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This dissertation is submitted in part fulfilment of the regulations for an MSc degree.

Oxford Brookes University

Statement of originality

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Abstract

The Jaraguá State Park in São Paulo, Brazil receives visitors daily, because of its famous tourist peaks, nature trails and the opportunity for people to have barbecues and celebration parties within the Atlantic forest and its wild monkey residents. Capuchins and marmosets usually interact with visitors by accepting food.

The study observed such interactions to understand why monkeys interacted with people. Locations where people and primates interact with the presence of food might have the potential for conflict between the participants. Consequently, the study considered the relationships between monkeys' agonism and the presence or not of food. In addition, the relationships between all interactions participants were also related to the monkey's agonism. The period of data collection were divided in weeks, where visitation is lower, and weekends with higher number of visitors. The environment and location of interactions were also considered via density of trees and choice of spot to interact by the monkeys.

To complete the study volunteer visitors participated in interviews to determine their opinions and attitudes towards having wild monkeys in an urban park and also what they knew about feeding the monkeys.

Most of the interactions occurred without the presence of food (54.6%), monkeys were majority in starting interaction during the week and they also ended most of them during both the week and weekends. During the weekends, people started most of the interactions. All interaction participants, monkeys and people, and the presence or not of food were all associated to the monkeys' agonism.

The high density of trees for the main interaction areas was considered to be important because most of all 1166 interactions (63.2 %) occurred on trees.

The majority of visitors considered the monkeys to be beneficial to the park and they were unanimous in saying they enjoyed observing the monkeys even if they feared or disliked them. Most visitors also said that the monkeys were mischievous, fun, pretty and brought people peace and happiness. Very few people mentioned that monkeys should not be in the park and that they were dangerous. In addition, people did not approved the idea of a platform feeder as it would not be good for the health of the monkeys and that people preferred the park as it is today.

On the basis of such results, it would be advisable to the Park to improve its conservation education programs and to involve more of the local community within such programs. The Jaraguá State Park is an Atlantic forest conservation hotspot with many endangered flora and fauna just 16 Km from the city centre of São Paulo. The park could be an ideal place to vouch for primate conservation, and conservation in general because it shows how an urbanized area can provide an important conservation message.

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1 . Introduction

The study of wild primates might be changing. Many wild monkeys today live in urbanized ecosystems instead of forests and they share their environment with people (Magle *et al.*, 2012; Sabbatini *et al.*, 2006; Luniak, 2004). At the 'Parque Estadual do Jaraguá', Jaraguá State Park (PEJ), Brazil, wild monkeys and visitors share public access areas and interact at a very close proximity. The presence of food brought by visitors seems to entice the monkeys to the zones of intensive use (ZUI) where trails, picnic, barbecue stands and playground areas are located. Similarly, the presence of monkeys entices the visitors to approach and observe their wild behaviour. However, at first sight it is not clear why monkeys interact with people at the PEJ. To investigate and characterize what influences monkeys to interact so closely with visitors and find out if there is any conflict related to food and to the participants of these interactions, a set of primate behavior observations were made and visitor's interviews applied. In addition, the environment (density of trees) at the PEJ is also considered as the park forested public areas seem to be important to both people and wildlife in a conservation area. The environment can be an important component in the primate-people relationship (Cunha *et al.*, 2006), especially for arboreal mammals (Eisenberg, 1981; Laurance & Laurance, 1999; Larney & Larson, 2004) like primates (Larney & Larson, 2004) that are mostly dependent on arboreal environments to survive (Chapman *et al.*, 2013; Chapman & Onderdonk, 1998) and especially in the Neotropics where large expanses of uninterrupted tree cover such as the Amazonia provide optimum primate environment (Hanya & Chapman, 2013; Peres, 1997).

1.1 Research expectations

The expectations of this study for the primate observations are; most interactions will involve food and more visitors will start the interactions than primates with mostly monkeys ending them. Also, there will be little aggression from monkeys involving or not food with very few real physical threats towards the visitors.

The expectations for the visitors' interviews are; most visitors will say that they do not feed the monkeys but they have seen other people feeding them. Also, after the visitors have been given some information about

the reasons why feeding the monkeys is not allowed, most of them will say that they prefer not to feed the monkeys. In addition, most visitors will say that the park should not allow platform feeders and that the park is to remain as it is today.

1.2 Primate-people conflict

The study of people-primate interactions in the literature usually comes from the perspective of conflict (Nekaris *et al.*, 2013; Lee & Priston, 2005; Southwick *et al.*, 1983). Conflict between people and primates in populated areas might develop when either people or primates are at some loss, such as crop raiding by monkeys in Japan (Sprague, 2002), India (Southwick *et al.*, 1983) and Africa (Hill, 2005; 2000; Naughton-Treves, 1998) or when there is no interest of people to keep monkey populations so close by their cities, similar to the aggressive behaviour by baboons towards people at tourist sites in South Africa (Kaplan *et al.*, 2011). The wild primate species in Brazil are different from their counterparts in other continents; however, conflict might still take place because of close proximity with people in urbanized ecosystems.

The importance of avoiding conflict and understanding how primate-people relationships develop at an urban park is critical, if we are to maintain such areas for conservation.

1.3 Importance of Conservation in the PEJ

Conservation is the reason why the PEJ is today a protected area. Although the park is surrounded by a densely populated area, urban area, it is a very important environment, where many endangered species still remain, such as the green beaked toucan, *Ramphastos dicolorus*, the brown-throated sloth, *Bradypus variegatus,* the ocelot, *Leopardus pardalis,* the chicken snake, *Spilotis pullatus* and the geoffroy's toadhead turtle, *Phrynops geoffroanus* (Schenell *et al.*, 2013, Freire dos Reis *et al.*, 2010). There are also critically endangered trees growing in the park such as the 'juçara' palm of heart, *Euterpe edulis* and the Brazilian cedar, *Cedrela fissilis* (Pereira *et al.*, 2013; Ribeiro *et al.*, 2013; Freire dos Reis *et al.*, 2010).

1.4 Wild primates at the PEJ

The only two wild primates that inhabit the PEJ are; the black-horned capuchin, *Sapajus nigritus*, and the common marmoset, *Callithrix jacchus*.

Capuchins are not a species usually seen as crop raiding pests (Freitas *et al*., 2008; Estrada, 2004) like the chimpanzees or baboons (McKinney, 2011), perhaps because capuchins are generally tolerant of people and people don't consider them as pests (Sabbatini *et al.*, 2006; 2008; Estrada, 2009), however when capuchins share an environment and compete with people for food there is a potential for aggression (Sabbatini *et al.*, 2006; 2008) and if they are unable to disperse and feed in a nearby forest, they remain living close to people and make use of all available resources, even if it means to threaten people and invade public or private property (Sales da Silva *et al.*, 2011; Sanqueta *et al.*, 2000).

Capuchins are very successful opportunistic omnivores whose manipulative skills allow them to make use of many opportunities to fulfill their daily needs (Ottoni & Izar, 2008; Visalberghi & Fragazy, 2012). At the PEJ aggression towards the visitors is limited to stealing items from people's hands or bags according to the park's incident reports, but generally capuchins there behave as naturally as if they were in the depths of a forest and they make frequent use of tools such as pieces of concrete or small rocks as hammers to crack the hard shells of the *Syagrus romanzoffiana* fruit and obtain the larvae from inside. This is easily observable at the PEJ and has been studied (Da Silva, 2008), but not yet published such as for other parks in São Paulo, like the Ecological Tietê Park (Ottoni & Izar, 2008; Ottoni, 2009).

Marmosets are also not traditionally related to people-primate conflict studies (Goulart *et al*, 2010; Leite *et al*, 2011) as they are usually regarded as pets (Chomel *et al.*, 2007) or laboratory animals (Duarte *et al.*, 2012), but marmosets such as the PEJ ones, *Callithrix jacchus*, have managed to spread their home range from the northeast of Brazil, where they are native, to southern Brazil hybridizing with other local native marmosets such as *Callithrix aurita* (Norris *et al.*, 2011) and *Callithrix penicillata* (Smith *et al.*, 2010).

Today, in Brazil, many marmosets of the *Callithrix jacchus* species are considered to be invasive and competing with other native species all over the country, such as lion tamarins (Ruiz-Miranda *et al.*, 2006) which might suffice to create a public policy to remove hybrids (Oliveira *et al.*, 2012). This situation might become a people-primate conflict if hybrids are to be removed from parks where people consider them to be residents.

Consequently, studying the relationships between visitors and resident primates at the PEJ might help understand if conflict exists already and how people deal with having wild primates in the park.

1.5 Study of urbanized areas

The interest of studies of wildlife in populated areas appears to be growing as urbanization becomes increasingly common (Magle *et al.*, 2012). Many wild primate species today do not necessarily live within the depths of large expanses of forest (Sambuichi & Haridasan, 2007; Williams-Guillen *et al.*, 2006), but live in relative small urbanized ecosystems also occupied or utilized by people (Sabbatini *et al.*, 2006; 2008; Ottoni, 2009). Such places might help maintain metapopulations of endangered species because these areas concentrate some of the most important expanses of protected land where endangered fauna and flora species still remain. This is the case of remnant areas of the Atlantic Forest in Brazil, one the world's natural hotspots (Courchamp *et al.*, 2013).

The choice of studying urbanized ecosystems and its wildlife might not only be because of its importance as a remnant area of Atlantic forest, but also for other reasons. Places such as the PEJ offer a daily safe opportunity for anyone, from children to adults, to see wildlife, experience it and even participate in free educational activities related to conservation of their own local park and their native biodiversity. If urban settings, such as the PEJ, can support biodiversity, and by their presence raise awareness for the value of biodiversity and the need to protect it, this provides an ideal opportunity for combining biodiversity protection with education opportunities, in an effective and economically sustainable manner.

Consequently, the study of people-primate interactions there becomes critical for primate conservation.

The study and characteristics of urban settings present other challenges for wildlife conservation such as fragmentation, isolation, genetic bottlenecks, anthropogenic influences, urban encroachment, non-native encroachment of flora and fauna and possible disease spread among many other claims (Chiarello, 1999). However, the focus of this study is on associations of conflict with the food given or not by visitors, on how people perceive having wild monkeys in the park and how the interactions environment is utilized by monkeys and people. The study is focused on the presence of food and its consequences for primate-people interactions as food handouts are reported as a precursor of aggression towards people (Sabbatini *et al*, 2006; Zao & Deng, 1992). In order to understand, minimize and perhaps resolve possible conflicts at the PEJ, the interactions between people and primates need to be studied.

This study also understands that primate observations might want to include population health indicators, such as the presence of infants, demography, social structure and body condition (Altman & Alberts, 2005). Such health indicators might also help explain behavior while interacting with visitors, and the relationships within and between primate groups (Sapolsky *et al.*, 2005). And finally, the study also investigated the presence of agonistic acts by monkeys in the presence of food and without the presence of food (Sabbatini *et al.*, 2006). Such interaction observations combined with the visitors' interviews and with the environment density of trees might be able to reveal the details of how monkeys and people interact in the PEJ.

2. Methods

2.1 Study area

The study took place at the 'Parque Estadual do Jaraguá', Jaraguá Estate Park (PEJ) in the city of São Paulo, Brazil. The PEJ's coordinates are 23º 27'30" S 46º 45'55" W and it is located (see fig.1) only 16km from São Paulo city centre, estate of São Paulo in Brazil.

