# VISITOR BEHAVIOURS AND VISITOR EFFECTS: A CASE STUDY ON THE WHITE-CROWNED MANGABEY (*CERCOCEBUS ATYS LUNULATUS*) OF ZSL LONDON ZOO

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# Visitor behaviours and Visitor effects: a case study on the white-crowned mangabey (*Cercocebus atys lunulatus*) of the ZSL London Zoo

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**Abstract**

One concern of contemporary zoos is the human-animal relation. On one hand, the welfare and successful breeding of animal species is top priority; and, on the other hand, the satisfaction and entertainment of the zoo visitors is a crucial goal. Yet, conflicts may emerge when the public's pleasure do not match with the animal wellbeing. It is around this problematic that our research is focused. More specifically, the aim of this research is to understand the effects that visitors may have on the white-crowned mangabeys (*Cercocebus atys lunulatus*) of ZSL London Zoo. Behavioural data on the mangabeys were collected by using focal animal samples and scan samples, and to collect data from the visitors, focal group samples and scan samples were used. Through Chi-square tests, selected mangabey behaviours were analysed to estimate the effects of some visitor conditions – presence/absence, activity/inactivity, concentration levels, noise levels, activity levels, as well as some specific behaviours. The results indicate that mangabeys' visitor-directed aggressions and affiliative behaviours increase together with the levels of visitor's concentration and noise. In addition, visitor-directed aggressions increased according to visitors' activity and their behaviours, especially when the visitors tried to interact with the primates. Intra-group aggression on the other hand did not indicate a positive relation according to the visitors' conditions tested. This suggests that not all types of aggression vary equally when the mangabey is expose to visitors. We concluded that visitors observing the mangabeys have an influence on their behaviours, and that the increase in aggressive and affiliative behaviours can be a possible indicator of distress in the primate group.

**Keywords**: visitor-captive animal relation, white-crowned mangabeys, visitor effects

Contents

# I. Introduction

One of the problems that zoos have to deal with at the present time concerns the human-animal relationship. This is a complex matter that emerges from the conjuncture in which contemporary zoos find themselves. One aspect of such problem emerge from the conflicts that may occur according to the zoos' main aims: on one hand, the welfare and successful reproduction of (endangered) animal species is top priority; and, on the other hand, the satisfaction and entertainment of the zoo visitor is a crucial goal. The contentious is that what may benefit the public not always is the best for the animals, and the other way around. Considering the philosophical argument of Tsing (1995 in Mullin, 1999: 214), that "our views of nature are not a simple reflection of our valued standards and ideals: our observations of non-humans present continual challenges to our cultural agendas that require new inflections and transpositions of our cultural sense"; we intend to grasp this potential conflict by carrying out a case study trough the scope of the "Visitor Effects" studies. Therefore, through the study of the relation between the white-crowned mangabeys and the visitors at the ZSL London Zoo, we intend to understand what are the implications of the visitors to this primate species.

This introduction is mainly divided into three parts. In the first, a briefly historical account of the human-nature dualism and zoo's development will be presented to take into consideration the ways in which the visitor-animal relationship have been conceived so far in zoo policies. The visitor-animal relationship will then be considered within academic research, where it will be given particular attention to the "Visitor Effects" studies. It will be succinctly focused how visitors are conceptualised in, and what are the limits of, this field of studies, as well as it will be considered the problems that emerge in the visitor-animal relationship pointed by such studies. By examining these matters, our object of study is therefore contextualised and so, in the end of the second part, we will explain in more detail the aims of our research. To finish, the non-human primate focused on this research will be presented – the white-crowned mangabey – attaining to its taxonomy, ecology, social behaviour, conservation status as well as the "Visitor Effect" studies regarding this specific primate species.

## 1. Human-animals relation and the zoo

The beginning and development of zoos, as well as the changes it has undergone, is immediately connected with the relation that people have had with the environment, which include non-human animals (referred as animals from now on). The institution was born out of the desire, "(…) for classification and control of the human world" (Anderson, 1995: 277) and the diffusion of zoos through metropolises " (…) represented the ultimate triumph of modern man over nature (…)" (Anderson, 1995: 279). Its ongoing development reflects how our attitudes and views towards nature and the animals have changed. It is not without basis, that the zoo can be called a cultural institution, that has encoded in its character cultural and social messages (Mullan & Marvin, 1999). Today's conservation-based attitudes, with "charismatic megafaunas"[1] or protection laws over rare animal species and endangered forests, show how we understand the natural world, and everything that belongs to it.

Furthermore, by means of showing how we relate to "nature", it also shows how we understand ourselves, as humans, in the universe. For instance, in the western world we separate between humans and nature by using categories such as the "wild" and the "domestic". As Ingold (2000: 63) explains:

> "Behind this opposition between the wild and the domestic there lies a much more fundamental metaphysical dualism – one that seems peculiar to the discourse which, as a convenient shorthand, we call 'Western', to the extent of being its defining feature. This is the separation of two, mutually exclusive domains of being to which we attach the labels 'humanity' and 'nature'. All animals, according to the principle of this separation, belong wholly in the world of nature (…) Humans, however, are the sole exception: they are different because the essence of their humanity transcends nature (…)".

[1] Animals with strong popular appeal which are mostly used for conservation campaigns.

In few words, we separate between humans and nature and we understand both by opposing each other. It is not important to discuss if such dualism is right or wrong, the point is that we mark a boundary between human products and the rest, which has said, belonging to the natural world. Although this separation is deeply rooted in thoughts, views and explanations of the universe, we cannot assume that such dualism remains the same trough time or it is the same everywhere. The zoo emerged as a product of the western world and, therefore, also from this dualism between humans and nature. In this sense, the zoo is a good example, as well as a mirror (Mullan & Marvin, 1999), that shows the changing attitudes and views we have had towards nature and non-human beings. A premise that will now be briefly explored in a historical perspective.

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When we search in our western literature about the early stages of the relation between humans and animals, we will find the term 'hunter-gatherer societies'. These societies were described as seeing "themselves as part of nature" (Coe, 1995: 95) and as "living little better then animals" (Ingold, 2000: 62). Hunting and gathering activities are understood as being the opposite to the ones of farmers and herdsmen. The former explore the "wild", defined in terms of absence of human control, while the later explore the domestic, denoting a control of nature by humans (O'Rourke, 2000). With domestication, new technologies developed and humans started to have an unquestioned control over the growth and reproduction of animals and plants, which in turn was understood as a successful battle of the humankind over the natural world (Robinson, 1995). Even though this is far from being a linear process, it can be said that the transition from the "wild" to the domestic marks the origin of civilization (Robinson, 1995), and at the same time as urbanization occurred and cities emerge, the first animal collections can be found.

The very first ones emerged mostly out of worship purposes, for example, in religious temples in Egypt, sacred places in ancient Greece, or much later in the Aztec empire (Mullan & Marvin, 1999). Either, for religious or private purposes, these first menageries were associated with kingdoms and empires and therefore equated with power and prestige (Mullan & Marvin, 1999; Robinson, 1995; Lee, 2005). Nonetheless, the decisive expansion of zoological exhibitions occurred with the period

of European exploration and colonization in the 16th century. Together with zoological gardens, Museums of Natural History were also established. Both expose examples of species and specimen brought back from exotic places in which the main aim of such collections were to serve scientific purposes. For instance, zoological gardens were exclusively directed towards members of the scientific committee and so they were not considered as public places.

Gradually, through the eighteenth and especially nineteenth century, the zoo audience changed and zoos started to become public places (Hosey et al., 2009). Zoological gardens expanded through some major cities in Europe and were "(…) meant in those days, to be the 'green lungs' in urban settings, where nature, domesticated, was created with trees, where people could escape from the bustle and the pollution of great cities." (Lee, 2005: 24). It can be said that the raise of the 'modern zoo'[2], more or less as we know it today, occurred on that period. More specifically, "(…) the 'modern' zoological garden had born, with the *Jardin des Plantes* in Paris and the Regent's Park Zoo in London (…)" (Hosey et al., 2009). Research, captive breeding and recreation were already part of the zoo discourse of those days. Nevertheless, since the birth of European zoological gardens of the 18th and 19th century until modern day zoos, a lot have changed in people's perception concerning the environment (including animals), and together with these changes, the zoo as an institution has changed as well.

It was after World War II, with the awareness about the reduction of forests, pollution of oceans and extinction of animal species, that zoo policies started to change to what they become today. This happened mostly as the result of criticism that zoos suffered. In part, supported through the role of television and film that powerfully emerged on that time (Rowan & Hoage, 1995). Such critics had their origin in the environmental and animal rights movement of the 60s and 70s, which compared deprived animals behind bars with free animals in wildlife (Hosey et al., 2009). Animals were no longer seen as dumb creatures, but as intelligent beings with emotions (Rowan & Hoage, 1995), and "free" they should be. Given this shift in public ecological perspectives and attitudes towards animals, zoos popularity started to decline extremely, and consequently, there was urgency for a reinvention of the traditional

[2] Although it is convenient to use the term 'modern zoo', or even contemporary zoo, it is also important to have in mind that each zoo is a particular case, how the zoo actually is, depends on the attitude towards keeping animals and what type of zoo it is (Hosey et al., 2009).

concept of the zoo. As a result, zoos came to include conservation-based aims and over all animal welfare priorities in their policies. For instance, the change from sterile cages to more naturalistic exhibitions or the responsibility they achieved as custodians of animals were a consequence arriving from the necessity of reinvention. Thus, the zoo main priorities become animal welfare, conservation, and education of the public, added to the previous ones, research and entertainment (AZA, 2008 in Fernandez, 2009).

