

**QUANTIFYING VERVET MONKEY'S EXPOSURE TO HUMANS THROUGH THE
USE OF CAMERA TRAPS**

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Abstract

Chlorocebus sabaeus (vervet) monkeys were introduced to Dania Beach, Florida, in 1948 after escaping from the Dania Chimpanzee Farm. Now, a group of descendants from those vervets live in a mangrove swamp bordering the urban environment of a parking lot 2.2 miles from the Fort Lauderdale International Airport. Despite their proximity, this particular group of vervet monkeys has rarely been studied. In 1995, the population of vervets in Dania Beach was documented for the first time. Since then, only five studies have been published on the vervets. In this urban environment, the vervet monkeys are frequently introduced to humans, cars, and food scraps. Using Browning and GradePro camera traps, the vervet's daily routes were tracked over a four-month period to see approximately how often the monkeys were spotted along the fence perimeter. We believe that the more time the vervets spent along the fence line increases their potential exposure to humans. This study hopes to be used in later research to compare the specific interactions between humans and vervet monkeys in Dania Beach and Africa as a potential explanation for behavioral differences that have been noted.

Key Words

“Vervet”, “*Chlorocebus sabaeus*”, “Schedule”, “Camera trap”, “Non-native species”

Introduction

The *Chlorocebus sabaeus* (vervet monkey) population in South Florida has been living wildly in Dania Beach, Florida since 1948. The population is originally native to the west coast of Africa, from Senegal to Ghana, but was brought to Dania Beach, Florida as part of the biomedical research facility called Anthropoid Ape Research Foundation, which later also became a tourist attraction under the name Dania Chimpanzee Farm. The lab was located on the Dania Beach cut-off canal and U.S.-1, however, in 1948 they escaped to an area filled with mangrove swamps that today resides 2.2 miles from the Fort Lauderdale-Hollywood International Airport (Williams, 2021; Williams, 2022; Fig. 1). In the time the vervet monkeys have lived in Dania Beach, the city has grown around them. Bordering the mangrove swamp where many of the vervets live today, a parking lot, Park 'N Fly, was built for people to leave their cars before flights. This parking lot has also provided consistent access from the public population to the vervet monkeys. At the time of the study, the troop of vervets was comprised of 16 individuals.

Amongst the local population in Dania Beach, Florida, the monkeys are considered to be somewhat of a local legend and are beloved by many of the people. This, in addition to the vervet's urban location, has resulted in vervet monkeys having a large amount of human exposure, a majority of which is more positive than negative as humans commonly feed the monkeys and do not chase them away (Brunson, 2021; Vazquez, 2022). In KwaZulu-Natal, South Africa, when people were asked their thoughts on vervet monkeys, about a third of the responses were negative due to the negative interactions that people have had with vervets caused by the vervet's aggression, such as raiding crop fields or homes (Patterson et al., 2018). In rural areas of Uganda, monkeys are often viewed as pests and in some cases might be killed by the local people (Mikula et al., 2018).

Currently, there have been no reports of aggression or damage to people's property in relation to the vervets in Dania Beach (Weinsier, 2021). This difference in temperaments and behavior of the two sets of vervet monkeys is potentially due to the difference in the nature of the human-to-vervet interactions that vervet monkeys in each of the locations experience. This research focuses on attempting to quantify a potential amount of human exposure time that a specific troop of the Dania Beach monkeys receives by creating a daily route in order to work towards answering the cause of apparent behavioral changes.

Experimental Methods

Study Population

The study included a vervet population with a total of 16 individuals that was composed of 5 (2 adult, 3 juvenile) male vervets and 11 females (6 adults, 5 juveniles) (Fig. 2). The population is located in Dania Beach, Florida at a Park 'N Fly parking lot. There is one other population of vervets in close proximity at the Park 'N Go parking lot, however, aside from when males disperse, the two troops do not interact and so it was not included in the study.