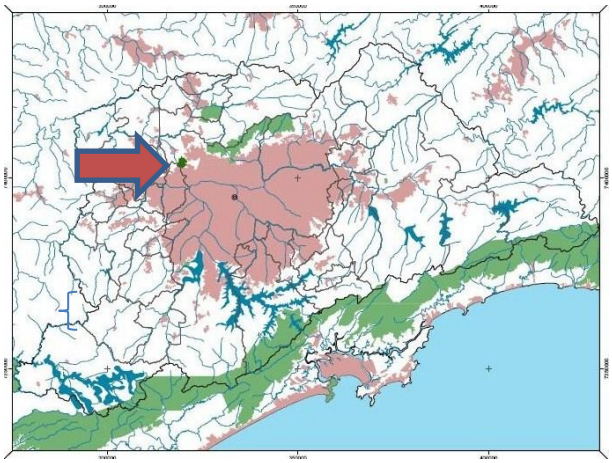

Fig.1: River and land map view of part of São Paulo State. Dense populated areas appear in pink and areas in green represent conservation units, including the PEJ pointed out by a red arrow (adapted from Freire dos Reis *et al.*, 2010).

The park's area and surrounding region were used in the 1600's to explore alluvial gold and after that in the 1800's it became a coffee farm, but only after the coffee crisis in 1929 was the park completely reforested with native Atlantic forest trees (Freire dos Reis *et al.*, 2010). The park was bought by the state in 1939 to be a conservation area, it became state park in 1961 and in 1994 it was declared by the United Nations a 'Mankind's heritage for Education, Science and Culture' as one of the 'Biosphere reserves of the Brazilian Atlantic forest' (Freire dos Reis *et al.*, 2010). Today the park is part of the green belt reserves of the Atlantic forests of São Paulo (Freire dos Reis *et al.*, 2010).

The park has a total area of 492.68 ha, with a perimeter of 11 km (see Fig. 2). The state park is a conservation unit and it is protected by federal, state and municipal environmental laws. The areas that people are allowed to visit are limited to a few small places and the total area of the zones of intensive use (the park's definition of public and staff use areas) is 35.02 hectares which represents 7.07% of the total area of the park (Freire dos Reis *et al.*, 2010).

Fig.2: An aerial view of the PEJ encircled by the main roads with its perimeter in red colour (Freire dos Reis *et al.*, 2010).

The research took place only at the zones of intensive use (ZUI), which includes natural areas and man-made areas. All the public services are concentrated in the ZUI, such as the 5 forest trails, Visitors Centre, museum, Education Centre, historical buildings, lake, open air theatre, amphitheatre, snack bars, toilets, office buildings, barbecue stands, playground, international Scouts' association building, small guard lodges and residential areas for a few working residents. The park has television and radio antennas on the top of its peaks, they are the highest peaks of the state of São Paulo, a major tourist attraction, with 1135m (Jaraguá peak) and with 1127m (Papagaio peak). Additionally, members of the indigenous Guarani tribes live outside the park in the surrounding area near the main entrance (Freire dos Reis *et al.*, 2010; Olmos *et al.*, 2004). The rest of the park outside the ZUI areas is closed to the public and is monitored daily by the guards and PEJ monitoring staff against illegal hunting and deforestation activities.

This is where the study took place, at one of world's conservation hotspots, the PEJ, a small park of almost 500 hectares of Atlantic forest (see figs.1 and 2) once connected to two other parks nearby, the Serra da Cantareira Park with 7.916.52 hectares and Anhanguera Park with 900 hectares (Freire dos Reis *et al.*, 2010). The largest reserve of Atlantic forest in São Paulo state is the Serra do Mar Park with 315.000 hectares (Pedroni *et al.*, 2013).

The areas from the ZUI utilized by this research were where monkeys and visitors met. The interactions were mainly concentrated at the barbecue stands, picnic areas, playgrounds, entrance of the park, forest trails, mountain peaks and paved roads leading to these areas within the main visitor locations.

2.2 Study species

The two primate species occurring at the PEJ are the black-horned capuchin, Sapajus *nigritus,* and the common marmoset, *Callithrix jacchus*. They are wild and make use of the almost 500 hectares of trees for feeding, resting, hiding and sleeping sites. They make good species to work with because observations can be made directly and their species specific natural behaviour characteristics can be seen at very close proximity, such as capuchin tool use (Visalberghi & Fragazy, 2012; Ottoni & Izar, 2009) and marmoset vertical clinging to tree trunks to get edible exudates (Duarte *et al.*, 2011; Garber, 1992). Also, they are tolerant of human presence, they move slowly enough to allow for observations to be made, they are naturally active during the park's opening hours, their natural behavior of foraging for food within trees and on the ground floor, and by utilizing social interactions (social learning, hierarchy) is suited to the study's questions (for capuchins Verdeane *et al.*, 2013; Visalberghi & Fragazy, 2012 and for marmosets Rapaport & Brown, 2008; Schiel & Huber, 2006). Also, there is an extensive literature available on the biology and behavior for both species. In addition, the chosen species are found in other similar park settings in Brazil, such as the nearby Cantareira Park and Anhanguera Park also in São Paulo city (Freire dos Reis *et al.*, 2010) and the Brasília Park in the country's capital (Sabbatini *et al*., 2006; 2008).

The origins of the primates in the PEJ are uncertain, though it is thought the founder population comprised animals that were released from a small zoo in the park when it was closed in the 1960's. Other animals are thought to have come from the illegal pet trade and were released by their owners or by the local authorities (Freire dos Reis *et al.*, 2010; Ottoni, 2009). However, the extant populations of primates in the PEJ today are very likely to have been born there.

2.3 Primate behaviour data collection

Sampling consisted of primate behaviour observations, visitors' interviews and tree density in the visitation areas. All data were collected during autumn/winter, from May through July 2013, on 26 week days and 26 weekend days and holidays. Data collection was dependent on the weather and on the monkeys' appearance together with visitors (see fig. 3 and 4), which was generally unpredictable. Visitors' data were obtained from interviews collected during the same days as primate observations. All data were gathered only during the parks' opening hours, from 7am until 5pm. The researcher went to the park on rainy days but there was no collection of data because monkeys and visitors were not present.

Fig 3: Typical interaction between visitors and capuchins (red arrow).

Fig 4: Typical interaction between visitors and marmosets (red arrow).

In this research, '*ad libitum'* (Altmann, 1974) and 'continuous sampling' (Martin & Bateson, 2007; Rose, 2000) recording methods were used because they provide more information on the repertoire and frequency of behaviours displayed by the monkeys with visitors. Such recording methods aim to observe more detailed interactions than only those within a predetermined time of sampling. This is important because such interactions might reveal interesting results when comparing the different variables and their frequencies. The sampling methods adopted were used to increase the chances of observing key behaviours without focusing on particular individuals or conspicuous behaviours (Martin & Bateson, 2007; Ruxton & Colegrave, 2003).

Table 1: Primate behaviour variables with categories for primate direct observations.

interaction questions	categories (answers or variables)
Which monkey agent?	male, female, juvenile
Which monkey species are involved?	capuchin marmoset
What are the numbers of monkeys involved?	demography 1, 2 (or more)
Which type of target the monkeys interacted with?	man, woman, children, conspecific, non-conspecific, dog
Who started the interaction?	human or monkey
Who ended the interaction?	human or monkey
Where did the interaction take place?	ground floor table (picnic or barbecue) bin three barbecue stand roof trail banister car
Any agonistic act by monkeys?	agonistic act
What type of food was involved?	sugar based foods (fruit, sweets, sweet biscuits, cotton candy, popcorn) salt based foods (salty biscuits, bread, meat, salt, flour) liquids (bottled drinks) food in the rubbish bin food on the floor
What type of agonistic act?	monkey attacks person repeated loud vocalizations alarm vocalizations shakes branches throws something at target physical threat (touch) facial threat (shows gums and teeth) faeces on target or near target attacks conspecific (touch)
Was the interaction with or without food?	interaction with food interaction without food

Vocalizations (see table.1) are considered as agonistic acts when occurring within the context of an interaction. The sounds here considered are different from contact calls or feeding calls. Vocalizations must be clearly loud and repetitive or of an alarm tone according to what is happening in the field during the interaction, the variable that shows this is 'type of agonistic act' (Marques, 2008; De Resende *et al*., 2007; Balestra *et al*., 2003; Di Bitetti *et al.*, 2003).

2.4 Collecting data process

The process of collecting data occurred when both primates and visitors were noticing each other's presence at the same time. The moment when the first subject (people or monkey) initiated an interaction often it took the form of approaching the other and getting their attention, which was considered as the beginning of an interaction. Each interaction was watched until the end and when one of the subjects terminated the interaction by leaving or ceasing to pay attention to the other, it was considered the end of an interaction.

An example of a completed data sheet it is in Appendix I. The interaction questions (see table.1) were followed in sequence when completing each data sheet row to make an individual, meaningful and detailed account of each interaction.

The interaction categories to be completed in each row of the data sheet following the variables table (see table.1) are seven as follows; (1) monkey agent (s), species and demography, (2) who initiates and who ends interactions and target; (3) location of interaction; (4) action 1 by agent; (5) type of food; (6) type of agonistic act and (7) interaction with or without food.

2.5 Behavioral data recording protocol

At the very beginning of April a three week pilot study was conducted and a selection of possible observations noted and check sheets and interview questions adapted accordingly. After that, directly observed behavioral data were collected and recorded on designed check sheets. The subjects (monkeys or visitors) were reasonably close to the researcher, at a maximum of 3m.

All observations happened lower down nearer the ground floor and not up in the tree canopy. Consequently, interactions were clearly visible and occurred no further than 5m from researcher.

As exemplified in Appendix I, each row of the field observation check sheet tells the full story of an interaction. Each observed interaction took a few seconds to a few minutes. Every time a monkey was observed near a person or a person moved towards a monkey the researcher was present and watched the full interaction until the end. Immediately after the end of an interaction, it was noted down, only then was another interaction observed.

The sex of the monkey agent was only noted down when it was clearly visible, i.e. males (testicles) and females (clearly carrying infants). This was only possible in capuchins, because in common marmoset's males can carry infants as well, due to the parental care system (Nievergelt *et al.*, 2000; Tardiff, 1997). Therefore, because the marmosets' sex was not visible they were only identified as species. In addition, when the sex of a juvenile capuchin was not visible, only the status 'juvenile' was noted down.

2.6 Recording methods: visitors' interviews

A series of Structured interviews (see table.2), including open ended questions, were completed with 115 willing volunteers (see ethics and permissions in Appendix II) visiting the park.

Only those visitors who confirmed they had seen the monkeys, irrespective of whether they had interacted with them or not, were invited to participate.

The interviews aimed at understanding the opinions and attitudes of visitors towards the presence of wild monkeys in the park, including whether visitors were aware of existing environmental laws prohibiting visitors feeding the monkeys, and how compliant people were with these regulations.

