depending on how inclement the weather was. The feeder was enclosed in a box, however the sound of the motor may have been loud enough for the giraffes to hear, thus causing the study to be less random. If the giraffes were able to hear a cue before the food dispensed, then their movements across the exhibit would be a cued response. Due to my schedule, the observations were done in an irregular manner, usually when I was available, which may have biased the time of day the giraffes were recorded, since I may have caught them at similar times on different days. Or maybe I observed the giraffes only at times they happen to be fed by the keepers.

Through instantaneous scan sampling and all-occurrences sampling, I was able to contend that my hypotheses were incorrect. However this study was limited in several ways, including time. Given the short amount of time to conduct the experiment, there could have been the observations could have been more extensive. This study, though statistically insignificant, still showed a small trend with some giraffes. I can conclude that the giraffes did notice a change in the exhibit. This is the first step towards futre studies. A suggestion for future studies is to have more more than one feeder set up throughout the exhibit, each dispensing food at random times. Another suggestion is a different type of food. If the giraffes were offered a different choice of dry feed, maybe their motivation to moving around the exhibit to get to the feeder would be different. A larger number of individuals would help in future studies.

While the study did not prove the hypotheses that the timed feeder would encourage movement and exhibit usage, it did provide an insight into the management of captive animals. The timed feeder can still be used as an enrichment device even if strictly for the novelty of food being dispensed during the day. By using enrichment such as the timed feeder, captive animals may live a better lifestyle and our goals as animal caretakers will be much more fulfilling.

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