It appears to be out of this change that the major concerns of these days' zoo policies emerged. If the traditional purpose of zoos was simply to expose wild, exotic and "dangerous" animal collections; today, zoos are also concerned with the wellbeing and conservation of animal species. Nonetheless, the main aim of such institution, in what concerns animals, still converges to the idea that "(…) no matter how enlightened the philosophy of zoo management regarding the conditions under which they are exhibited, as exhibited they must be" (Lee, 2005: 35). This means that zoos nowadays have a paradox between the living conditions and exhibition of their animal collections, a relation that not always is as good as it is desired. Even if the philosophy of zoo management is not yet enlightened, this should not be regarded as a free critic but as a challenge in which zoo professionals as well as academics should work on. Therefore it is important to understand what are the conditions in which captive animals live in the zoo.

Despite the particularities of each one, as a whole, the zoo is somehow limited to and dependent on a specific environment, that is made up, unavoidably by the concept of a zoological garden as we know. Hosey (2005) identify three main conditions that are important to consider, and which are inseparable, to define the specificity of the zoo environment, namely, restricted space, being managed, and the chronic presence of unfamiliar humans. Concerning the space, the area of a zoo is obviously restricted to a limited geographical space, and therefore even more restricted are the animal enclosures. Research results have shown that disturbed animal behaviour can be caused by space inadequacy (Southwick, 1967; Alexander and Roth, 1971; Nash and Schilton, 1986 all in Hosey, 2005), and so, zoos have to work on transforming their animal enclosures, not just concerning the physical space but also in the average complexity of the enclosures. In any case, no matter how big and naturalistic an actual enclosure is, it is not equal to the wild and it will always be a captive enclosure.

The second condition that makes part of the zoo environment is that zoo animals "(…) live under conditions not of their own choosing but under those designed and chosen for them by their human keepers/carers" (Lee, 2005: 35). In this sense, the management of the animals is an intrinsic part of the zoo concept, under which we find the management of: "Group membership, spatial accommodation, feeding routine, health and reproduction (…)" (Hosey, 2005: 112). Zoo professionals have therefore the crucial role of providing the animals with an adequate management, to guarantee the best possible physical and psychological health of the captive animals (Hosey, 2005).

The last condition is related to humans. Everyday a zoo is visited by a numerous amount of people which are not familiar to the animals, even if the actual number depends obviously on the popularity of each zoo. Visitors queue, spend money, and so forth, all for the same purpose, to experience animals, mostly wild, in close up and real-life (Mullan & Marvin, 1999). Visitors are in this sense, an integral part of each zoological garden, and their satisfaction and attraction will make necessarily part of the policies and aims of these institutions. In financial terms, zoos would maybe struggle to maintain themselves without the financial support of the admissions, and therefore, the visitors are, without doubt, the guarantee for the survival of a zoo. However, the public's satisfaction does not always harmonise with today's zoo philosophies regarding animal welfare, and keeping the balance is not an easy job for zoo professionals.

Therefore, as our views and attitudes towards nature have changed, zoo professionals have to work out the best possible arrangement to harmonize inherent zoo conditions with today's zoo aims. In other words, keeping a balance between the undisclosed zoo environment and conservation-based aims of animal welfare. The following research is going to look more specifically on one of these conditions, the visitor. The visitor is understood not just as part of the zoo environment but also as belonging to some of the zoo aims. The visitor satisfaction and attraction is a crucial aim of zoo managements, and so visitors have an importance for zoos that cannot be simply ignored. However, the zoo visitor can also enter in conflict with today's animal welfare policies, and it is exactly around this conflict, that this study is situated. Thus, in what follows it will be explored how the visitor has been considered in zoo research as well as it will be considered what are the exact conflicts that arise between visitors

and animal well-being in a zoo setting and how professionals and academics have come to work on it.

## 2. The visitor

Zoo visitor research is included in a wider range of visitor research, which includes visitors of botanical gardens, museums, and so forth. The very first approach happened in a museum setting in the earlier 1910s. The aim was to understand "(…) visitor movements within the museum galleries, the influence of gallery design on behaviour, and visitor interest" (Davey, 2006: 144). Specifically to zoos, research on visitors appeared from the 1970s onwards and was mostly limited to count the number of visitors that enter daily in the zoo. In any case, with the development and changes in the philosophy of the zoo, visitor research did not just drastically rose but there was also a diversification in approaches and fields. Visitor research, a subject of study mostly for social scientists (sociology, education, and psychology), also became a subject of zoologists and market researchers (Davey, 2006). According to Davey (2006), visitor research can be categorized into four main areas: "Audience Analysis", "Orientation and Circulation", "Exhibit Design and Evaluation" and "Interaction with Captive Animals".

"Audience Analysis" is the topic of two different kinds of professionals: market researchers and academic departments or zoo professionals. For the market researchers, it is important to identify visitor profiles, as much as possible, so they can use them to both attract more visitors and provide good customer satisfaction. The academics, on the other hand, are more concerned with the zoo visitor behaviour in general. Most of these studies are trying to understand what are the specific factors that can influence visitor's perception and/or behaviours towards the exhibition, such as different species of animals or the exhibit design. For example, Margulis (2003) studied, on seven different cat exhibitions, if felid activity influences visitor interest in the exhibition, or Kutska's research (2008) investigated if the type of environmental enrichment in a polar bear enclosure alters visitors' perceptions. Furthermore, Davey and colleagues (2005) found that the viewing times and stoppings at the exhibit were related with more

naturalistic designs. One last example can be provided by the study of Altman (1998 in Fernandez et al., 2009), which indicates how polar bear activity attracts visitor's interest in opposition to their inactivity, which in turn tend to stimulate human-directed conversations.

The second area that Davey (2006) indentifies within the visitor research is "Orientation and Circulation". Basically, it is the study of how people move in the zoo. The researcher tries to identify predetermined patterns of circulation, such as "right-turn bias" or "museum fatigue". The first pattern means that people tend to turn right when entering an exhibition. This was first detected by a Yale University research in a museum setting and later also confirmed to happen in zoo settings, through a study conducted in a primate house (Davey & Henzi, 2004). The "museum fatigue", as the name suggests, was also investigated first in a museum setting. However, in the meantime, Mitchell and colleagues (1990) noticed, in a zoo setting, that the exhibitions near the entrance have a greater visitor number and viewing duration then the ones located further away from there. These insights are obviously important for the zoo management to decide where to strategically locate exhibits. Two reasons for that are: on the one hand, to ameliorate and enrich the zoo visits in locating poorly visited exhibitions more adequate (Martin & O'Reilly, 1989; Martin, O'Reilly, & Albanese, 1983 all in Davey & Henzi, 2004), and on the other, in terms of animal welfare, for example, to evaluate where to place animals that are more sensible to large visitor crowds (Davey & Henzi, 2004).

The third area in the visitor research is "Exhibit Design and Evaluation", which is interested in understanding both how exhibit designs influence visitor interest and how positive conservation-based attitudes can be stimulated in them. As "Educating the public about animals, and raising their awareness and support of conservation, are a fundamental part of modern zoo's mission (…)" (Hosey et al., 2009: 480), it is important, for zoo professionals, as well as for other professionals, to receive a feedback in how far a certain type of exhibition can go, with a positive effect on visitor's behaviour and attitudes. The results that arise out of this topic, assume that more naturalistic enclosures promote positive animal related views in the visitors (Coe, 1985; Tofield et al., 2003 all in Fernandez et al., 2009; Blaney and Wells, 2004; Johnson, 1998; Kuska, 2008) and that viewing times and interest in the animals

increase (Davey et al., 2005; Fernandez et al., 2009; McGivern, 1994 in Dierking et al., 2002).

The last research area is "Interaction with Captive Animals". This research area aims to identify the components and consequences of the interaction between the visitors and the captive animals. Interaction in a zoo setting is defined as the behaviour of the visitor or the animals directed towards an individual of each other's group (Cook & Hosey, 1995 in Davey, 2007). In name of the animal welfare, the majority of these studies tried to identify if the visitor has an impact on captive animals, and of what nature this impact is (neutral, positive or negative). This concern has tended to be studied more by animal welfare specialists that are concerned about the stress situations that different visitor variables can mean for captive animals. Consequently, this research area has been carried out in more isolation from the other visitor research areas (Davey, 2006). Publications and discussions occur in separate journals and conferences, with almost no communication occurring between fields. This led to the emergence of two separated, but overlapping areas, namely "(…) "Visitor Studies" (the study of visitors' behaviour) and "Visitor Effects" (the study of visitors' influence on, and interaction with, captive animals)" (Davey, 2006: 151). This is to say that the first three areas mention above are comprised under the rubric "Visitor Studies" and this last one has been carried out on its own terms. As the main aim of the present study is concerned with the conflict that arises between the condition 'zoo visitor' and the conservation concerns of contemporary zoos, we will now focus in more detail on the "Visitor Effects" studies, which are trying to understand the consequences that visitors can have on the animals in captivity as their expertise area.

## 2.1 "Visitor Effects" studies

Since the 1980s, researchers have tried to explore what visitors exactly mean for animals in the zoo. This topic raise in interest after the first evidence of this relationship been observed (Hediger, 1965; Thompson, 1976; Oswald and Kuyuk, 1977 all in Hosey et al., 2009); though, a more explicit theory about visitor effects on captive animals just came in 1987 with Hosey & Druck (in Davey, 2007). In the study of 12 different non-

human primate species they concluded that the visitor presence and activity have an effect on the primates' behaviour, such as an increase in locomotion in relation to more active visitors (Mitchell et al., 1992b).