Table 2: Structured open ended interview survey questions.

visitors' questionnaire	
question number	questions
1	Determine visitor's sex
1a	Determine visitor's age
2	Is this your first visit or do you come here often?
3	What is the reason for your visit today?
4	What do you know about this park?
5	What do you think about having wild monkeys in the park during your visit?
6	Did you feed the monkeys today?
6a	Did you see anyone feeding them today?
6b	Why do you think people feed them?
7	Are there any benefits or not to your visit in finding wild monkeys in the park?
7a	What is the benefit or the disadvantage in finding wild monkeys in the park?
8	Would you prefer this park with or without monkeys?
8a	Why?
9	Do you enjoy or not observing the monkeys behaviour?
9a	Why?
Information given	Explain to visitor about the environmental law and then ask if he would change his behavior after knowing the reasons not to feed the wild monkeys: THE BRAZILIAN ENVIRONMENTAL LAW DOES NOT ALLOW PEOPLE TO FEED WILDLIFE AS IT IS A CRIMINAL OFFENSE, BUT ALSO TO AVOID CONFLICTS WITH PEOPLE AND ENCOURAGE ANIMALS TO SEARCH FOR NATURAL FOOD SOURCES. THE PRIMATES HERE HAVE ENOUGH FOOD IN THE FOREST, BUT NOW THEY GOT USED TO PEOPLE FEEDING THEM. THE PRIMATES HERE MAY NOT UNDERSTAND IF PEOPLE STOP FEEDING THEM AND EVENTUALLY THEY MIGHT BEHAVE AGGRESSIVELY TOWARDS THE VISITORS. IN ADDITION, PEOPLE FOOD INCLUDING FRUITS, CAUSE DECAY IN THE MONKEYS DENTITION (HIGH SUGAR AND SALT CONTENT) AND MIGHT RESULT IN HEALTH PROBLEMS. THE MONKEYS HERE MIGHT TRANSMIT DISEASES SUCH AS RABIES AND HERPES, IF THEY BITE OR SCRATCH VISITORS.
10	After knowing more about the reasons why not to feed the monkeys, would you prefer to feed them anyway?
10a	What if the park decided to use a platform feeder so people could leave any food there without interacting so close to the monkeys, do you agree?
10b	Or do you prefer that the park stays as it is, even if we could not feed the monkeys?

The data collected during each Structured interview were coded as numbers (see table.12) according to visitors' answers. There were no pre-determined answers or multiple choices. All types of visitors answers were considered and later grouped if similar replies appeared. The visitors were free to answer the questions as they pleased.

2.7 Some methodological considerations:

2.7.1 Random variation, replication and sampling

The PEJ has a few troops of capuchins and marmosets, but not all of them necessarily interact with visitors. The park has small open visitation areas and other larger areas are closed to visitors. The study is focused on those individuals that choose to interact with visitors. Consequently, they share the same environment, might be related and undergo pseudo replicated stimulus. This could compromise the independence of data points. To control for pseudo replication and the effects of random variation the following measures were taken. When an individual capuchin was recognizable its data were removed from the final analyses. Additionally, the researcher took care to collect data from different public parts of the PEJ. The peak public areas have limited access to different troops and the distance between the peaks and other public areas was about 5km. Also, the number of replicates was reasonably large, troops of 15 to around 20 individuals or more could be easily identifiable as belonging to different groups acting in different areas of the PEJ, both for marmosets and capuchins.

There is no perfect study (Wiley, 2003) and if the focus of research is to understand how primates interact with visitors at one particular site, the sample has to be representative of that area and its individuals. The use of controls to avoid and minimize the effects of between-individual variation, pseudo replication and lack of randomization were utilized from the experimental design to the data collection, analyses and the interpretation of results. The conclusions might also be affected and limited but can still be useful to general conservation and in places like the PEJ.

The researcher presence effect on visitors and monkeys was also considered on this study. It was clear that the researcher's presence could be affecting how monkeys and people behaved.

To minimize such influences on the data collection, the researcher avoided as much as possible being noticed by monkeys and visitors by staying not so close to them. Also, the interviews were only applied when monkeys were not present.

2.8 Tree density and area measurement

Some areas within the ZUI seem to be preferred by the monkeys for interacting with people in. Such areas were noticeably dense (see fig.5) in trees. Such landscape seemed to be important to visitors and monkeys, as they were heavily used by both. To determine tree density of these areas a simple counting method was utilized. The two areas A (A=barbecue) and B (B=playground) were measured by e-trex 10 Garmin GPS and their area calculated. The two areas (A, B) are connected, the shape uneven and there is not a half and half division. Therefore the entire area was sampled as one to guarantee that all possible areas had the same chance of being sampled. The entire area was relatively small and the researcher was able to count and recount the exact number of trees in the two areas by using parking cones. The parking cones were utilized as area boundaries and the trees among those boundaries were counted until all boundaries were sampled to obtain the total number of trees per square meter.

Fig 5: The trees near the barbecue stands area with terracotta tiles.

To determine the average tree diameter at breast height (DBH) and circumference at breast height (CBH) the areas were randomly sampled. The measured areas A and B were divided in random points in the GPS grid map and 30 random squares of $9m^2$ were chosen and placed in each area. The sampling squares were made of 4 ropes of 3 meters each to form a square figure, the ropes were connected with nails. For each sampling square, the number of trees that were rooted within the squares were considered and the trees' CBH measured by putting the measuring tape around each tree trunk at the researcher's breast height, to calculate the DBH of each tree. Here all trees were considered, even with DBH $\leq$ 10cm, because they were all utilized by monkeys.

2.9 Ethical issues and ethics clearance

There were some potential ethical issues during the research that were dealt with via my research design.

The first issue was to do with the inability of visitors to understand why more than one person at a group of people could not answer my interview questions and why people under 18 years old could not also volunteer at interviews. The researcher explained that if more than one person in a group of people answered the same questions, the answers could be influenced by the group and that people under 18 years old are not legally adults in Brazil, therefore they did not qualify as adult volunteers.

On a few other occasions, volunteers and park's staff wanted me to explain why I could not include the indigenous tribes and park's employees in my questionnaires, in other words, why their opinions were not important to my research. It was explained that such groups of people were not included because they were not visitors to the park and if they were included it would influence the results and the validity of my study.

The last ethical issues were the most complicated to deal with. I was not able to interfere when monkeys were being fed or attacked by people. I was occasionally thought by some people as working in the park and therefore not following the law. All park's staff are asked to stop such actions as part of their jobs.

I was questioned by visitors and park's employees about it and after explaining about my research and the possible positive results to the park, people understood that my intentions were good, but that created another ethical problem. Visitors and staff decided to help me by not doing their jobs when they noticed I was present, so they did not stop people feeding the monkeys and did not stop people attacking the monkeys. Consequently, I had to explain that I wanted the park to be as if I was not there and it would be very helpful to me if visitors and staff carried on as they usually do, because then I was able to really assess a typical day and get better results.

My explanations to visitors and staff seemed to settle the potential ethical issues encountered.

This project was given ethics clearance by the University Research Ethics Committee at Oxford Brookes University prior to beginning data collection. Please see Appendix II for completed and signed paperwork.

2.10 Data Analysis

The data were collected in the form of counts by using '1' as the event occurred and '0' if there was no occurrence of the behavior. The counts were initially examined using descriptive statistics such as frequency tables, and subsequently analyzed by Chi-square statistics testing method.

The Chi-square test of association was straight forward to carry out from a table of counts of observations if the data is arranged so that each individual is represented by a row with entries in two columns for the two factors to be compared. Percentages or data transformations cannot be done to frequency tables if Chi-square is to be applied. It must be carried out on frequencies (numbers of observations) and not on data transformed in any way due to information loss when variables are forced into a small number of categories. The way in which Chi-square worked was by looking at associations of two categorical variables, which is the intention of this research. There were no assumptions made about the form of data because Chi-square is a non-parametric test without a parametric equivalent.

The analysis utilized two categories of variables that might have an association or not to be able to reject or accept each Null hypothesis.

If the data associations were confirmed by Chi-square, the research's hypothesis about the relationships between the presence of food given by the visitors and the agonistic acts performed by the wild monkeys at the PEJ would be accepted or rejected. Associations between the participants of the interactions, such as the subjects that started the interactions (people and monkeys) and monkeys' gender and species are also compared to the agonistic acts to see if there are any associations between them.

The significance was determined by $p<0.05$ as good and $p<0.001$ as very good association and the statistical package used was SPSS 19 and Excel for Word 2010.

The density of trees was calculated for a areas A+B as representative of all forested public areas of the PEJ because it was there that most interactions occurred and ended, to determine whether monkeys' preferences for a forested area might be explained, at least in part, by tree density.

3. Results

3.1 Interactions' variables and categories

A total of eleven interaction questions generated 11 variables or categories for each period of data collection, week days and weekends. The data collected shows the observed interactions between visitors and primates in the PEJ. The eleven interaction questions had a few categories each (see table.3) and the data were divided in week days (S) and weekend days (F).

Table 3: Interaction questions proposed and collected variables during the week and weekends at the PEJ.

interaction questions	proposed variables	collected variables (S or F)
Which monkey agent?	male, female, juvenile	agent (male, female, juvenile) (S or F)
Which monkey species are involved?	capuchin marmoset	capuchin (S or F) marmoset (S or F)
What are the numbers of monkeys involved?	demography 1, 2 (or more)	demography 1, 2 (S or F)
Which type of target the monkeys interacted with?	man, woman, children, conspecific, non-conspecific, dog	as target(man, woman, children) (S or F) as target (conspecific, non-conspecific, dog) (S or F)
Who started the interaction?	human or monkey	starts (human or monkey) (S or F)
Who ended the interaction?	human or monkey	ends (human or monkey) (S or F)
Where did the interaction take place? (location for most of the interaction time)	ground floor table bin tree kiosk roof trail bannister	where (ground floor)(S or F) where (table) (S or F) where (bin) (S or F) where (tree) (S or F) where (roof) (S or F) where (trail banister) (S or F)
Any agonistic act?	agonistic act	action1 (agonistic act) (S or F)
What type of food was involved?	sugar based foods salt based foods liquids food in the rubbish bin food on the floor	sweet food (S or F) salty food (S or F) liquid food (S or F) food from bin (S or F)
What type of agonistic act?	monkey attacks person alarm vocalization shakes branches throws something at target repeated loud vocalization facial threat faeces on target or near target physical threat	agonistic act attacks person (S or F) agonistic act vocal alarm (S or F) agonistic act shakes branches (S or F) agonistic act throws something (S or F) agonistic act vocal repetitive loud (S orF) agonistic act facial threat (S or F) agonistic act faeces (S or F) agonistic act physical threat (S or F)
Was the interaction with or without food?	interaction with food interaction without food	interaction with food (S or F) interaction no food (S or F)

(S) week (F) weekend

The above interaction questions table had a total of thirty six variables (see table.3) to direct the data collection in the field.

Table 4: The total numbers of interactions, sampling days and sampling hours.

sampling period	number of interactions	number of sample days	number of sampling hours per day	mean number of observed interactions per day	mean number of observed interactions per hour
week days	416	26	6	16	2.6
weekends	750	26	6	28.8	4.8
totals	1166	52	312	44.8	7.4

The data collection at the PEJ (see table.4) took 52 days from May through to July, 26 days during the week and 26 days during the weekends. A total of 1166 interactions were observed, with 416 in the week and 750 at the weekends. Each sampling day lasted around 6 hours and during those hours interactions were observed, with a mean value of 16 interactions per day during the week and 28.8 during the weekends. In addition, the mean value of observed interactions per hour were of 2.6 in the week and 4.8 in the weekends. The total number of observation hours was around 312 within the 3 months of research at the PEJ.