Camera Traps

The camera traps used in this study were from two different companies: Browning and GradePro. Beginning in November 2021, cameras were tested around several locations in the parking lot and the study ultimately used 7 locations (Fig. 3).

The camera traps were all motion-triggered and in picture mode. The cameras were set to take 3-4 photos with a 1-2 second delay after detecting motion. 32 GB SD cards were placed inside the cameras at all times.

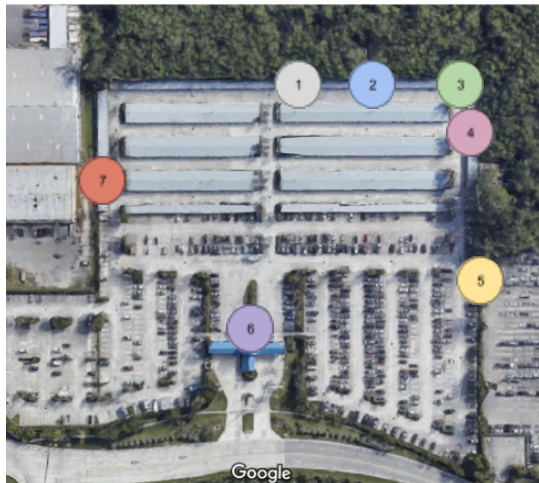


Fig 3. Map of Park 'N Fly taken from Google Maps (8) with approximate camera locations overlaid. Each camera has an associated number and color- Camera 1, grey; camera 2, blue; camera 3, green; camera 4, pink; camera 5, orange; camera 6, purple; camera 7, red.

Collecting Data

The SD cards were taken out from the camera traps generally twice a week and replaced with empty SD cards. The photos from the SD cards were placed onto a OneDrive account into various folders for each camera, and then all photos were erased from the SD card.

Sorting and Recording Pictures

The photos were manually sorted and any photos where there were no vervets seen were erased from the OneDrive folder (Fig. 4). Each photo taken by the cameras has the date and time the photo was taken, this information was recorded into a spreadsheet using a color coding system for the camera locations, as a general rule a time was included on the spreadsheet if the time before from the same camera was not closer than 9-10 minutes before (Fig. 5). The data was then reformatted into a new spreadsheet that lined up the hours of each day in a column and the final data inputted was from the dates 2/26/2022 - 6/9/2022 (Fig. 6).

Calculations and Creating the Map

Using the second formation of data, the number of days between the 104-day period that the cameras took photos of vervets during each individual hour was added, then divided by 104 and multiplied by 100 to get the average number of days the monkeys were seen at each location. This was repeated for each of the camera locations individually as well. Values higher than or equal to 20% for the total locations or higher than or equal to 10% for the individual locations were considered to be the most common times. Using the most common times, the daily ranges of 6 a.m. - 9 a.m. and 4 p.m. - 8 p.m. were made (Fig. 7).

Results

The results showed that the vervet monkeys were most commonly seen by the cameras between the hours of 6 a.m. - 9 a.m. and 4 p.m. - 8 p.m., with the most common time in total being at 7 p.m. and the most common camera site throughout the time-frame being the camera 1. Cameras 6 and 7 were found to have no individual hours in which the percentage of the days seen on that camera was above 10% and were therefore not considered to be part of the vervet's daily schedule.

A.M. Map

Based on the average amount of times each camera was seen per hour, the map shows the vervets as coming from the mangroves behind the parking lot and going to cameras 1, 2, and 3 with relatively equal frequencies. The vervets then make their way to cameras 1 or 3 depending on where they started and from there travel to camera 4. From camera 4, the vervets then go to

camera 5, where they presumably head into the mangroves to avoid the heat as the sun rises higher after 9 a.m (Fig. 8).