From that time on "Visitor Effects" studies have expanded in interest through academics and animal welfare specialists. Also for the zoo management it has become an imperative matter. This happened for two major reasons. First, the well-being of zoo animals is one of the most crucial conditions that a good zoo must be able to guarantee, and without animal physiological health, breeding programmes are not successful and the zoo fails in one of its highest aims, that is to contribute to the conservation of endangered species; and second, animal welfare may increase, indirectly, visitors interest (Fernandez et al., 2009; McGivern, 1994 in Dierking et al., 2002), which in turn can provides satisfaction and lead them to environmental concerns and education.

A preponderant number of studies concluded a negative effect of visitors in the animals. For instance, the work of Mallapur & Chellam (2002), who studied the response of Indian leopards (*Panthera pardus*) to visitor presence, show that leopards were more inactive when visitors were present then when visitors were absent. In addition, when the animals were exposed to high visitor density, high levels of stereotypic pacing were observed. Another study by Sekar and colleagues (2008) verified that captive bison (*Bos gaurus gaurus*) at the Arignar Anna Zoological Park in India showed a higher rate of aggressiveness when visitors were present in opposition to absent. Similar results were seen in captive jaguars (*Panthera onca*) by Sellinger and Ha (2005). Here, significant behavioural changes in the animals were measured for visitor presence and intensity, with the last variable provoking the highest effect in aggressive and pacing behaviour. These three studies are examples of the very few "Visitor Effects" studies conducted on non-primate animal species; nonetheless, the most attention has been drawn to non-human primate species and visitor variables as their presence and density.

One example of such studies is provided by Maki and colleagues (1987), who conclude an increase in aggressive behaviour in a colony of chimpanzees (*Pan troglodytes*), when researchers were present. In another chimpanzee colony, housed in a research facility in Texas, higher rates of aggressive behaviour (intra-group) was also measured during the days when the laboratory was fully staffed (Lambeth et al., 1997). While these examples were conducted in non-zoo settings, the majority of "Visitor

Effects" studies have drawn their attention towards zoo-housed primates, and more results have come to support the assumption about a negative visitor effect.

One of the earlier studies in a zoo setting, by Chamove and colleagues (1988), found, within 15 different non-human primate species, that five[3] of them confirm a significant increase in aggressive behaviour and a decrease in the affiliative one when visitors were present, compared to their absence. Glatston and colleagues (1984) also found a significant decrease in social behaviour in cotton-top tamarins (*Saguinus oedipus oedipus*) given the presence of visitors. Additionally, they saw an increase in within-group agonism when the visitor density was higher. More about the negative visitor effect was verified by Wormell and colleagues (1996). The research shows that bare-faced tamarins (*Saguins bicolor bicolor*) had an increase in aggressive behaviour, but also piloerection and approaching behaviour, when visitors were present.

More recently, Mallapur and colleagues (2005), who studied lion-tailed macaques (*Macaca silenus*) in an Indian zoo, compared the rates of social and reproductive behaviours between days, when the zoo was open to the public with the ones it was closed. The non-human study subjects show an increase of self-biting when visitors were present. One more research project, with two different primate species, namely stump-tailed macaques (*Mandarillus shinx*) and goeldi's monkey's (*Callimica goeldii*), shows a positive correlation between visitor density and an increase in aggressive behaviours in the primate groups (Simpson, 2004). Furthermore, Wells (2005) examined the visitor effect on western lowland gorillas at Belfast Zoological Garden. The non-human primates showed an increase in intra-group aggressions, stereotypic body rocking, teeth clenching, and auto grooming when the visitor density was higher.

Although most visitor variables that have been measured in "Visitor Effects" studies focus on presence or density, other ones have explored visitor activity, loudness and behaviour. Most of the results also come to support a strong assumption of the negative visitor effect, as for example the study of Mitchell and colleagues (1992b). The researchers tested the effect of visitor density and activity on the behaviour of 11 different non-human primate species. The conclusion was that an increase of visitor-

[3] The species were: cotton-top tamarins (*Saguinus oedipus oedipus*), lemurs (*Lemur catta*c), Diana monkeys (*Cercopithecus diana*) and two mandarill species (*Mandrillus sphinx* and *Mandarillus leucohpaeus*).

directed behaviour was positively correlated with high visitor activity (either for large and small visitor crowds), compared to visitor inactivity (in large and small crowds). A second study, Cooke and colleagues (2007), explored if noise, group size and the presence of children had any effect on two separated pairs of white-handed gibbons (*Hylobates lar*). The results show little consistence between all subjects, except for the males. In their case, high noise levels lead to more hanging, climbing, open-month displays and looking at public behaviours. The presence of children was difficult to interpret, because it was mostly correlated with higher noise levels and larger visitor groups, which in turn seemed to provoke an increase in look at mate and look at public behaviours in all subjects. Another study, that measured noise levels and visitor behaviour, was done by Birke (2002 in Fernandez et al., 2009). The author concluded that orangutans (*Pongo pygthaeus*) responded aggressively towards visitor staring. In addition, they also looked and approached visitors more often when the noise levels of visitors increased. Moreover, the author also found that larger visitor groups resulted in orangutans hiding (covering heads with paper sacks) and infants holding on their mother significantly more. One other research comes from Nimon & Dalziel (1992). In this study, Siamangs (*Hylobates syndactylus*) at Adelaide Zoo in Australia responded aggressively, with staring or yawing, when visitor mimicked them. More on the effects of visitor activity comes from the work of Chamove and colleagues (1988). The measures show that primate behaviour was correlated with audience activity levels. The results illustrate higher rates of visitor-directed behaviour when active crowds of visitors were present compared to passive ones.

Although all these examinations came to underline a negative and stressful influence coming from a considerable number of visitor variables, there is yet a controversial debate about the interpretation of stress in captive animals (Davey, 2007; Hosey et al., 2009). To a great extent, a negative effect was deducted when primates show behavioural changes in locomotory behaviour, mother-young interactions, vigilance, and so forth; nevertheless, it is not fully defined what are the exact behavioural changes connoted to the negative influence in animal well-being. One suggestion would be to conduct more studies including physical measures of stress (Davey, 2007), which would offer more evidences.

Under this assumption, cortisol levels in urine were tested in spider monkeys (*Ateles geoffroyii rufiventris*) by Davis and colleagues (2005). The findings show a

significant correlation between cortisol levels and visitor number. Another example comes from Carlsted & Brown (2005) with non-primate animals. A higher concentration of corticoid was found in black rhinos (*Diceros bicornis*) when visitor were present. Other evidences of stress came from measuring endocrine levels in response to a variety of visitor variables (Kalthoff, Schmidt, & Sachser, 2001; Wehnelt, Fishlock, Condon, Coleman, & Schaffner, 2004 all in Davey, 2007).

Besides measuring stress in captive animals, more recently some research has come to suggest practical improvements for animal-wellbeing in captivity. In this sense, it was tested if the visitor effect can be minimized by the use of specific management practices. These studies show some progress, since they take a step forward to directly ameliorate the conditions in captivity. One of the most known is the study of Blaney & Wells (2004), who used a camouflage netting around a gorilla enclosure, that came to stay in-between the animals and the visitors. The results show a reduction in aggressive and abnormal behaviour in the captive primates. In addition, something interesting also occurred, the proper visitor behaviour changed: the public tended to be quieter, and intrusive behaviours (banging on the glass) reduced significantly. More about this kind of approach was brought by Carder (2008), who explored the effect of visitor's number on two different lowland gorillas in Port Lympne and Chessington zoos. Here, feeding enrichment was used to see if it would mediate the visitor effect on the non-human primates. In one of the gorilla groups, no evident conclusions were obtained. In the second group, however, the effects of high visitor numbers were more felt when no feeding enrichment was given to the primates and less felt during feeding enrichment.

The studies presented so far have all come to conclude a negative visitor effect, however, there is still no conformity between researchers. The debate if there are actually a visitor effect and if it is of negative or positive nature is still open. Although positive and neutral effects have less often been the result of investigations, they were also reported. That is the case when the interaction between visitors and captive animals was understood as a potential source of enrichment (Cook & Hosey, 1995), mostly in interactive zoo settings. Here the question that arises, is whether the benefit for animal welfare comes from the actual interaction or from the type of exhibition itself. One other study, concluded that visitors were enriching a group of green monkeys (*Cercopithecus aethiops sabaeus*) at Mexico City Zoo (Fa, 1989 in Davey, 2007 and in Hosey et al., 2009). The authors draw this statement out of the fact that the

monkeys spent time and effort to get food from the public, while at the same time, there was no increase in agonistic behaviour. A neutral visitor effect has also been suggested. For example, in a study with captive felids, no significant visitor effects were detected through seven different felid enclosures (Maragulis et al., 2003). The authors suggest taxon-specific response to visitors, deducted out of similar results in other studies with cats (Rybak, 2002 in Maragulis et al., 2003).

## 2.2 Weak points in the "Visitor Effects" studies

"Visitor Effects" studies have come to bring new insights about what zoo visitors can actually provoke in captive animals. Nevertheless, there is still much work to be done, and certain points need to be ameliorated to guarantee the progress of knowledge (Davey, 2007). For instance, a clearer definition of key terms is needed, such as the meaning of stress behaviours (Hosey et al., 2009). In addition, an enlargement of research methods would be enriching for the field. In this sense, the combination of physiological measures with behavioural ones, would result in a clearer picture of what exactly is stress in captive animals (Gregory, 2005 in Davey, 2007). Moreover, Davey (2007) alerts to the fact that it is preponderantly visitor's presence, size and activity that have been taken into account, and so, an amplification of visitor's variables would improve knowledge. In addition, the use of more concrete rather than vague description of visitor variables would bring better insights (Davey, 2007), this is to say that visitor conditions such as activity, as a category, is not so clear as referring to specific visitor behaviours such as banging on the viewing window or waving.