3.2 Interactions frequency tables

The collected data were in the form of counts, so frequency tables could be created and the number of observations characterized and compared. The frequency tables (see table.5) are divided in week days and weekends.

Table 5: Week day's frequency table with collected variables.

variable name week days(S)	frequency	percentage of the total (%)	variable name week days(S)	frequency	percentage of the total (%)
agent maleS	105	25.2	agonistic act vocal alarmS	5	1.2
agent femaleS	69	16.6	agonistic act shakes branchesS	4	1.0
agent juvenileS	139	33.4	agonistic act throws somethingS	4	1.0
capuchinS	312	75	agonistic act vocal repetitive loudS	35	8.4
marmosetS	108	25.7	agonistic act facial threatS	5	1.2
demographyS (1)	231	55.5	agonistic act faecesS	5	1.2
(2 or more)	182	43.6	agonistic act physical threatS	2	.5
man as targetS	91	21.9	sweet foodS	41	9.9
woman as targetS	119	28.6	salty foodS	61	14.7
children as targetS	198	47.6	liquid foodS	9	2.2
not conspecific as targetS	1	0.2	food from binS	7	1.7
dog as targetS	6	1.4	where treeS	230	55.3
conspecific as targetS	6	1.4	where roofS	62	14.9
man startsS	183	44	where trail banisterS	0	0
monkey startsS	234	56.3	where tableS	8	1.9
man endsS	81	19.5	where binS	26	6.3
monkey endsS	334	80.3	where ground floorS	90	21.6
action1 agonistic actS	60	14.4	interaction with foodS	125	30
agonistic act attacks personS	8	1.9	interaction no foodS	287	69

The table of frequencies (see table.5) shows the numbers of occurrences or counts for each variable during the week days of research.

The agents that participated in the interactions were in the majority composed of 139 juveniles (33.4%) followed 105 males (25.2%) and 69 females (16.6%). There were more capuchins interacting than marmosets, with 312 (75%) capuchins for 108 marmosets (25.7%).

The number of monkeys that participated in the interactions were mainly alone with 231 individuals (55.5%) and 182 duets (43.6%) or more interacted together with visitors.

The type of targets that interacted with monkeys were mainly children with 198 counts (47.6%), followed by women with 119 counts (28.6%) and men with 91 counts (21.9%). The other targets that were also involved during the interaction were 6 counts of conspecifics and 6 counts of dogs (1.4%) each and only 1 count of not conspecific (0.2 %) was involved while monkeys interacted with people, in this case it was an eagle.

The interactions were mainly started by monkeys with 234 'starts' (56.3%) and then by people with 183 counts (44%) of the total. The termination of interactions was mainly done by monkeys with 334 counts (80.3%) while people only finished 81 interactions (19.5%) of the total.

The location of interactions was mainly on 'trees' with 230 counts (55.3%) followed by the 'ground floor' with 90 counts (21.6%), then 'kiosk roofs' with 62 counts (14.9%), 'rubbish bins' with 26 counts (6.3%) and 'tables' with 8 counts (1.9%). There were no recorded observations for interactions in the 'top of cars' or on the 'trails' bannisters'.

After that, comes the 'agonistic acts' by monkeys with 60 counts (14. 4%).

The type of food given or utilized by monkeys during interactions were mainly 'salty based' foods with 61 counts (14.7%) followed by 'sweet based' foods with 41 counts (9.9%), by 'liquids' with 9 counts (2.2%), by 'food from bins' with 7 counts (1.7%).

The types of 'agonistic acts' performed by monkeys during interactions were mainly 'loud repetitive vocalizations' with 35 counts (8.4%), followed by monkeys 'attacking people' with 8 counts (1.9%). Also there were 'facial threats', 'faeces' and 'vocal alarm calls' with 5 counts (1.2%) each, then 4 counts (1 %) each with monkeys 'throwing something' at visitors and 'shaking branches'. Finally, there were 2 counts (0.5%) with monkeys doing 'physical threats' towards the targets.

From the total of interactions, 287 were 'without the presence of food' (69%) and 125 were 'with the presence of food' (30 %) of the total.

Table 6: Weekends frequency table with collected variables.

variable name weekends(F)	frequency	percentage of the total (%)	variable name weekends(F)	frequency	percentage of the total (%)
agent maleF	224	29.9	where tableF	12	1.6
agent femaleF	99	13.2	where binF	28	3.7
agent juvenileF	274	36.5	where treeF	508	67.7
capuchinF	591	78.8	where roofF	71	9.5
marmosetF	156	20.8	where trail banisterF	0	0
demography (1)	525	70	sweet foodF	227	30.3
(2 or more)	225	29.9	salty foodF	127	16.9
man as targetF	272	36.3	liquid foodF	18	2.4
woman as targetF	304	40.5	food from binF	19	2.5
children as targetF	153	20.4	agonistic act attacks personF	8	1.1
conspecific as targetF	14	1.9	agonistic act vocal alarmF	15	2.0
not conspecific as targetF	1	0.1	agonistic act shakes branchesF	11	1.5
dog as targetF	42	5.6	agonistic act throws somethingF	7	0.9
monkey startsF	280	37.3	agonistic act vocal repetitive loudF	108	14.4
man startsF	460	61.3	agonistic act facial threatF	8	1.1
monkey endsF	631	84.1	agonistic act faecesF	3	0.4
man endsF	110	14.7	agonistic act physical threatF	9	1.2
action1 agonistic actS	169	22.5	interaction with foodF	400	53.3
where ground floorF	129	17.2	interaction no foodF	350	46.7

The table of frequencies (see table.6) shows the numbers of occurrences or counts for each variable during the weekends. The agents that participated in the interactions were composed of 274 juveniles (36.5%), followed 224 males (29.9%) and 99 females (13.2%). There were more capuchins interacting than marmosets, with 591 (78.8%) capuchins for 156 marmosets (20.8%).

The numbers that participated in the interactions were in the majority alone with 525 counts (70%), then 225 counts were duets (29.9%) or more monkeys interacting together with visitors.

The type of targets that interacted with monkeys were mainly 'women' with 304 counts (40.5%) followed by 'men' with 272 counts (36.3%) and 'children' with 153 counts (20.4%). The other targets that were also involved during the interaction were 14 'conspecifics' (1.9%) and 42 'dogs' (5.6%) and only 1 'not

conspecific' (0.1%) was involved while monkeys interacted with people, in this case it was a group of squirrels.

The interactions were mainly started by people with 460 'starts' (61.3%) and then monkeys with 280 counts (37.3%) of the total. The termination of interactions was mainly done by monkeys with 631 counts (84.1%) while people only finished 110 interactions (14.7%) of the total.

The location of interactions was mainly on 'trees' with 508 counts (67.7%) followed by the 'ground floor' with 129 counts (17.2%), then 'kiosk roofs' with 71 counts (9.5%), by 'rubbish bins' with 28 counts (3.7%) and tables with 12 counts (1.6%). There were only one recorded observation for an interaction in the 'top of cars' (0.1%) and there were no recorded interactions on the 'trails' bannisters'.

There were 169 counts (22.5%) of monkeys performing 'agonistic acts' in action 1 variable.

The 'type of food' given or utilized by monkeys during interactions were mainly 'sweet based' foods with 227 counts (30.3%) followed by 'salty based' foods with 127 counts (16.9%), by 'food from bins' with 19 counts (2.5%) and food as bottled drinks as 'liquids' with 18 counts (2.4%) being consumed during interactions.

The types of agonistic acts performed by monkeys during interactions in the weekends were in the majority 'loud repetitive vocalizations' with 108 counts (14.4%), followed by 'vocal alarm calls' with 15 counts (2%). Also, there were monkeys 'shaking branches' with 11 counts (1.5%), monkeys doing 'physical threats' with 9 counts (1.2%) and with 8 counts each (1.1%) monkeys were displaying 'facial threats' and 'attacking' people. After that, there were agonistic acts with monkeys 'throwing something' at visitors with 7 counts (0.9%) and finally monkeys utilizing 'faeces' with 3 counts (0.4%).

From the total of interactions 400 were 'with the presence of food' (53.3%) and 350 were 'without the presence of food' (46.7 %) of the total.

3.3 Interactions frequency tables' comparison

For such a large amount of data collected a good visual inspection is important, so a comparative histogram (see fig.6) provides some assistance in visualizing the entire interactions data set at once. Please see the histogram on the following page 33.

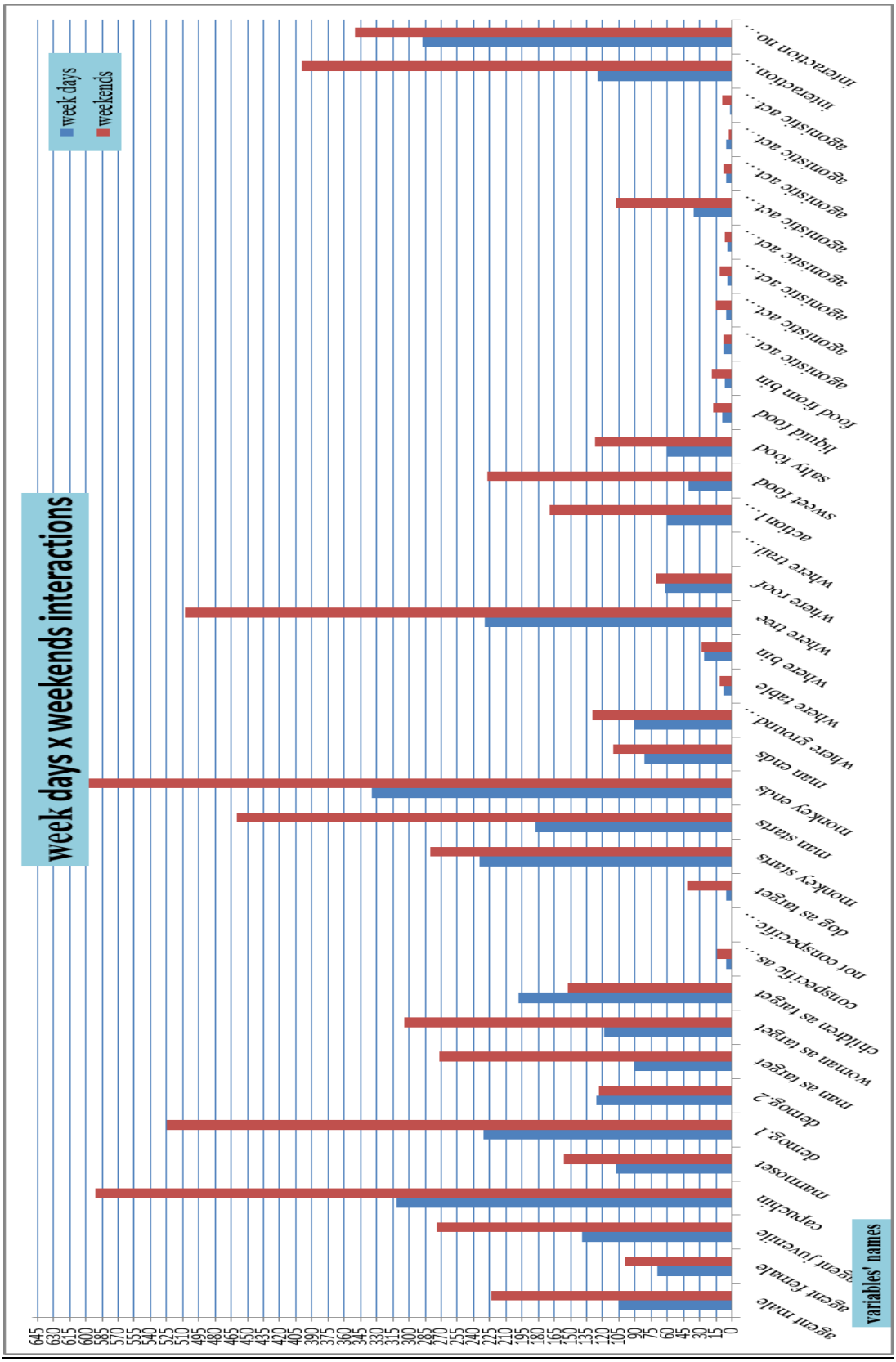

Fig.6: Comparative histogram showing week days with weekend's data for the interaction variables.