P.M. Map

Similarly to the a.m. map, this is also based on the average amount of times each camera was seen per hour. This map shows the vervets as coming from the mangroves back to the location of camera 5 at 4 p.m. (though they also may appear at 2 p.m.) and then traveling to camera 4. From camera 4, the vervets go to either camera 3 or 2 and ultimately make their way back to the mangroves going from either camera 1 or camera 2's site (Fig. 9).

Discussion and Conclusion

As the Park 'N Fly parking lot is open 24 hours a day, 7 days a week, whenever the vervets appear they are likely prone to some amount of human exposure either through customers of the parking lot or through the staff members on patrol. However, the busiest times of the FLL airport are found to be from 6:00 a.m. - 7:00 a.m. and 3 p.m. - 8 p.m. (Fort Lauderdale Hollywood airport FLL, 2022; USA Today, 2017). This is in line with the common times of the vervet's schedule being from 6 a.m. - 9 a.m. and 4 p.m. - 8 p.m. It is also worth noting that at any given time between 9 p.m. and 5 a.m. there was an average of a 6.22% chance of the vervets being seen by one of the cameras, despite being diurnal animals. It is possible that human exposure and positive interactions have altered the vervet's schedules, encouraging the vervets to travel at night when they would otherwise be asleep. Potential errors of this study include: the vervets being on the parking lot, but necessarily seen by the cameras; errors in sorting through photos by either including photos without vervets or disregarding a photo containing vervets; or changes in time due to the camera traps having a manually set time.

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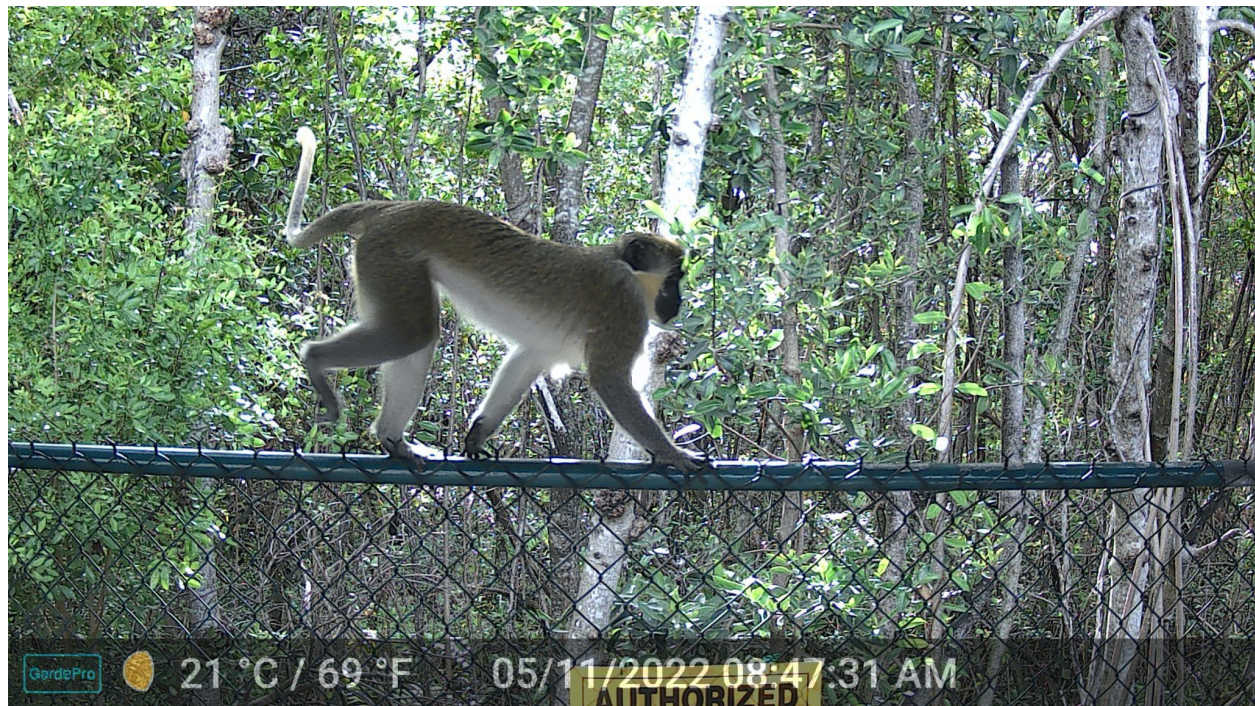
Figures and Tables