One other issue to be considered is the lack of cooperation one can found within "Visitor Effects" studies and between that field and "Visitor Studies" in general. With regard to the latter, as Davey (2006) refers "Visitor Effects" studies have been developed in isolation from other "Visitor Studies". This is a weak point, since interdisciplinary work would offer more data with different variables which could be helpful to clarify some issues about the visitor-animal relationship. For instance, the "Orientation and Circulation" studies mentioned above can bring some important ideas for the "Visitor Effects" studies. This can be illustrated with the example of Mitchell

and colleagues (1990), also mentioned above, who shows that cage location had significant differences on the number of visitors attending the exhibits, and this in turn had significant consequences for the animals, such as an increase in aggressive behaviours. In regard to the former, "Visitor Effects" studies should avoid being site-specific since this obstruct possible generalisations (Davey, 2006). Although the present study do not accomplish this point, it is important to "(...) resolve this issue by replicating studies in different situations and across institutions" (Davey, 2006: 150), which mean, for instance, to use the same research methods as well as the same visitor and animal variables.

There are some issues that can be improved, yet others exist in zoo research that although they can be controlled, they cannot be completely eliminated. As for example, the difficulty to demonstrate some causality relations (Hosey, 2000; Davey, 2007), since it is not always possible to identify the precise cause for certain observable facts. To make it explicit, visitor behaviour can be caused by specific animal behaviour, but at the same time, specific animal behaviour can be caused by certain visitor variables, and so, it becomes difficult to know exactly which one is the cause and the effect. In addition, the visitor-animal relation when studied in isolation can lead to misinterpretations, as Hosey and colleagues (2009: 489) mention, "(…) the way in which animals change their behaviour in response to stressors is itself affected by a number of other variables, such as cage space and complexity, (...)".

Make clear these points will help to know the visitor better, such as how visitors behave in the zoo, how they think about the captive animals and so forth. For instance, more naturalistic exhibitions can have a positive effect on visitor's view about the animals (Coe, 1985 and Tofield et al., 2003 all in Fernandez et al., 2009; Blaney & Wells, 2004; Johnson, 1998; McGivern, 1994 in Dierking et al., 2002), and consequently the behaviour towards animals in zoos. The clue is that there is a potential relation between visitor satisfaction and animal welfare. That is, when animals are healthy and active, people are more easily satisfied with observing them, and will probably not need to attract their attention. In contrast, "Inactive animals are less interesting to visitors, which again may result in visitors provoking or interacting with the animal on their own terms" (Fernandez et al., 2009: 4). This and other similar findings have lead to the "visitor attraction model", which means that the relationship between zoo animal activity and visitor interest is not unidirectional (Maragulis et al.,

2003). Therefore, it becomes important to keep doing this kind of studies as well as it is important to elucidate these weak points since the insights concerning visitors in general indirectly involve three zoo aims: the visitor satisfaction, public education and animal welfare.

## 3. Aims of research

"Visitor Effects" studies help to identify the consequences of the animal-human encounter in a zoo setting. Consequently, possible ideas and suggestions can be developed which, as a result, can improve not just animal well-being in captivity, but possibly also visitor experience and learning in the zoo, and therefore these outcomes are of great importance for today's zoo management. In recognizing the importance of this field, and considering the issues that are yet to be resolved, the present research wishes to offer a contribution to understand the human-animal relation trough the framework of "Visitor Effects" studies. More specifically, this case study seeks to observe the human visitor in front of the white-crowned mangabey enclosure of ZSL London Zoo. In this sense it aims to identify which are the specific visitor variables that can have an effect on the behaviour of the captive mangabey group.

To attain these goals, the study proposed to observe with the same detail the visitor and the mangabey behaviours. This follows out of the considerations mention above with regard to the importance of visitor studies, which not just the study of the captive animals but also a better knowledge of the visitors can help to improve the relation between both. Additionally, in view of a weak point mention by Davey: "There is a disproportionate amount of research across different visitor variables (…) Most research has focused on the effect of visitor presence and visitor density (…)", and also that "Studies tend to use vague and insufficient descriptions of visitor variables. A more meaningful division could be to define different types of activity – pointing, tapping on glass, or waving (…)" (Davey, 2007: 179), to observe in detail the specific behaviours that visitors adopt in front of the mangabey enclosure and to analyse how these behaviours can affect the wellbeing of the mangabey group, was also taken into consideration.

To approach these objectives, the observations were divided into two separated but complementary parts. In one part, the observation intensity will be focused on the mangabey behaviour concerning the visitor absence and presence, concentration on the enclosure and noise levels. In the second part, it will be given special attention to visitor activities and specific visitor behaviours, concerning the mangabey behaviour. Thus, more specifically, the questions that will be explored in this research are:

- Is there a significant relation between the visitor presence and the rate of the mangabey group aggressive (intra-group and visitor-directed) and affiliative behaviours?
- Is there a significant relation between the visitor loudness and the rate of the mangabey group aggressive (intra-group and visitor-directed) and affiliative behaviours?
- Is there a significant relation between the visitor activity and the rate of the mangabey group aggressive behaviours (intra-group and visitor-directed)?
- Is there a significant relation between the visitor's behaviours and the rate of the mangabey group aggressive behaviours (intra-group and visitor-directed)?
- Are the visitors in majority inactive or active?
- When the visitors are active, what kind of behaviours do they adopt when staying in front of the mangabey enclosure?

A more detailed explanation on these matters will be given further on, in the Methodology chapter. For now, it is worth to say that the plan outcome is to consider if this captive mangabey group is being influenced by their human audience. In the case that visitor effects will be concluded, suggestions to enhance the well-being of the captive mangabey group will be offered. Nonetheless, it is important to allude to the limitations of this case study since it has a restricted sample size and long duration responses to the visitor effects were not searched. Further observations would be needed to support the outcomes. In the following part, the non-human primate specie that is going to be the subject of research will be presented by looking on its taxonomy

and ecology, social behaviour, conservation status and finally on the "Visitor Effects" studies that have been done on them.

# 4. The white-crowned mangabey

## 4.1 Taxonomy and Ecology

Based on recent molecular studies, mangabeys have been divided into two separate genres, the *Cercocebus* and the *Lophocebus*. Following Noel Rowe's *Pictorial Guide of the Living Primates* (2006), the genre *Cercocebus* includes the agile mangabey (*Cercocebus agilis*), the tana river mangabey (*Cercocebus galeritus*), the white-collared mangabey (*Cercocebus torquatus*) and the sooty mangabey (*Cercocebus torquatus atys*). The sooty mangabey was once subsumed as a subspecies of the white-collared mangabey, but from actual data appears evidence that the sooty mangabey is an independent species, with the white-crowned mangabey (*Cercocebus a. lunulatus*) as subspecies (Booth 1956; Groves 2001; 2005 all in Gron, 2008). It is the white-crowned mangabey that will be the subject of the present research. However, given the fact that there are fewer details available on this subspecies, it will be expose information about the sooty mangabeys in general. Nevertheless, details regarding the white-crowned mangabey will also be added when possible. Most data concerning wild-living mangabeys have come from research done in the 'Taï National Park forest'[4], while most data on captive mangabey have come from the Yerkes Regional Primate Centre[5].

[4] The Taï National Park belonged once to the Upper Guinea Forest (form Gahna to Sierra Leone) which has declined dramatically. The only intact block of forest is the Taï forest, which has been protected since 1927 and is now internationally recognized as 'Biospere Reserve' under 'UNESCO's Man and the Biosphere Programme' (McGraw & Zuberbühler, 2007). The Taï National Park forest has been the preferred study area to conduct observations on wild-living forest monkeys. The first contributions to the 'Taï Project' came from Angus Booth and later series of studies on behavioural and positional behaviour of the Taï Monkeys have come from Scott McGrraw and his students (McGraw & Zuberbühler, 2007).

[5] The Yerkes Regional Primate Centre keeps a captive mangabey colony since 1966. At the beginning, the colony comprised 27 individuals and was mostly studied by Bernstein (Gust, 1995b). Today the colony comprises 160 individuals (Gust, 1995b) and has been the subject of a large number of investigations.

The sooty mangabey has a brown gray colour with white under-pads. On the ventral part the colour is lighter and sometimes is light-blue. The facial area is grey-pink around the muzzle, and the ears are dark. The particularity of the white-crowned mangabey is that it has a complete white ventral area (including inner limbs), as well as a white back head (Mittermeier et al., 2006). Between females and males exists a high level of sexual dimorphism. Females are recorded to weigh up to 5.5kg, whereas males are double in weight, attaining 10.2kg (Harvey & Clutton-Brock 1985 in Gron, 2008). Both genders have as longevity up to 18 years.

The sooty mangabey passes up to 75% on the ground and on lower levels of the forest strata, like under story, shrub layer and the ground (McGraw, 2007a). In geographical terms, it exits in the high forest of West Africa (Range & Noë, 2002 in Gron, 2008), the tropical moist evergreen rainforest in the Côte d'Ivoire of the Taï National Park (Range & Noë, 2002 in Gron, 2008), the gallery forests and the deciduous Bissine forest (Gron, 2008). More exactly, we find the sooty mangabey along the West coast of Africa, between Senegal and Ghana. The white-crowned mangabey is only found in the east side of the Nzo-Sassandra river (Booth, 1956 in Gron, 2008), or following Mittmeier and colleagues (2006), in the east sides between the Sassandra River in the Côte d'Ivoire and the Volta River in neighbouring Ghana.