The comparative graph (see fig.6) shows how the collected variables during the week (S) (blue) versus weekends (F) (red) compare to each other and to all other variables.

It is clear to see that most variables in red scored higher than the ones in blue, as there were more interactions during the weekends. However, there were a few exceptions, when week scores are higher than weekends. These exceptions are in 'demography.2' where monkey groups of two were a little bit more numerous with 182 counts (S) against 225 counts (F) during the weekends.

For the 'agent' variables grouping the 'juvenile agent' came in first place with 139 counts (S) (33.4%) and with 274 counts (F) (36.5%), while 'agent male' came in second place with 105 counts (S) (25.2%) and 224 counts (F) (29.9%) and finally 'agent female' came in third position with 69 counts (S) (16.6%) and 99 counts (F) (13.2%).

In sequence comes the species grouping where 'capuchins' had a higher number of agents than 'marmosets' for both periods of data collection. These are 'capuchins' first with 312 counts (S) (75%) and 591 counts (F) (78.8%) and 'marmosets' second with 108 counts (S) (25.7%) and 156 counts (F) (20.8%).

After that, the numbers of monkeys that interacted as individuals or as groups with the park's visitors. In first place comes a higher number of counts for 'demography 1' with 231 counts (S) (5.5%) and with 525 counts (F) (70%), in second comes 'demography 2' with 182 counts (S) (30.3%) and 225 counts (F) (29.9%).

For the variables grouping showing who ended the interactions there was a similar result for both periods of data collection. In both week and weekends 'monkey ends' came first with 334 counts (S) (80.3%) and 631 counts (F) (84.1%), in second place came 'man ends' with 81counts (S) (19.5%) and with 110 counts (F) (14.7%).

Another similar descending order position for variable grouping comes with the location of interactions. In first place came 'where tree' with 230 counts (S) (55.3%) and 508 counts (F) (67.7%), in second place came

'where ground floor' with 90 counts (S) (21.6%) and with 129 counts (F) (17.2%), in third place 'where roof' with 62 counts (S) (14.9%) and 71counts (F) (9.5%), then in fourth place 'where bin' with 26 counts (S) (6.3%) and 28 counts (F) (3.7%), after that in fifth place came 'where table' with 8 counts (S) (1.9%) and 12 counts (F) (1,6%). Finally, there were no counts for 'where trail bannister' for both week and weekends.

On the next variable which defines the type of agonistic act displayed by monkeys the only similarity is in the first place for 'agonistic act vocal repetitive loud' with 35 counts (S) (8.4%) during the week and 108 counts (F) (14.4%) during the weekend.

The last variable shows in total how many interactions occurred with or without food. A total of 1166 interactions for both week and weekends had a total of 525 (45.4%) interactions with food and 637 (54.6%) interaction without food.

3.4 Analysis' results of interactions' frequency tables

The data were collected in the form of counts (binary nominal) to create frequency tables and compare a few variables for associations using cross tabulation for chi-square statistics tests. The data was not transformed in any way. The observations were assigned to one of two or more categories (see table.7) in two variables allowing for chi-square to be applicable.

Table 7: Chi-square statistics results for variables associations for interactions with or without food against 'agonistic acts'.

variables association	x^2	d.f.	P-value	week	weekends	altogether (week and weekends)	total number of valid cases
interactions with food x ago act	4.57	1	.032	(*)			416
interactions with food x ago act	40.06	1	.000		(*)		750
interactions with food x ago act	31.88	1	.000			(*)	1166
interactions no food x ago act	5.26	1	.022	(*)			416
interactions no food x ago act	40.58	1	.000		(*)		750
interactions no food x ago act	33.49	1	.000			(*)	1166

(*) result corresponding column

There is a reasonable association between interactions with food (x^2= 4.57, d.f.=1, P<0.05) and no food (x^2=5.26, d.f.=1, P<0.05) in the week data. Also, there is a very good association for all other interactions with food (x^2= 31.88, d.f.=1, P<0.001), (x^2= 40.06, d.f.=1, P<0.001), and also for interactions without food (x^2=33.49, d.f.=1, P<0.001), (x^2= 40.58, d.f.=1, P<0.001) in the weekends and altogether data.

Table 8: Chi-square statistics results for variables associations for capuchin gender against 'agonistic acts'.

variables association	x^2	d.f.	P-value	week	weekends	altogether (week and weekends)	total number of valid cases
male agent x ago act	6.37	1	.012	(*)			416
male agent x ago act	8.73	1	.003		(*)		750
male agent x ago act	1.17	1	.279			(*)	1166
female agent x ago act	1.22	1	.268	(*)			416
female agent x ago act	10.09	1	.001		(*)		750
female agent x ago act	11.27	1	.001			(*)	1166
juvenile agent x ago act	4.34	1	.037	(*)			416
juvenile agent x ago act	2.24	1	.134		(*)		750
juvenile agent x ago act	0.08	1	.771			(*)	1166

(*) result corresponding column

There is a good association between female interactions against agonistic acts (x^2= 10.09, d.f.=1, P<0.005) and (x^2=11.27, d.f.=1, P<0.005) respectively in the weekends and altogether data.

Also, there is a good association for male interactions against agonistic acts (x^2= 8.73, d.f.=1, P<0.005) in the weekends data and a reasonable association (x^2= 6.37, d.f.=1, P<0.05) for the week data. The other reasonable result is for juvenile association with agonistic act (x^2= 4.34, d.f.=1, P<0.05) in the week results. All other associations between gender and agonistic acts did not present a good enough P-value result.

Table 9: Chi-square statistics results for variables associations between 'who starts' and 'species' interactions against 'agonistic acts'.

variables association	x^2	d.f.	P-value	week	weekends	altogether (week and weekends)	total number of valid cases
man starts x ago act	10.26	1	.001	(*)			416
man starts x ago act	70.10	1	.000		(*)		750
man starts x ago act	64.73	1	.000			(*)	1166
monkey starts x ago act	10.01	1	.002	(*)			416
monkey starts x ago act	51.99	1	.000		(*)		750
monkey starts x ago act	48.80	1	.000			(*)	1166
capuchin x ago act	0.41	1	.519	(*)			416
capuchin x ago act	15.09	1	.000		(*)		750
capuchin x ago act	11.64	1	.001			(*)	1166
marmoset x ago act	7.27	2	.026	(*)			416
marmoset x ago act	16.47	1	.000		(*)		750
marmoset x ago act	17.08	2	.000			(*)	1166

(*)=result corresponding column

The results here show mostly good associations between 'man starts' and 'agonistic acts' with (x2= 10.26, d.f.=1, P<0.005) in the week , very good associations with (x^2= 70.10, d.f.=1, P<0.001) in the weekends and (x^2= 64.73, d.f.=1, P<0.001) in all together results. The same occurs for 'monkey starts' with good associations with (x^2= 10.01, d.f.=1, P<0.005) in the week and very good with (x^2=51.09, d.f.=1, P<0.001) in the weekends and (x^2=48.80, d.f.=1, P<0.001) in altogether results.

The results for 'species' associations with agonistic acts were also mostly very good with marmosets (x^2=16.47, d.f.=1, P<0.001) in the weekends and (x^2=17.08, d.f.=2, P<0.001) in the altogether results. The marmosets associations in the week (x^2=7.27, d.f.=2, P<0.05) had a reasonable P-value.

In the case of the capuchins associations there were very good results for (x^2=15.09, d.f.=1, P<0,001) in the weekends and (x^2=11.64, d.f.=1, P<0.001) for all together results. There was no association for capuchins and agonistic acts during the week (x^2=0.41, d.f.=1, P>0.005).

3.5 Trees and main interaction area sampling

The two main interaction areas (A+B) used by the monkeys and visitors during interactions are the 'barbecue stands' area and the playground area. These two areas are connected but differ in the quantity of trees and type of entertainment equipment. There are 16 barbecue stands with tables and 12 picnic tables for 4-5 people each throughout the two areas, the barbecue stands have a total of 32m^2 without considering picnic tables.

3.5.1 Area and tree density sampling

The total area measured by the use of e-trex 10 Garmin portable GPS is 14.410 m^2 which corresponds to 1.41 hectares in area. The total number of trees was 1250 individuals and any measurement of CBH was considered as all trees are used by monkeys. The density of trees was calculated by dividing the number of trees by the total area which results in 0.08 trees per m^2.

Table.10: Trees circumference at breast height random sampling.

Plot number	Square number	Number of trees per sample	Minimum CBH cm	Maximum CBH cm	Mean CBH cm	Std. Deviation	CBH/3.1416 = DBH cm
plot 1	9m2 1	5	16	90	41.8	32.01	13.30
plot 2	9m2 2	2	49	86	67.5	26.16	21.48
plot 3	9m2 3	2	31	58	44.5	19.09	14.16
plot 4	9m2 4	1	51	51	51	n/a	16.23
plot 5	9m2 5	1	60	60	60	n/a	19.09
plot 6	9m2 6	4	38	76	62.75	16.87	19.97
plot 7	9m2 7	3	43	59	52	8.18	16.55
plot 8	9m2 8	2	65	93	79	19.79	25.14
plot 9	9m2 9	4	0	90	52.5	37.78	16.71
plot 10	9m2 10	2	54	113	83.5	41.71	26.57
plot 11	9m2 11	5	31	114	70.2	32.15	22.34
plot 12	9m2 12	6	55	87	75.66	14.97	24.08
plot 13	9m2 13	5	18	160	73.8	54.72	23.49
plot 14	9m2 14	1	108	108	108	n/a	34.37
plot 15	9m2 15	2	31	101	66	49.49	21.00
plot 16	9m2 16	2	39	66	52.5	19.09	16.71
plot 17	9m2 17	4	27	94	57.5	29.69	18.30
plot 18	9m2 18	4	61	84	69.25	10.14	22.04
plot 19	9m2 19	4	54	360	146	144	46.47
plot 20	9m2 20	4	54	150	92.5	44.16	29.44
plot 21	9m2 21	4	24	144	75	51.02	23.87
plot 22	9m2 22	3	41	67	51.66	13.61	16.44
plot 23	9m2 23	4	33	136	64.5	47.98	20.53
plot 24	9m2 24	4	41	59	50.5	7.37	16.07
plot 25	9m2 25	3	29	78	53.66	24.50	17.08
plot 26	9m2 26	2	106	147	126.5	28.99	40.26
plot 27	9m2 27	5	50	86	70.6	16.75	22.47
plot 28	9m2 28	5	83	150	115.4	25.10	36.73
plot 29	9m2 29	4	113	162	128.25	22.69	40.82
plot 30	9m2 30	4	45	118	79.5	32.46	25.30
totals	$270m^2$	(*) 3.3	(*)48.33	(*)108.23	(*)74.05	(*)32.23	(*)23.56

n/a= not applicable (*) mean average of each category

The results show that 30 plots of 9 m^2 were sampled and 105 trees found and measured. The CBH sampling shows that all trees measured have a DBH≥10cm and the plots sampled varied from having 1 tree to 6 trees in $9m^2$ sampled areas. The total sampled area was 270 m^2 and there was a 3.3 mean number of trees per plot.