Fig. 1 To the left is the Fort Lauderdale International Airport, and to the right is the Park ‘N Fly parking lot in red and general territory of the vervet monkeys in orange. Image taken from Google Maps (8)

	Adult	Juvenile	Total
Male	2	3	5
Female	6	5	11

	Adult	Juvenile	Total
Total	8	8	16

[illegible]

date is located on the far left column in month/day format, and the times listed in each box indicate when a photo was taken on the camera trap.

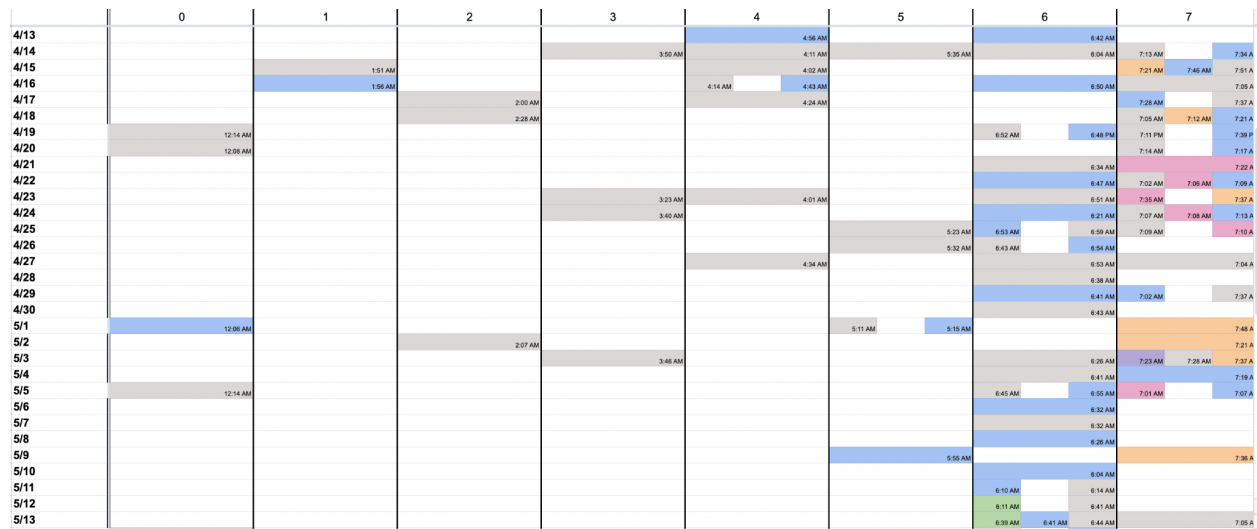


Fig. 6 Second formation of data (from 4/13 - 5/13), labeled by the hour using times 0-23, dates are on the far left column in month/day format, each color represents a camera location, and each hour shows the first time that a vervet was seen at a camera throughout the hour.