In these habitats, the sooty mangabey occupies home ranges that are estimated to be between 4km and 6.5km (McGraw & Zuberbühler, 2007). The different home ranges, occupied by different individuals, can overlap significantly. This in turn can lead to aggressive encounters, though the mangabey pre-resolves the majority of these situations by avoidance (Range, 2005 in Gron, 2008). Besides intra-species emergence in the same habitats, there is also a lot of inter-species coexistence in the same areas. The sooty mangabey shares the forest, with a wide range of other primates. For example the western black and white colobus monkeys (*Colobus polykomos*), the red colobus (*Piliocolobus sp.*), the olive colobus (*Procolobus verus*), Diana monkeys (*Cercopithecus diana*), Campbell's guenon (*Cercopithecus campbelli*), among others (Gron, 2008; McGraw & Zuberbühler, 2007). There are also predators, which the sooty mangabey encounters, namely leopards, crowned hawk eagles and chimpanzees.

The sooty mangabey passes most of his day time feeding and foraging. These activities are followed by resting, social activities, and travelling during the day.

Between the activity budget of a lower ranking animal and the one of a higher ranking animal, lies a significant difference. Range and colleagues (2007), discuss the differences as being related to the dominance position and the benefits that this can bring in terms of foraging efficiency, access to security and access to mates. In captivity, a biological zoo day is described by as having three important time periods. The morning - when the primates are very active with travelling and 'presenting', the late morning - when locomotory behaviours decrease and social activities increase, and the late afternoon - when individuals occupy most of the time with feeding and social activities and travelling starts to increase again slightly (Bernstein, 1976 in Gron, 2008). The specie in focus, is mostly engaged in feeding activities, where the ingestion of fruit, seeds, leaves and flowers, but also invertebrates, are common (McGraw & Zuberbühler, 2007).

## 4.2 Social behaviour

The sooty mangabey lives in multi-female multi-male social groups, with all sex and age classes of individuals. A single mangabey group has been recorded to have a maximum of 120 individuals and a minimal of 20 to 45 individuals. The females are philopatric and the males are the dispersing gender (Range, 2006). In the wild, individuals have a strong linear dominance hierarchy (Range, 2006), which allows the higher ranking males with the best breeding opportunities, and the females with better security and therefore higher foraging efficiency. From captive studies, has been deducted that mangabey's dominance hierarchy is not matrilinear and not related to age or gender. It is said to be an individualistic dominance system (Gust, 1995b). Individuals start on the age of three to attempt to move up in hierarchy, and with this, to leave their mother's rank. According to Gust (1995a), the most common practice is the direct challenge to a higher-ranking animal by the juvenile. Frequently, happens when the juvenile joins with an aggressor against a higher ranking victim than the juvenile. Normally, by the age of six, both sexes over-rank their mothers, with males outranging all females of the group (Gust, 1995a and b).

Beside these sorts of disputes, that make part of sooty mangabey development, aggressiveness is rare. However, if aggressiveness does occur, it is mostly in two forms

of biting: the body biting (normally without wounding), and the tail biting (normally with wounding) (Gust & Gordon, 1993). After agonist encounters, managebys show three post-conflict behaviours: redirect aggression to a lower rank individual, fight away from the aggressor, and returning to the opponent and staying within 1 metre from him (Gust & Gordon, 1993). The last is the most common and when it occurs, the victim approaches the aggressor by showing him its hindquarters while crouching and looking over the shoulder to the opponent. This behaviour is explained to be a strategy of ending the aggression and placating the aggressor (Aureli et al., 1998 in Gust & Gordon, 1993). Yet, as mentioned, aggressive clashes are rare and one possible explanation is the affiliative relations that sooty managebys have with other members of the group, independent of kinship or dominance rank. The reason can also be the other way around, "(…) the non-kin-based social system exists because of the moderate aggression, given the notion that strong alliances are not necessary for protection from intra-group aggression and as suggested by the relatively low frequency of aid to victims." (Gust & Gordon, 1993: 693).

## 4.3 Reproduction

Females are mature at the age of three, with birth usually occurring around 4.7 years. Females have a visual ovulation period, with swelling and colouring (pink bright) of the anogenital region, which lasts for around two weeks. The maximum swelling is around two weeks prior to menstruation (Stevenson, 1973 in Gron, 2008). Additionally, females show a post-conception swelling with an average of 49 days (Gust, 1995b). This sexual swelling of females will attract all males of the group, but the alpha male seems to have a sensibility for the fertile tumescent ovulation of females (Gust, 1995b). This presumption comes from data indicating that the alpha male tends to copulate extensively more with females during the ovulation period (Gust, 1995b). Post-conception swelling is a curious fact, which has been explained by some theories. One of such theories as notice that it promotes additional male investment and avert males infanticide (Hrdy-Blaffer, 1974 in Gust, 1995b).

Infanticide is known to occur in sooty mangabeys, and the captive mangabey colony at the Yerkes Regional Primate Center offers some examples of this behaviour

(Busse & Gordon, 1983 in Gust, 1995b). Most cases occurred when a new alpha male had took over. In respect to the sexual selection theory, this behaviour would happen to ensure that the new male has the certainty of his own offspring in the next coming generations. Although it appears that the dominant male has the best mating opportunities, sneak copulation is widely known in the wild (Range, 2005 in Gron, 2008).

Females have usually up to seven infants, with a gestation period of approximately 167 day, and interbirth intervals up to 16.6 month (Rowe, 1996 in Gron, 2008). When a female has a newborn, she carries her infant in a clinging ventral position. During the first period, the mother will start grooming her infants back and later on his hands and feet. From the 6 week onwards, the infant will leave his mother for the first time, although remaining very close to her. It is about that time that the infant starts exploring his surroundings. By the age of 16 weeks, social interaction takes place and the infant starts to have more independence. Finally, around the 18 weeks, the mother will begins refusing the infant attempts to nurse (Gron, 2008).

In males, maturation occurs at the age of seven. Yet, copulation behaviours start very early, with nine month old infants are already showing mounting behaviour directed towards mature females. In total, immature males copulate more frequently then mature ones, and a female will curiously maintain the same behavioural patterns (sexual vocalization and the darting away), during and after copulation, despite of being a immature or a mature male (Gust, 1995b).

## 4.4 Communication

The sooty mangabey has a vast communication repertoire manifested either in corporal or in vocal expressions. Communication can be said to happen in two major contexts, in agonistic and in non-agonistic ones. In agonistic situations, the most common threat expression is the “Stare”. Accordingly to Chalmers:

> “(…) the displaying monkey stares straight at its opponent with eyes wide open and eyebrows and crest raised. The mouth is usually slightly opened

> and the lip corners brought forward, the mouth being 'O' shaped and the teeth remaining concealed. The ears are flattened back against the side of the head. If the displaying monkey is sitting, it leans forward towards his opponent, bracing itself on tensed arms. If the monkey is standing, it frequently crouches as a preparatory movement for springing forward. In either positions it may jerk its head rapidly up and down two or three times." (1968: 259).

Another typical menace expression is the "Yawn". Here the mouth is open at the same time as the head is thrown back, showing in full size the teeth to the opponent (Chalmers, 1968). Sill in agonistic contexts the "Alarm screams" is known as a loud noisy call, which is given by all sex and age classes (except for adult males), and either by the attacking or attacked animal during a fight (Chalmers, 1968). One more typical threat expression, the "Growl", is given by higher ranking subjects, that simultaneously raise their eyebrow and stare at the victim (Range & Fischer, 2004). The sound consists of one essential low frequency band that is accompanied by other overtones. Other known vocalizations, given normally by the aggressor, are "wherrs" (Chalmers, 1968; Horn, 1987 all in Gust, 1994), "Grumble", "Hoo", "Intense threat" and the "Wau" (Range & Fischer, 2004).

Apart from the aggressive ones, the non-agonistic contexts can be sub-divide into non-mating and mating ones. Beginning by facial expressions within the non-mating situations, one very common is the "Lip-smacking". Here the "(…) mouth is opened and closed rapidly several times. The lips are pouted slightly and the teeth are not exposed. The tongue is sometimes protruded slightly when the mouth lateral shaking of the head." (Chalmers, 1968: 261). Another very typical body expression is "Presenting", which is when individual A is facing individual B with it callosities, while it tail is held up. "Presenting" can provoke a variety of reactions in the second individual, as Chalmers (1968) accounts: "Sits by presenting monkey after approaching it, ignores presenting monkey, is groomed by presenting monkey, grooms presenting monkey, touches or puts nose to genital region of presenting monkey, mounts presenting monkey." (Chalmers, 1968: 265) One other affiliative expressive behaviour is the mutual embrace (Kyes, 1989 in Gust, 1995b). Here two individuals simply sit in ventral-ventral contact and hug each other for 5 to 30 seconds (Wallis, 1981).

In terms of vocal communication, the “Grunts” and the “Chuckle” are common. They are given in a variety of situations, for example by watching agonistic encounters between other individuals, by approaching and being approached, during feeding, sitting or slow locomotion and even for no apparent cause. These short low frequency vocalizations are given by all sex and age classes, but not by infants. (Chalmers, 1968: 268). A different vocalization is the “Twitter”, that is a melodic sound, most heard from adult females and juveniles, which happens in similar situations as the “Grunts” and “Chuckle”. One vocalization just given by adult males, is the “Whoop Calls” (Chalmers, 1968). Although it seems related to group spacing, the function is still not well discovered (Santee, 1992 in Gust 1994).