The total mean number of each category shows the average values of minimum CBH as 48.33cm. and maximum CBH as 108.23cm. The mean CBH of all trees was 74.05cm, a standard deviation of 32.23 and the mean DBH of all trees was 23.53cm.

3.6 Interviews' frequency tables

The answers of all interviews are coded as numbers (see table.12) according to visitors' answers. There were no pre-determined answers or multiple choices. All answers given by visitors were considered and later grouped if similar replies appeared. The visitors were free to answer the questions as they pleased.

Table 11: The total number of interviews and sampling days at the PEJ.

interview period	number of interviews	number of sample days	number of sampling hours per day	mean number of interviews per day	mean number of interviews per hour
week days	33	26	6	1.26	0.21
weekends	82	26	6	3.15	0.52
totals	115	52	312	4.41	0.73

A total of 115 interviews were applied. There were 33 interviews during the week days and 82 during the weekends. A mean number of 1.26 interviews per day during the week and 3.15 during the weekend.

Table.12: Part one; interviews' frequency comparative table between week days and weekends.

question number	type of answer during the week days (S)	frequency (S)	percentage of the total (%)(S)	type of answer during the weekends (F)	frequency (F)	percentage of the total (%)(F)
Q1	1 (male) (*)	17	51.5	1	38	46.3
	2 (female)	16	48.5	2	44	53.7
Q1a	22,24,26,29,32,37,38,39,42,48,50,51,52,60,,64,79,82,83	1	3.0	19,21,40,43,47,50,52,55,59	1	1.2
	31,43,46,49	2	6.1	2224,35,38,39,41,44,48,53,54,56,58,61,66	2	2.4
	28	3	9.1	27,32,.37	3	3.7
	25 (ages)	4	12.1	23,25	4	4.9
n/a				26,31,34	5	6.1
				18	6	7.3
				30	7	8.5
Q2	1(first visit)	8	24.2	1	18	22.0
	2 (more than one visit)	25	75.8	2	64	78.0
Q3	1 (leisure)	13	39.4	1	47	57.3
	2 (tourism)	5	15.2	2	8	9.8
	4 (to see nature)	1	3.0	3 (to see the monkeys)	8	9.8
	6 (bring children to park)	14	42.4	4	8	9.8
n/a				5 (educational activities)	2	2.4
				6	9	11.0
Q4	1 (Jaraguá peak)	5	15.2	1	23	28.0
	2 (historical facts)	7	21.2	2	12	14.6
	3(it is a park)	15	45.5	3	34	41.5
	4 (conservation unit)	6	18.2	4	12	14.6
n/a				5 (park has monkeys)	1	1.2
Q5	1 (good)	15	45.5	1	30	36.6
	2 (very good)	17	51.5	2	49	59.8
	3 (not good)	1	3.0	3	3	3.7

The answers for question one show that during the week the interviews had more male volunteers with 17 counts (51.5%) than female with 16 counts (48.5%), while at the weekends there were more females with 44 counts (53.7%) than male volunteers with 38 counts (46.3%).

On question one (a) there was a variety of ages of volunteers that took part in the interviews. During the week the majority of people were 25 years old with 4 counts (12.1%) and the minority with one count of each age between 22 to 83 (3%). Another group had 2 people of each age between 31 and 49 years old (6.1%), and 3 people were 28 years old (9.1%). During the weekends, the majority with 7 counts (8.5%) were of people with 30 years old and the minority with one count (1.2%) were of people between 19 to 59 years old. After that, there were people with 2 counts each (2.4%) between the ages of 22 to 66 years old.

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In addition, there were 3 counts each (3.7%) of people of 27, 32 and 37 years old. Also, there were volunteers with 4 counts each (4.9%) with 23 and 25 years old and then people with 5 counts each (6.1%) with the ages of 26, 31 and 34 years old respectively. Finally, there were 6 counts (7.3%) of volunteers that were 18 years old.

On question two, the week and weekends volunteers were composed in the majority of visitors that had been to the park more than one time with 25 counts (75.8%) and 64 counts (78%) respectively. And, in the minority numbers of people visiting the park for the first time with 8 counts (24.2%) and 18 counts (22%), during the week and weekends accordingly.

On question three, visitors during the week were in the majority visiting the park to bring their children there with 14 counts (42.4%), then for leisure with 13 counts (39.4%), for tourism with 5 counts (45.2%) and one count (3%) was there to see nature in the park. Also, during the weekend the visitors were in the majority there for leisure with 47 counts (57.3%), then to bring their children for a visit with 9 counts (11%), to see the monkeys, do tourism and to see nature with 8 counts each (9.8%). Finally, with 2 counts (2.4%) there were of people visiting for educational activities.

On question four, people told what they knew about the park and the majority during the week with 15 counts (45.5%) said they knew it was just a park, then 7 people (21.2%) said they knew something about the park's historical facts. After that 6 people (18.2%) knew that the park was a conservation unit and finally only 5 people (15.2%) knew that the park included the Jaraguá peak. During the weekend, the majority of people with 34 counts (41.5%) knew that it was just a park, then with 23 counts (28%) people knew about the peak and after that with 12 counts each (14.6%) people knew about some historical facts and that the park was a conservation unit. Finally, only one person (1.2%) knew about the presence of wild monkeys in the park.

On question five, the majority of people during the week said that having monkeys in the park was 'very good' with 17 counts (51.5%), then people said 'it was good' with 15 counts (45.5%) and the minority with 1 count (3%) said 'it was not good' to have monkeys in the park. During the weekends, the majority of people with 49 counts (59.8%) said 'it was very good' to have monkeys in the park, then visitors said 'it was good' having them with 30 counts (36.6%) and finally the minority with 3 counts (3.7%) told the researcher that 'it was not good' having monkeys in the park.

Table.13: Part two; interviews' frequency comparative table between week days and weekends.

question number	type of answer during the week days (S)	frequency (S)	percentage of the total (%)(S)	type of answer during the weekends (F)	frequency (F)	percentage of the total (%)(F)
Q6	1 (yes)	6	18.2	1	26	31.7
	2 (no)	27	81.8	2	56	68.3
Q6a	1 (yes)	25	75.8	1	59	72.0
	2 (no)	8	24.2	2	23	28.0
Q6b	1 (get closer to monkeys)	12	36.4	1	30	36.6
	2 (take a picture)	1	3.0	2	1	1.2
	3 (monkeys are pretty)	4	12.1	3	21	25.6
	4 (feel sorry because they are hungry)	7	21.2	4	14	17.1
	5 (didn't know I could not feed them)	3	9.1	5	3	3.7
	6 (for fun)	6	18.2	6	13	15.9
Q7	1 (yes)	33	100	1	80	97.6
n/a				2 (no)	1	1.2
				3 (I don't know)	1	1.2
Q7a	1 (for children to see them)	6	18.2	1	13	15.9
	2 (pleasure to watch)	1	3.0	2	14	17.1
	3 (brings me peace)	3	9.1	3	7	8.5
	4 (take a picture)	1	3.0	4	1	1.2
	5 (to see monkeys' behaviour)	2	6.1	5	3	3.7
	6 (to interact with them)	4	12.1	6	4	4.9
	7 (to preserve and see nature)	8	24.2	7	27	32.9
	8 (it is fun)	4	12.1	8	5	6.1
	9 (I fear them)	1	3.0	9	2	2.4
	10 (they are pretty)	2	6.1	10	1	1.2
	12 (the park is their home)	1	3.0	11(monkeys suffer, too many visitors)	2	2.4
n/a				12	3	3.7
Q8	1 (with monkeys)	31	93.9	1	80	97.6
	2 (without monkeys)	1	3.0	2	2	2.4
	3(I don't know)	1	3.0	n/a		
Q8a	1 (the park is their home)	5	15.2	1	9	11.0
	2 (a pleasure to watch)	4	12.1	2	9	11.0
	3 (to see them so healthy)	5	15.2	3	18	22.0
	4 (biodiversity)	3	9.1	4	11	13.4
	5 (park and monkeys are beautiful)	7	21.2	5	20	24.4
	6 (for fun)	4	12.1	6	5	6.1
	7 (brings me happiness)	2	6.1	7	5	6.1
	8 (they are mischievous)	2	6.1	8	4	4.9
	9 (they are dangerous)	1	3.0	9	1	1.2

On question six, during the week the majority of people with 27 counts (81.8%) said that they did not feed the monkeys and 6 people (18.2%) said they did feed the monkeys. During the weekends, the majority of people with 56 counts (68.3%) said that they did not feed the monkeys and 26 people (31.7%) said that they did feed the monkeys.

On question six 'a', during the week, the majority of volunteers with 25 counts (75.8%) said that they did see other people feeding the monkeys and 8 people (24.2%) said that they didn't see anyone feeding the monkeys. During the weekends, the majority of visitors with 59 counts (72%) said that they did see other people feeding the monkeys and 23 people (28%) said that they did not see anyone feeding the monkeys.

On question six 'b', during the week, the majority of volunteers with 12 counts (36.4%) told the researcher that the reason why people fed the monkeys was to get close to them, then with 7 counts (21.2%) people said that they 'felt sorry because monkeys were hungry', after that with 6 counts (18.2%) visitors said that they fed the monkeys 'for fun', then with 4 counts (12.1%) people said that they fed the monkeys because they were pretty, also with 3 counts (9.1%) visitors said they had no idea they could not feed the monkeys and finally with one count (3%) people said that the fed the monkeys to take pictures of them.

During the weekends, the majority of people with 30 counts (36.6%) said they fed them to get closer, then with 21 counts (25.6%) they fed them because they were pretty, after that with 14 counts (17.1%) they fed the monkeys because they felt sorry for them as they monkeys were hungry, after that with 13 counts (15.9%) people told that they fed them 'for fun' and with 3 counts (3.7%) they fed them because they had no idea they could not feed the monkeys and finally with one count (1.2%) people said that they fed them to take pictures.

On question seven, during the week, all volunteers said that there was a benefit to having the monkeys in the park.

During the weekends, the majority of people with 80 counts (97.6%) said that it was beneficial having monkeys and finally with one count each (1.2%) people told the researcher that there were no benefits and that they didn't know if it was beneficial or not having monkeys in the park.