All cameras >=20																								
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
# of days	5	2	4	6	10	9	94	50	43	25	17	16	9	10	14	13	24	40	57	61	42	7	6	7
% of days	6	2	4	6	10	9	100	48	41	25	16	15	9	10	13	13	29	43	50	58	45	7	6	7
1 <=10																								
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
# of days	6	1	3	4	7	5	20	20	10	7	5	3	1	2	1	0	1	4	15	30	29	6	5	4
% of days	6	1	3	4	7	5	19	19	10	7	5	3	1	2	1	0	1	4	14	27	28	6	5	4
2 <=10																								
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
# of days	2	1	1	1	3	5	23	21	9	7	5	2	0	1	2	0	4	10	19	38	19	3	4	4
% of days	2	1	1	1	3	5	22	20	9	7	5	2	0	1	2	0	4	10	18	37	18	3	4	4
3 <=10																								
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
# of days	1	0	0	1	0	0	21	13	7	6	6	8	5	3	1	5	9	12	22	21	6	1	1	0
% of days	1	0	0	1	0	0	20	13	7	6	6	8	5	3	1	5	9	12	21	20	6	1	1	0
4 <=10																								
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
# of days	0	0	0	0	0	0	11	14	9	6	6	2	2	1	4	6	9	15	16	19	0	0	0	0
% of days	0	0	0	0	0	0	10	13	9	6	6	2	2	1	4	6	9	14	15	18	0	0	0	0
5 <=10																								
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
# of days	0	0	0	0	0	0	17	21	9	4	4	0	6	11	5	14	18	19	1	0	0	0	0	0
% of days	0	0	0	0	0	0	16	20	9	4	4	0	6	10	5	13	17	18	1	0	0	0	0	0
6 <=10																								
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
# of days	0	0	0	0	0	0	2	2	0	0	2	1	0	1	2	0	1	2	0	0	0	0	0	0
% of days	0	0	0	0	0	0	2	2	0	0	2	1	0	1	2	0	1	2	0	0	0	0	0	0
7 <=10																								
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
# of days	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of days	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Fig. 7 A table showing the total and specific camera locations' numbers of times being seen at each hour throughout the 104-day period. The percentages used for creating the map were highlighted in yellow, locations with no percentages at or above 10% have percentages highlighted in orange.

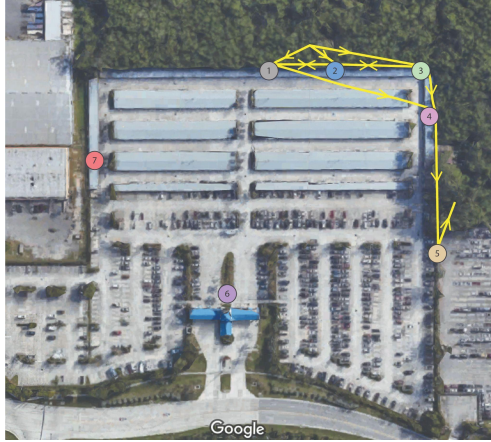


Fig. 8 Map from Fig 3. overlaid with the most likely routes of the vervets from 6 a.m. - 9 a.m. based on percentages from the cameras

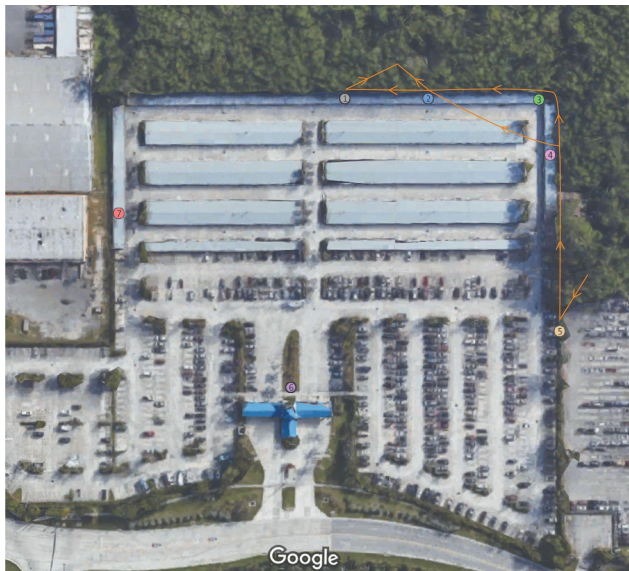


Fig. 9 Map from Fig 3. overlaid with the most likely routes of the vervets from 4 p.m. - 8 p.m. based on percentages from the cameras