Finally, communication in non-agonistic matting situations are, for instance, the “Head flag” of males and the “Sexual presenting” of the female and the. Usually, the male is moving the head to left and right side of his shoulders, while a sexually swollen female is facing him with her callosities (Wallis, 1981). As a result of these body expressions copulation mostly follows (Chalmers, 1968; Range & Fischer, 2004).

## 4.5 Conservation status

The sooty mangabey is listed since 2008 as a vulnerable specie in the IUCN Red List of Threatened Species (Oates et al., 2008a) and in the The Convention for the International Trade of Endangered Species (CITES) in the Appendix II (Gron, 2008). The white-crowned mangabey subspecies is in a very critical status. Since 2001 they make part of breeding programs of the ‘European Endangered Species Programme’ (EEP) in some European zoos (Mittermeier et al., 2006). Between 2004 and 2006 it was listed as one of the 25 most endangered primate species in the world (Mittermeier et al., 2006). And, since 2008 the white-crowned mangabey is considered as ‘Endangered’ in the IUCN Red List (Oates et al., 2008b).

The major threats known are both habitat destruction and hunting. While the forests become smaller, the hunting pressure has increased (Mittermeier et al, 2006) and, as a result, white-crowned mangabey populations have declined by 50% in the last 27 years (Oates et al, 2008b). With deforestation, for the timber and firewood industry,

the forests have decrease from 2% to 3.1% ever year between 1990 and 2000 (Gron, 2008). Recent studies indicate that the white-crowned mangabey just remains in forest patches in the Guinean forest zone and in Côte d'Ivoire, respectively in the Ankasa Resource Reserve, Dadieso Forest Reserve, Yoyo Forest Reserve in Ghana (Magnuson, 2002 in Mittermeier et al, 2006), and in the Marahoué National Park, Dassioko Forest Reserve, Niegre Forest Reserve, and the forest east of the Ehi Lagoon (McGraw 1998; McGraw and Oates 2002; Kone 2004 all in Mittermeier et al, 2006). In addition to habitat destruction, hunting by local people is a serious threat to this specie long-time survival. Hunting in and around the Taï Park Forest is said to occurred three times more than it is possible for the specie to reproduce successfully in terms of sustainability (Refisch & Koné 2005 in Gron, 2008).

## 4.6 Visitor effects on mangabeys

The few "Visitor Effects" studies conducted on captive mangabeys were carried out on the golden-bellied mangabey (*Cercocebus galeritus chrysogaster*), by Mitchell and colleagues (1990; 1991; 1992a; 1992b; 1992c) in the Sacramento Zoo, USA. Mostly, Mitchell and colleagues studied the effect of visitor numbers (presence, density) on captive groups. This was tested by moving different mangabey groups between cages that had different intensities of visitor attendance (Mitchell et al., 1991 and 1992c). The idea to conduct this investigation resulted from a previous one, which shows that the number of visitors differ according to the locations of the exhibits (Mitchell et al., 1990).

Therefore, in Mitchell and colleagues (1991), three groups of golden-bellied mangabeys were moved between low, medium and high visited cages. The measures show that aggressive behaviour (intra-group, visitor-directed and neighbour-cage directed) varied according to the cages in which the subjects were located. This means an increase in visitor-directed aggressions in the medium and high visited cages compared to the low visited ones. Intra-group aggressions were highest when the mangabeys were located in the medium visited cage, but only average when in the high visited cage (1991). One last result is that, the neighbour-cage directed aggression was highest when animals were in the low visited cage. In addition, the authors did not

found any effect of the location (also visitor number) with regard to sexual, grooming and playing behaviour. However, cage change seemed to have a positive effect on these behaviours as they increased when mangabeys were moved to a different cage. According to these results, the authors argued that visitor numbers do not affect all types of aggressive behaviour equally, and therefore attention to the different forms of aggressive display should be paid in this kind of analysis.

One more study (Mitchell et al. 1992c) in which aggressive behaviour (in form of facial display) was measured on golden-bellied mangabeys shows significant higher visitor-directed and within-group displays when the animals were moved to cages with higher number of visitors. However, aggressive displays towards neighbour cages were highest when visitor and intra-group aggression were lowest. In response to these results, Mitchell and colleagues presume that mangabeys in the wild will direct aggressions towards other sympatric species and that the visitors replace the sympatric species as a target of this aggression.

In another study, Mitchell investigated if differences on the sex and age of the visitors have an influence on mangabeys visitor-directed aggressions. The results show that male visitors tended to threaten male mangabeys more often than female mangabeys. However, non-human males also threatened visitors significantly more then did females. According to the authors, "the intriguing finding of this research is that of the mutual threatening of mangabeys and the interloping visitors within the same age/sex groups." (Mitchell et al., 1992a: 110).

Concluding, Mitchell's studies emphasize the fact that the mangabeys housed in captivity increase visitor-directed aggressions according to the visitor number, which leads to the evidence that a negative visitor effect may exists, in the sense that visitor-directed aggressions increase and this might be understood as sign of stress in captive primates. Furthermore, it is suggested to differentiate between the different types of aggressive displays, since results show that not all types of aggressive behaviours depended equally on the exposure to zoo public. These studies show the importance of adequate zoo management, regarding which species should be housed in which cages and in terms of which species should be located in neighbouring cages.

# II. Materials and Methods

## 1. Subjects

### 1.1 Group composition

Observational data was collected from a group of White-Crowned Mangabeys (*Cercocebus atys lunulatus*) of ZSL London Zoo. This group was formed from three individuals in 2007, and now comprises a total of six individuals, namely two adult females, one adult male, a male and a female juvenile, and an infant. The infant was born in October 2009 and was not used as focal subject during the data collection, because it was still dependent from his mother and would just start to engage in social interaction about 4.2 month (Gust, 1999). He was, nevertheless, object of behavioural patterns emitted by the other individuals, and those were registered during the other subject's focal observation. Details of each observed subject are given in Table 1.

**Table 1 –** Individuals information

| Name | Sex | Year of birth | Age at the time of data collection (approximately) | Parents | Origin | Rearing history |
|---|---|---|---|---|---|---|
| Lucky | male | 2002 | 8 years old | Unknown | Ghana | Unknown |
| Leonie | female | 2001 | 9 years old | Unknown | Germany | Unknown |
| Bella | female | 2002 | 8 years old | Unknown | Barcelona | Unknown |
| Conchita | female | 2008 | 3 years old | Leonie & Lucky | London | Hand reared |
| Luca | male | 2008 | 3 years old | Bella & Lucky | London | Parent reared |
| Paddy | male | 2009 | 3 months | Bella & Lucky | London | Parent reared |

## 1.2 Environment and Housing

The mangabey exhibition is situated within the Gorilla Kingdom, which hosts, beside the study subjects, the western lowland gorilla (*Gorilla gorilla gorilla*), the Diana monkeys (*Cercopithecus diana diana*) and the Kikuyu black-and-white colobus (*Colobus guereza kikuyuensis).* The mangabey enclosure is situated next to the Diana monkeys and parallel to the western lowland gorilla.

The actual mangabey enclosure (Figure 1) can be divided into two main areas: the outdoor enclosure and the indoor enclosure. The outdoor enclosure (Ex) has the approximate dimensions of 9m x 6m. The space is delineated by a covered surround fence on which the mangabeys can climb. On three sides of the space, one can find a mix of grasses, shrubs and a second fence, demarcating the border between the public and the non-human primates. The whole outdoor space has a naturalistic environment, with woodchips covering the ground, some trees, bushes and grasses and all over naturalistic climbing structures. The 'Ex' can be accessed by the individuals from all indoor enclosures, which are subdivided into five separated spaces, two viewing enclosures (InA and InB) and three small out of view enclosures (R).

The two indoor viewing enclosures are independent areas. 'InA' is in the inner face of the Gorilla Kingdom complex, located parallel to the western lowland gorilla enclosure. 'InB', on the other hand, is situated on the outer face of the building pointing to a not much used path and has therefore much lower visitor affluences. Although separated spaces, 'InA' and 'InB' are physically very similar with almost identical equipment and disposition. Both areas have the approximate dimensions of 6m x 4,5m and are composed of three main walls and one big frontal viewing window. The ground and walls are made of a stoned material, but one can find several bunches of wood pieces or hay distributed over the ground. Additionally, both enclosures are equipped with naturalistic climbing structures. These two indoor viewing areas are separated by the out of view area (R).

'R' is composed of three separated spaces; two of them have the dimensions of 3,05m x 0,91m, and one of 1,22m x 1,22m. The areas are equipped with climbing structures and naturalistic substrate, where the animals can find a comfortable rest. The areas can be accessed by the individuals through a tunnel, which can also be shut off by the keepers if it is necessary to separate the group.

## 1.3 Diet and daily Routine

The white-crowned mangabeys get food up to four times a day, starting with the morning feed around 9.30am, some enrichment feed about midday and again at 2.00pm, and finally the afternoon feed at approximately 4.45pm. The precise diet is shown in Table 2.

**Table 2 –** Diet plan

| **AM** | **PM** |
|---|---|
| 120g pellet<br>350g apple<br>25 grapes<br>400g other vegetables<br>450g leafy green<br>150g banana | 100g pellet<br>150g banana<br>300g pear<br>300g soft fruit<br>200g orange<br>350g other vegetables<br>650g leafy green |
| - Additionally each individual receives three eggs a week, on monday, wednesday and friday.<br>- Enrichment feed is usually peanuts, seeds, etc. | |

## 1.4 Conditions of handling and Maintenance in captivity

An unpredictable and frequent situation was the presence of keepers in the enclosure, either to clean or to equip it with some enrichment. In these situations the subjects were locked in one of the areas, either inside or outside, to prevent physical contact between keepers and animals.