On question 7 'a', during the week, the majority of people with 8 counts (24.2%) said the benefit of having monkeys in the park was to preserve and see nature, then with 6 counts (18.2%) they said it was for children to see the monkeys, after that with 4 counts each (12.1%) people said it was to interact with the monkeys and also because it was fun. After that, with 3 counts (9.1%) people said it brought them peace and with 2 counts each (6.1%) they told the researcher that the monkeys were pretty and that people wanted to see the monkey's behavior. Also, with one count each (3%) visitors said it was because the park was their home, people also feared the monkeys. people wanted to take pictures of the monkeys and that monkeys were a pleasure to watch.

During the weekends, the majority of people with 27 counts (32.9%) said it was to preserve and see nature, then with 14 counts (17.1%) they said it was a pleasure to watch, after that with 13 counts (15.9%) people said it was for children to see the monkeys and then with 7 counts (8.5%) people said it brought them peace. In addition, with 5 counts (6.1%) visitors said it was fun, with 4 counts (4.9%) they said it was to interact with the monkeys, with 3 counts each (3.7%) people said it was to see the monkeys behavior and that the park was their home.

Finally, with 2 counts each (2.4%) people said that monkeys suffered in the park as there were too many visitors and also that people feared the monkeys. Finally, with one count each (1.2%) people said that monkeys were pretty and that they wanted to take pictures of the monkeys.

On question eight, during the week, the majority of people preferred the park with the monkeys with 31 counts (93.9%), one person preferred the park without the monkeys and one person didn't know what to choose (3%).

During the weekend, the majority of visitors preferred the park with the monkeys with 80 counts (97.6%) and two people preferred the park without the monkeys (2.4%).

On question 8 'a', during the week, the majority of visitors with 7 counts (21.2%) wanted to have the monkeys in the park because the park and the monkeys were beautiful, then with 5 counts (15.2%) people said they wanted to see the monkeys healthy, also with 4 counts each (12.1%) people said they wanted the monkeys there for pleasure to watch and for fun. After that, with 3 counts (9.1%) visitors said monkeys were biodiversity, with 2 counts each (6.1%) people said monkeys brought happiness and also that they were mischievous.

Finally, with one count (3%) people said monkeys were dangerous. During the weekend, the majority of visitors, with 20 counts (24.4%) said that the monkeys and the park were beautiful, then with 18 counts (22%) they said they wanted to see the monkeys healthy, with 11 counts (13.4%) the visitors said monkeys were biodiversity. Also, with 9 counts each (11%) volunteers said that the park was the monkey's home and they were a pleasure to watch. After that, with 5 counts each (6.1%) people said the monkeys were fun and it brought them happiness. Finally, with 4 counts (4.9%) people said monkeys were mischievous and with one count (1.2%) they said that the monkeys were dangerous.

Table.14: Part three; interviews' frequency comparative table between week days and weekends.

Q9	1 (yes)	33	100	1 (yes)	82	100.0
Q9a	1 (unlike the city)	6	18.2	1	10	12.2
	2 (to see and understand them)	7	21.2	2	26	31.7
	3 (for fun)	4	12.1	3	18	22.0
	4 (brings me happiness)	1	3.0	4	7	8.5
	5 (they are pretty)	4	12.1	5	8	9.8
	6 (to interact with them)	8	24.2	6	11	13.4
	8 (to take pictures)	1	3.0	7 (brings me peace)	2	2.4
	9 (they are funny)	2	6.1	n/a		
Q10	1 (yes)	5	15.2	1	8	9.8
	2 (no)	28	84.8	2	74	90.2
Q10 a	1 (yes)	8	24.2	1	17	20.7
	2 (no)	25	75.8	2	65	79.3
Q10 b	1 (to stay as it is)	23	69.7	1	72	87.8
	2 (to change)	10	30.3	2	10	12.2

n/a=not applicable; (*) number coding of answers

On question nine, during the week, every single visitor, with 33 counts in the week (100%) and with 82 counts in the weekend (100%), said that they enjoyed observing the monkeys in the park.

On question nine 'a', during the week, the majority of people said they enjoyed observing the monkeys with 8 counts (24.2%) because they wanted to interact with monkeys, then with 7 counts (21.2%) they said they wanted to see and understand the monkeys and that with 6 counts (18.2%) people said that the park was different from the city because of the monkeys. After that, with 4 counts each (12.1%) people said monkeys were pretty and it was fun observing them. Finally, with 2 counts (6.1%) people said that monkeys were funny and with one count each (3%) people said that they wanted to take pictures of the monkeys and that the monkeys brought them happiness.

During the weekend, the majority of visitors, with 26 counts (31.7%) said that they wanted to see and understand the monkeys, then with 18 counts (22%) people thought monkeys were fun. Also, with 11 counts (13.4%) people wanted to interact with the monkeys and with 10 counts (12.2%) the visitors thought the

park was different from city because of the monkeys. Finally, with 8 counts (9.8%) people thought monkeys were pretty, then with 7 counts (8.5%) people said monkeys brought them happiness and with 2 counts (2.4%) people though that the monkeys brought people peace.

On question ten, during the week, after receiving information from the researcher about the law and reasons not to feed the monkeys, the majority of people with 28 counts (84.8%) said that they would not fed them and 5 people (15.2%) said that they would feed the monkeys anyway. During the weekends, the majority of people with 74 counts (90.2%) said that they would not fed them and 8 people (9.8%) said that they would still feed the monkeys anyway.

On question 10 'a', during the week, the majority of people with 25 counts (75.8%) said that they did not approve of a platform feeder for the monkeys and 8 people (24.2%) said that they liked the idea. During the weekend, the majority of people with 65 counts (79.3%) said that they did not approve of a platform feeder for the monkeys and 17 people (20.7%) said that they liked the idea.

On the last question 10 'b', during the week, the majority of people with 23 counts (69.7%) said they preferred the park to stay as it was and 10 people (30.3%) said that they wanted some change. During the week, the majority of people with 72 counts (87.8%) said they preferred the park to stay as it was and 10 people (12.2%) said that they wanted some change.

4. Discussion

4.1 Visitor-primate interactions

The majority of interactions with capuchins involved mostly juveniles followed by males and then females during both sampling periods, weeks and weekends. Capuchins interacted in more numbers than marmosets, also, these two species rarely shared the same area and they were usually found when the other species was not available (author's personal observation). In addition, most of the monkeys were alone interacting with visitors instead of groups of monkeys of more than one individual.

The PEJ seemed to have a lot more juveniles (author's personal observation) than males and females within the different troops, which might explain why they interacted more than males and females. This is also a good indicator of population health with the presence of so many juveniles and females carrying infants, both for capuchins and marmosets, as they occurred in great numbers at different locations within the park during the entire research.

After the juvenile monkeys, males came in higher number than females which agrees with the differences in their behavior foraging strategies, where males take more risks in approaching food targets and females wait for more reliable sources (Fragaszy *et al*.. 2004; Agostini & Visalberghi, 2005). Also, the results here agree with other similar interaction studies where males interacted more than females (Sabbatini *et al*., 2006).

Capuchins are very flexible on their feeding behavior strategies and towards approaching humans for food (Visalberghi *et al*., 2003), while marmosets do not associate so close to capuchins in the wild due to predation risks and competition for resources (Piddington & Rogers, 2013; Ferrari & Ferrari, 1990), but they are both tolerant of humans offering food (Cunha *et al*., 2006).

In hierarquical primates, such as capuchins and marmosets, foraging social behavior for food occurs in bouts and individuals compete for food sources in a hierarchical contest, which might explain why the results showed the majority of monkey agents competing for the human food more as individuals then in groups (Verderane *et al*., 2013 for capuchins; Stevenson and Poole, 1976 and Norsia & Palagi, 2011 for marmosets).

There were some contrasting results of the interactions that seemed to be very characteristic of each sampling period.

During the week the majority of interactions occurred without food with 70% of all 416 interactions.

During the week (see fig.4), the interactions occurred mainly with children followed by women and men, which is compatible as the park received less visitors.

In the week, the visitors are usually groups of school children doing environmental education activities in the park, a few families on a day off work or a few people walking the trails. Also, the majority of interactions were started by monkeys and ended by them, which coincides with the smaller amount of people and food which might stimulate monkeys to approach visitors more than vice-versa.

Finally, during the week the type of food utilized by monkeys was mostly salty based foods, such as crisps, salty biscuits and bread. There were no mobile vendors, very few celebration parties with cakes and the children doing environmental education brought mainly small snacks similar to packed lunches.

During the weekends, the majority of 750 interactions 53.3% of 750 in total occurred with the presence of food.

During the weekends, the interactions (see fig. 3) were mainly with women, man and children. The park is a very different place during Saturday, Sundays and public holidays. Visitation is high with families, groups of people and weekend athletes gathering in great numbers to spend the day at the park. The barbecue stands, picnic tables, playground areas and the nature trails become quite crowded. Not surprisingly, people started most of the interactions, which was expected on this research and observed in the literature (Sabbatini *et al*., 2006). Also, as expected, monkeys ended the majority of interactions at the weekend as well as during the week.

The weekend monkeys interacted with almost double the number of conspecifics during people-primate interactions and eight times more the number of dogs got involved during interactions than during the week, usually because of the higher number of visitors, there are much more dogs and different troops of monkeys, competing for interactions and food.

The type of food was also quite characteristic of each sampling period. There were more sweet foods consumed by monkeys during the weekend, as there were more celebration parties with cakes and mobile vendors selling all sorts of sweets and fruits.

The data analyses compared the associations between the presence or not of food and the occurrence of agonism. During the week, results with food ($x^2= 4.57$, d.f.=1, $P<0.05$) and without food ($x^2=5.26$, d.f.=1, $P<0.05$) showed a reasonable association.

However, in the 'weekend' and 'altogether' data ($x^2= 31.88$, d.f.=1, $P<0.001$) ($x^2= 40.06$, d.f.=1, $P<0.001$) results with food and without food ($x^2=33.49$, d.f.=1, $P<0.001$) ($x^2= 40.58$, d.f.=1, $P<0.001$) respectively, showed a very good association between the presence or not of food and agonism. It seems the interactions occurred no matter if there was food or not.

The data analyses also compared the agonism with the participants of all interactions. For male capuchins, the best association with agonism was ($x^2= 8.73$, d.f.=1, $P<0.005$) during the weekends, and there was no association for males performing 'agonistic acts' during the week. In the case of females, the best association was ($x^2= 10.09$, d.f.=1, $P<0.005$) during the weekends, there was no association for females and agonism during the week. And, for juveniles, the best association with agonism was ($x^2= 4.34$, d.f.=1, $P<0.05$) a reasonable one during the week and there were no associations during weekend and altogether data.

The Chi-square associations also compared the participants that started the interactions and the occurrence of agonism. The best association was of 'man starts' ($x^2= 70.1$, d.f.=1, $P<0.001$) in the weekends ($x^2= 64.7$, d.f.=1, $P<0.001$) and in altogether results. The same occurred for 'monkey starts' with ($x^2=51.09$, d.f.=1, $P<0.001$) in the weekends ($x^2=48.80$, d.f.=1, $P<0.001$) and in all together results. In the case of monkey species, both species were highly associated with the occurrence of agonism, very good associations with marmosets ($x^2=16.47$, d.f.=1, $P<0.001$) in the weekends ($x^2=17.08$, d.f.=2, $P<0.001$) and in the altogether results. Associations in the week, ($x^2=7.27$, d.f.=2, $P<0.05$) had a reasonable value for marmosets, capuchins during the week were not associated with agonism.