As these kinds of situations were numerous and occurred spontaneously during data collection, the observations were not interrupted, but went on with a note about the kind of situations that were occurring.

# 2. Data collection

## 2.1 Two parts in the data collection

The data collection was divided into two separate but complementary parts, namely, the Mangabeys' Behaviour – M-Part, and the Visitors' Behaviour – V-Part. Each part had both the visitors and the mangabeys as study subjects. The specificity of each part was the observation intensity given on each of the study subjects in one but not in the other part. Therefore, the M-Part had a major focus on the mangabey group and the V-Part paid special attention to the visitors observing the mangabeys. The choice of the two parts came out of the difficulty to study both focus groups with the same detail at the same time, given the fact that there was only one observer available. Thus, the V-Part served as a complement, to look beyond the more general visitor variables (concentration, loudness and activity) and observe in more detail what specific behaviours visitors adopted in front of the mangabey enclosure.

## 2.2 The observation period

The study took place from January 2010 to July 2010, subdivided into two periods, the habituation period (Martin & Bateson, 1993) and the data collection period. The habituation period had the purpose of accustomisation to the study subjects and the other way around. Also in this first period, the study aim was adjusted, the ethogram (Appendix A) established and the hypotheses defined. The actual data collection period took place from May 2010 to July 2010. The data was collected throughout five days per week, on both weekdays and weekend days. One zoo day was divided into four time periods: Morning (10am -12pm), Afternoon (12pm – 14pm), Evening (14pm – 16pm) and Late Evening (16pm to 18pm). The Gorilla Kingdom opened between 10.30am and 17.30pm[6], what gave the possibility to have some visitor-free focal samples, which provided a good basis for comparison between the conditions of 'Visitor Presence' and 'Visitor Absence' (for further details see below "Data Analysis", p. 34-35).

[6] The viewing times were not always obeyed by the visitors.

On one observation day, two to four hours of observation were alternated between the M-Part and the V-Part, with the aim to prevent dependency of data within each part. Prior to the data collection, a randomised sample sequence, within each part, was worked out to prevent bias at the end of the observational period.

In total, 100 hours of focal samples (explained below) on the mangabey group were collected (20 hours per individual) and 70 hours of focal group samples on the visitors. Also, 4200 scan samples on the mangabey group were done and 3600 on the visitors.

## 2.3 Sampling methods

In the M-Part (Appendix B), the mangabey group was observed using the 'focal animal sampling' method (Martin & Bateson, 1993) with 'continuous recording' (Martin & Bateson, 1993). The focal samples had the duration of 10 minutes, during which the frequencies and the durations of selected mangabey behaviours (Appendix A, p. i-iii) were recorded. Additionally, in a two minute interval, 'scan sampling' (Martin & Bateson, 1993) with 'instantaneous sampling' or 'point sampling' (Martin & Bateson, 1993) was used. At each 'sample point' (Martin & Bateson, 1993), the visitors present within 1 meter from the mangabey enclosure were scanned. This resulted in 6 scan samples per each focal sample. During a scan, the number (0, 1-5, 5-10, 10-15, 15-20, 20 and more) and loudness ("quiet", "voice loud" or "loud": Appendix A, p. vii) of the visitors were estimated.

In terms of the V-Part (Appendix C), all people that stayed within 1 meter from the mangabey enclosure, observing them (not just passing by), were considered 'visitors'. They were observed using a 'focal group sampling' method of 10 minutes, with nine 1-minute 'sample intervals' (Martin & Bateson, 1993). Via the use of 'continuous recording' (Martin & Bateson, 1993), the frequencies of selected visitor behaviours (Appendix A, p. v-vi) were recorded during each of the intervals. In addition, like in the M-Part, 'scan sampling' (Martin & Bateson, 1993) was used. At the instance of each 'sample point' (Martin & Bateson, 1993), the mangabey group was scanned using 'instantaneous sampling' or 'point sampling' (Martin & Bateson, 1993).

At the end of each 10 minute focal group sample, a total of 10 scan samples were obtained with information about the presence or absence and behaviour of each individual of the mangabey group.

## 3. Data analysis

The data analysis was carried out with EXCEL 7.0a. and the statistical tests were run in SPSS (Version 18). The data from the two separated samples, namely the M-Part and the V-Part, were analysed separately and the results will be presented independently.

To analyse if the visitor conditions have an effect on the mangabey group, frequencies of aggressive and affiliative mangabey behaviours were chosen. They were considered good indicators because, on one hand, increased aggressions on the captive animals can be understood as an expression of an undesirable behaviour, and therefore, as an indicator for a tension caused by a stimulus (Mitchell & Hosey, 2005). And on the other hand, elevated affiliative behaviours (e.g. social grooming) are usually understood as an indicator for stressful situations, since they can serve as distress prevention (Aureli & Yates, 2010) and/or as reconciliation (Mitchell & Hosey, 2005) from conflict situations.

In the M-Part, the frequencies, rather then the durations, of agonistic and affiliative behaviours of the mangabey group were analysed in relation to specific visitor conditions, namely 'Visitor Presence/Absence', 'Visitor Cumulative Presence' and 'Visitor Loudness' ("Data Analysis", p. 34-36). The agonistic displays of the mangabeys, used in the data analysis, are called 'Aggressive Behaviours', which include two different types, the 'Intra-group Aggressive Behaviours' ('Attack', 'Avoid', 'Chase', 'Flee', 'Stare': Appendix A, p. ii-iii) and the 'Visitor-directed Aggressive Behaviours' ('Threat Visitors', 'Attack Visitors': Appendix A, p. iii-iv). In turn, the 'Affiliative Behaviours' used in the data analysis, include two behaviours, 'allo-grooming' and 'non-sexual presenting' (Appendix A, p. i). These two specific affiliative interactions were chosen, as they both happened predominantly in stress situations. It is

suggested in literature that social grooming is used to reduce distress in non-human primate species (Aureli & Yates, 2010), and the presenting behaviour is used by mangabeys as a reconciliation strategy after conflict situations (Gust & Gordon, 1993).

In the V-Part, the frequencies of the mangabey 'Aggressive Behaviours' ('Intra-group Aggressive Behaviours' and 'Visitor-directed Aggressive Behaviours') were analysed in relation to 'Visitor Activity/Inactivity', 'Visitor Activity Levels' and also to the occurrence of specific 'Visitor Behaviours' ("Data Analysis", p. 36-38).

## 3.1 Mangabeys' Behaviour – M-Part

### Activity Budget

To set up the activity budget of the whole mangabey group, total frequencies (of elementary behaviours) of 'Resting/Observing Visitors', 'Locomotion', 'Nutrition', and 'Social Behaviours' were used. The first behavioural category includes two behaviours, namely 'resting' and 'observing visitors' (Appendix A, p. iii). During the observation period, it was difficult to accurately distinguish between these two activities, since one of the two behaviours could pass very quickly into the other and again, the other way around, without any recognisable modification of the individual's body expression. To avoid false statements, the total frequencies of both behaviours were summarized, resulting in one behavioural category named 'Resting/Observing Visitors'. The 'Locomotion' category comprises all locomotory behaviours such as walking, climbing, and so forth (Appendix A, p. iii). The category 'Nutrition', includes either 'Foraging' as well as 'Alimentation' (Appendix A, p. iii). The last category, 'Social', is subdivided into social behaviours of agonistic and affiliative nature (Appendix A, p. i-ii).

### Mangabey Behaviours and Visitor Absence / Presence

It was tested if there is a significant relation between the frequencies of both mangabey 'Aggressive Behaviours' and 'Affiliative Behaviours' and the absence or

presence of visitors in the viewing areas. For the condition 'Visitor Absence' was used focal samples recorded only when the Gorilla Kingdom was closed (10.00 - 10.30am and 17.30 - 18.00pm), which had definitely a visitor number nil (see Footnote on page 31). In contrast, it was used data recorded in all other times for the 'Visitor Presence' condition (10.30am – 17.30pm) when the visitor's number was > 0.

Mangabey Behaviours and Visitor Cumulative Presence

The aim of this analysis is to see if there is a significant relation between the rate of both the mangabey 'Aggressive Behaviours' and 'Affiliative Behaviours' and the intensity of the 'Visitor Cumulative Presence' in front of the mangabey enclosure. The 'Visitor Cumulative Presence' is not equivalent to the real number of visitors. During each 'sample point', the number of visitors was estimated without considering if it was a new or continual visitor. By continual visitor is meant the ones that remained from the previous scan sample. In other words, when just one visitor was present throughout the whole 10 minutes focal sample period, the 'Visitor Cumulative Presence' for this period was said to be 6, since it was 6 times the presence of one visitor at each of the 6 'sample points'. This means that the 'Visitor Cumulative Presence' for a 10-minute focal sample period, results from the sum of the number of visitors at each of the 6 'sample points'.

For this analysis, the frequency of the mangabey 'Aggressive Behaviours' and 'Affiliative Behaviours' was related to three different grades of 'Visitor Cumulative Presence':

a) "low" – focal samples with a 'Visitor Cumulative Presence' of 0 (it was considered "low", but not "nil", because the record of 0 visitors at each 'sample point' did not guarantee that in-between, during the intervals, there were no visitors present at all);

b) "medium" – focal samples with a 'Visitor Cumulative Presence' of > 1 and < 20;

c) "high" – focal samples with a 'Visitor Cumulative Presence' of > 20.