4.2 Interviews

The visitors to the PEJ that volunteered to participate in the interviews were both men and women of various ages, but the majority were of a young age, from 18 to 35. Most people had been to the park many times and were there mainly for leisure and to bring the children to visit the park.

Most people only knew that the park was just a park and that the Jaraguá peak was located there, very few people knew about the fact that the park is a conservation unit.

Most people thought it was good to have monkeys in the park and most people said they did not feed them, but they did see other people feeding the monkeys. The visitors thought monkeys were fed by other visitors mainly because people wanted to get close to them and also that monkeys were very hungry so visitors felt sorry for them, however, other people also said they fed them because they were pretty.

The visitors were almost unanimous to say that the monkeys were beneficial to their visits in the PEJ and the benefits were that people wanted to preserve and see nature, monkeys were good for children to see and that monkeys were a pleasure to watch. Very few people thought the monkeys were not beneficial to their visit because monkeys suffered in the park with so many visitors, while other few visitors feared the monkeys.

The majority of people preferred the park with the monkeys instead of not having them at all. In addition, people thought that the park and the monkeys were beautiful and also people wanted to see the monkeys there during visits.

One interesting result was that everyone interviewed liked to observe the wild monkeys behavior in the park, even people that disliked them or were fearful of them.

The reasons visitors liked to observe the monkeys behavior were mostly to see and understand the monkeys and also to interact with them, other people thought monkeys were fun to watch and that they made the park a very different place from the city.

After the researcher explained about the law and why it was not good to feed the monkeys, most people agreed and said they would not feed them and very few said they would feed the monkeys anyway. Finally, most people said at the end of the interviews that they wanted the park to stay as it is and did not think having a platform feeder was good for the monkeys or the park.

4.3 Forested public areas

During the interactions it was considered important to find out where monkeys were physically during the interactions. No other primate or wild life interaction with people study found such consideration important. Most wildlife interactions with people studies mention location as a map locality or a region. Areas with wildlife such as national parks or marine areas (Orams 1996) for bears, areas for people and wildlife in national parks (Coleman *et al.*, 2013), for dogs and people (Hughes & Macdonald, 2013), for chimpanzees and people (Hockings & Sousa, 2013), for capuchins (Sabbatini *et al.*, 2006; 2008) and for marmosets and people (Cunha *et al.*, 2006).

To evaluate if trees were really an asset for people and primates, the main zones of intensive use were considered and its density of trees calculated. These trees are located where the bulk of interactions occurred and were widely used by people and monkeys on a daily basis. Consequently, it was important to find out whether the presence and quantity of such substrates, such as trees and barbecue stands were important in the places where most interactions took place.

Primates are arboreal creatures that evolved both physically and socially to depend on trees to survive (Wasserman *et a*l., 2013; Grand, 1972), with savannah baboons (Jooste *et al*., 2013; Barton *et al*., 1996) being one of the exceptions. The environment where monkeys live in the wild seem to be of major importance because most conservation studies concentrate in forested areas leaving urbanized areas as least considered (Magle *et al.*, 2012), therefore considering a forested environment for wild monkeys, even if they live in a urbanized ecosystem seems to be a sensible research choice.

The majority of locations for interactions indeed occurred on trees, after that on the ground floor, barbecue roofs, rubbish bins and tables. The location variable referred to the entire time of interaction, and when the trees were used as majority, it is because the actions on those particular interactions occurred perhaps because of the presence of a tree.

The areas for interactions in the PEJ are very similar and the chosen area to represent the park was the barbecue and playground areas. Visitors concentrate there during most of the time they spent at the park and monkeys do the same, although the different troops seem to stay at different forested areas of the park interacting with visitors. The density of tree of 0.08 trees per m^2 is quite high at this area and it is comparable to tree densities in the Amazon (Hubbell, 2013; Hubbel, 1979) and just lower than eucalyptus plantations around the world (Gonzalez-Garcia *et al.*, 2013; Mabvurira & Jari, 2002). Such density of trees is important because for each meter squared of area in the forested public areas of the PEJ people are very likely to find 1/8 of a tree and in 100 m^2 you are likely to find at least one tree with a minimum mean CBH of 48.33cm and a mean DBH of 23.56 cm.

Also, the areas are also occupied by the barbecue stands, playground's sports pitch, skate ramp and children's equipment which means that the 1250 trees occupy an even smaller distance from each other.

4.4 Weaknesses and Strengths of this research

The study was focused on the relationship of primates receiving food and the association with agonism from monkeys. Also, whether the participants of interactions were at all associated with agonism as well. Although this was clear during the planning of the research and the collection of data, the results did not point at any differences if food was or not related to agonism, because all Chi-square associations were good or very good for both the presence of food and no food. This was considered to be a weakness related to the type of data collected.

The same happened to the associations of agonism with monkey species and with who started the interactions, most of all associations were good or very good and did not point at any differences.

This was very disconcerting and pointed at the fact that the data could have been collected with more focus with perhaps less variables. The researcher tried to detail interactions very well to be able to understand exactly why monkeys and visitors chose to interact so closely, but unfortunately this was not possible in many ways.

The interesting achievement of this study, which could be considered as a strength was that although some of the interactions data were not very helpful to the main hypothesis of the study, other hypothesis were quite well understood and the results showed a very interesting point of discussion. This relates to the relationship of the locations where interactions happened and the environment at the PEJ. The hypothesis could not be tested statistically as the type of data could not be compared as such, but results do show how much trees were used by monkeys and people as locations for interactions.

During data collection it was quite clear to see that the trees and their density were important to the visitors and the monkeys during interactions.

The interviews data could be also considered as strength of this research. The results clearly pointed at how visitors thought and considered the PEJ as a park for leisure and to see nature, with the presence of monkeys.

5. Conclusion and recommendations

The observational findings of this research in the PEJ show that due to the different periods of sampling and its characteristic visitation regime, the monkeys behaved accordingly.

Monkeys started more interactions than people during the week and the majority of interactions happened without the presence of food. During the week, the park received much less visitors than at the weekends, which suggests that there were much less people with food for the monkeys, therefore they could have been more active in approaching for an interaction with the visitors.

The opposite occurred during the weekends, with much higher visitation, people started more interactions and the majority of them occurring with the presence of food.

During both periods, monkeys were the ones responsible for ending most of the interactions, which suggests that monkeys might have interacted just to get something, food or just the opportunity of food.

The association results did not show any differences between interactions with food and agonism or without food and agonism. Such result points at the fact that monkeys seemed to interact no matter what they got, or how they got it. The choice to interact and the chance of getting any food seemed to be more important than having to spend energy doing agonisms such as vocalizations, alarm calls, shaking branches or physically stealing food from people's bags. This might also explain why they chose to finish most of the interactions, perhaps so they could start another one again, somewhere else in the park or with another visitor.

If the interaction participants, the food or no food were all well associated with agonism, with the few exceptions of capuchins and marmosets as species during the week, this might suggest that agonism might work as a way to get the visitors attention, for defense or to compete with other monkeys. The monkeys might have done the agonistic behaviours for different reasons other than food.

In relation to the visitors' interviews, people's opinions and attitudes did not suggest that monkeys were actually doing any aggressive behavior when performing vocalizations, shaking branches or stealing food from people's bags. They were not considered a nuisance or to be doing any agonism. The monkeys' agonistic acts were not considered as such by the visitors. Most people considered their presence important, fun and joyful. Also, visitors were unanimous to say that they enjoyed observing the monkeys.

In addition, people showed a positive attitude towards worrying about the health of the monkeys. When the majority of people said that they did not approve the idea of a platform feeder, after receiving some information about the reasons not to feed the monkeys, they preferred that the park stayed as it is today, even if it meant they would not be able to feed them, which would keep the interactions similar to what they were when the interviews were applied.

Although the results do not point at any specific direction regarding the presence of food, the opportunity of food seemed good enough for monkeys and people to engage in an interaction even when food was not present and agonism happened.

The majority of interactions occurred on trees, which coincides with the park having public visitation areas with many trees. Such well forested areas seem to provide people and monkeys with a safe and pleasant space to spend their time at the park.

The trees seemed to function as a safety net to both people and monkeys, because both participants chose to stay where the trees were for the interactions. Trees occur in quite high density in the park, which is one of the reasons the park is a conservation unit. Conservation units are remnants of the Atlantic forest in São Paulo and are protected by law because they have so many trees. The park provides an ideal environment to the many endangered species there, including the monkeys.

Having a high density of trees is consistent with important environments such as the Amazon and the Atlantic forest. The trees clearly functioned as an asset to the park in providing a place which suits people and monkeys to interact without monkeys being considered aggressive.

It seems important to recommend that the PEJ continues to be protected as a conservation unit with more emphasis on the environmental educational aspects. Parks such as the PEJ are very important to primate conservation.

Parks that are located within urbanized areas provide an ideal opportunity for the local communities and anybody to see and learn about their native species, both of fauna and flora. Such opportunities are critical in primate conservation efforts by showing people what they have so near to their homes.

Parks as the PEJ could be considered ideal for conservation in general. This park alone shows how an area that was once exploited for gold and coffee, later reforested by man with native species, today suffices in providing conditions for wildlife, such as former zoo primates, to thrive.

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7. Appendices

7.1 Appendix I- completed data sheet for primate behavior observations

APPENDIX I

Table X: Primate behaviour variables: example of a completed data sheet

categories during interaction	A/E/# (1)(*)	I/EN/TA (2)	W (3)	A1 (4)	F (5)	AGOA (10)	IF/IWF (12)
interaction 1	CA/M/1 (1 male capuchin)	M/H W (monkey starts/human ends) (woman)	T (tree)	X (did not occur)	X	X	IWF (interaction no food)
interaction 2	MA/3 (3 marmosets)	H/H/M (human starts/human ends) (man)	F (floor)	X	SW (sugar based food)	X	IF (interaction with food)
interaction 3	MA/7 (7 marmosets)	H/M CH (human starts/monkey ends) (children)	T (tree)	AGO (agonistic act)	X	VOC (repeatedly vocalizes)	IWF (interaction no food)
interaction 4…	CA/M/2	M/M/W	T	AGO	SW	X	IF

(*) letter coding used on data sheet;

1) A/E/#: monkey (A)gent, sp(E)cies and demography (#) (how many capuchins or marmosets)

2) I/EN/TA: who (I)initiates/who (EN)ds/(TA)rget (who initiates, who ends and with whom they are interacting with)

3) W : (W)here (location of interaction, where monkey is)

4) A1: (A)ction 1 (any agonistic acts?)

5) F: type of (F)food (type of food involved during interaction)

6) AGOA: type of (AGO)nistic (A)ct (type of agonistic act done by monkey)

IF/IWF: (I)nteraction with (F)ood/ (I)nteraction (W)ithout (F)ood (does it involve food or not

7.2 Appendix II- ethical clearance and approval from Oxford Brookes University

Original forms attached on the next pages.