Mangabey Aggressive / Affiliative Behaviours and Visitor Loudness

It was explored if the frequency of mangabey 'Aggressive Behaviours' and 'Affiliative Behaviours' are related to 'Visitor Loudness' levels. To determine the average loudness for a focal sample of 10 minutes, the single loudness levels ("quiet", "voice loudness" and "loud") that were registered during the sample points were ranked. According to this, "quiet" was given the rank 1, "voice loudness" the rank 2 and "loud" the rank 3. In the next step, all the single loudness levels, for one focal sample period, were multiplied by the corresponding rank number. Subsequently, these single results were subsumed, and the final result came to offer an average loudness level that could best characterize the corresponding focal sample period. To exemplify, if during each of the 6 sample points the loudness was "quiet", the formula was 6x1 (because the rank for "quiet" was 1). Therefore, this would show an average loudness of 6 for this specific focal sample, which means a "low" level. The three levels of 'Visitor Loudness', with which the rates of aggressive and affiliative behaviours were related, are listed below:

a) "low" – a loudness from 0-6;

b) "medium" – a loudness from 7-12;

c) "high" – a loudness from 13-18.

## 3.2 Visitors' Behaviour – V-Part

Active / Inactive Visitors and Mangabey Aggressive Behaviours

In this specific analysis, the frequencies of the mangabey 'Aggressive Behaviours' were compared to focal group samples of visitor's activity and inactivity. The condition of 'Inactive Visitors' was given when the visitor did not behave according to the following visitor behaviours: 'personal', 'invasive' or 'attract attention' (these behaviours will be explained below), while observing the mangabeys. This 'inactive' condition was recorded through focal group samples of 10 minutes with a 'Visitor Cumulative Presence' > 0. In contrast, the condition of 'Active Visitors' was

given to the ones that show any of the visitor behaviours mentioned, also recorded through focal group samples.

In addition to the condition 'Visitor Activity/Inactivity', the 'Visitor Activity' itself was also analysed through levels and associated with mangabey 'Aggressive Behaviours'. The level of the 'Visitor Activity' for a focal group sample of 10 minutes was established through the total frequency of visitor behaviours that have occurred. This means that to each focal group sample was sum the number of activities that visitors have done, and were comprised according to the following levels:

a) "inactive" – nil activity occurrences;

b) "low" – between 1-5 activity occurrences;

c) "medium" – between 6-10 activity occurrences;

d) "high" – 11 or more activity occurrences.

Visitor Behaviours and Mangabey Aggressive Behaviours

A step further was taken in this part with regards to the visitors activity, while the aim is to understand if any particular behaviour of the visitors has an effect on the 'Aggressive Behaviours' of the mangabey group. This analysis is focused on single visitor behavioural variables that have been comprised into three major categories (see below). When any correspondence between a visitor behavioural category and the mangabey 'Aggressive Behaviours' was found, the specific visitor behaviours (included in the visitor behavioural category), were analysed. The three major behavioural categories and the specific behaviours associated are:

a) 'Attract Attention Behaviours' – includes visitor behaviours that tried to catch the attention of the animals, such as 'bang on glass', 'attract attention with gestures', 'attract attention vocally', and 'attract attention with object';

b) 'Invasive Behaviours' – consist of visitor behaviours that somehow intrude the enclosure by throwing anything from the visitor area into the mangabey area. The specific behaviours are: 'throw item', 'feed personal food', 'feed/throw leafs';

c) ‘Personal Behaviours’ – contains all visitor behaviours that happened in front of the enclosure but were not mangabey-directed. They were included because it was observed during the habituation period that they may cause a reaction in the animals, namely ‘take child up in arms’, ‘climb fence’ and ‘eating’.

## 3.3 Statistical analysis

To verify if the mangabey behaviours show significant relation to the visitor conditions tested, we run non-parametrical Chi-square tests. In more detail, on the group level the total frequencies of ‘Aggressive Behaviours’, ‘Intra-group Aggressive Behaviours’, ‘Visitor-directed Aggressive Behaviours’ and ‘Affiliative Behaviours’ were analysed according to the following visitor conditions: a) absence and presence; b) low, medium and high levels of cumulative presence; and c) low, medium and high levels of loudness. In addition, total frequencies on group levels of ‘Aggressive Behaviours’, ‘Intra-group Aggressive Behaviours’ and ‘Visitor-directed Aggressive Behaviours’ were also analysed according to a) visitor activity and inactivity’, b) inactivity and low, medium and high levels of activity of visitors’, and c) ‘invasive’, ‘personal’ and ‘attract attention’ behaviours of the visitors.

The statistical results were carried out according to the following procedure: since the hours of observations were not equal between the visitor conditions that need to be compared, it was considered the same number of hours to such conditions. This means that the visitor conditions that have more observation hours was compared with the visitor condition that have less observation hours through the same number of hours of this last one, so that a balanced sample size of observation hours, within each of the visitor conditions, could be achieved. For example, in opposition to the ‘Aggressive Behaviours’ category, both visitor conditions of ‘Absence’ and ‘Presence’ need to be compared, therefore, from the one that have more observation hours, let us say, ‘Presence’, it will only be considered the same number of hour of the other, ‘Absence’. In addition to this, the visitor condition with less hours of observation was compared against two different parts of the visitor condition which have more observation hours. For instance, if the number of hours of the visitor condition that has less observation

hours is, let's say, 50, this number of hours will be compared against the first 50, but also the last 50 hours, of the visitor conditions that has more observations hours. In the case that the comparison of the visitor condition with less observation hours, against two different parts of the same visitor condition shows the same result, such as both significant, it will be considered the first comparison as the final result (according to the example, it would be the first 50 hours of one visitor condition against the total of 50 hours of the other visitor condition). In the case that the results are not the same, such as the case in which one would be significant and the other would be not significant, a third test was conducted. Here, it was used the same number of hours but from the middle of the column of the visitor condition that have more observation hours. Therefore, the third result came to decide the final result. Again, it is the first comparison used that indicates in the end which is the final result. All results < 0,05 were considered significant.

# III. Results

The results are divided in two separated parts according to the two different observation methods that were used to record separated but complementary data – namely, the 'Mangabeys' Behaviour - M-Part' and the 'Visitors' Behaviour - V-Part', (for further details see chapter II., Material and Methods: 3.1 and 3.2).

## 1. Mangabeys' Behaviour - M-Part

### 1.1 Activity Budget

The first figure (Figure 2) shows the Activity Budget for the whole mangabey group. 'Nutrition' (35%) followed by 'Locomotion' (26%) and 'Resting/Observing Visitors' (26%), were the most performed behavioural patterns. Lastly, with the smallest percentage in the pie chart, are 'Social Behaviours' (13%), which in turn have been subdivided into 'Agonistic Interactions' (3%) and 'Non-agonistic Interaction' (10%) (Appendix A).

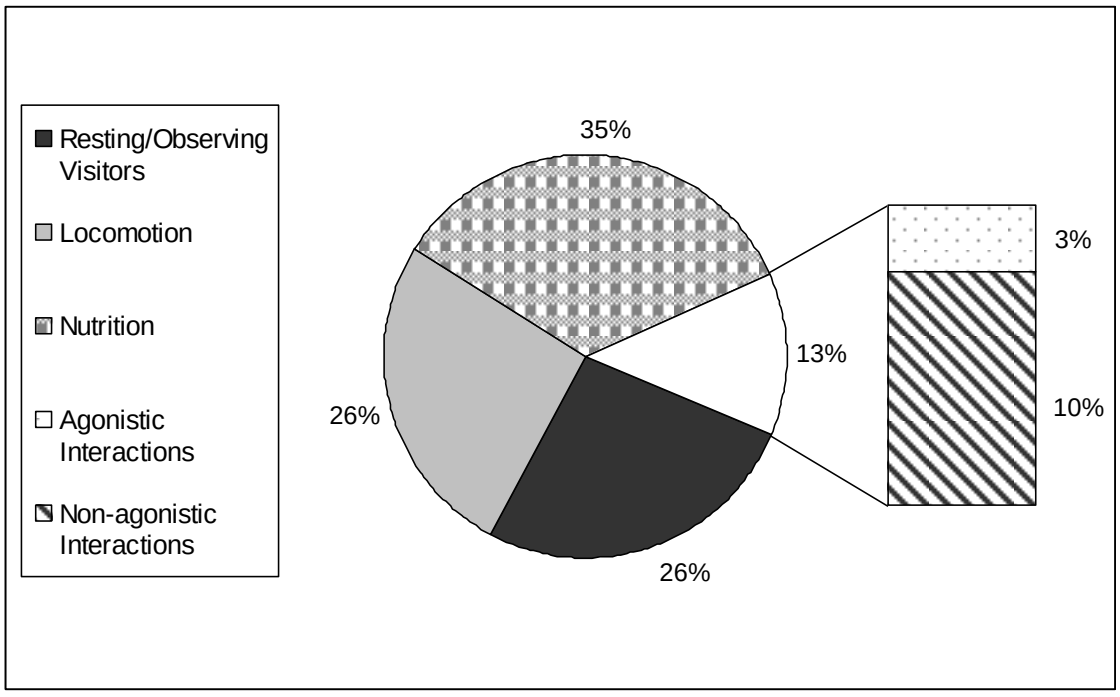


**Figure 2 –** Activity Budget, based on the total frequencies for the mangabey group with the associated propotion for each of the behaviours.

Table 2 shows the total frequencies of the mangabey behaviours that are going to be analysed in relation to specific visitor conditions, namely 'Visitor Presence/Absence', 'Visitor Cumulative Presence' and 'Visitor Loudness'.

**Table 3 –** Total frequencies

| **Affiliative Behaviours** | | **Intra-group Aggressive Behaviour** | | **Visitor-directed Aggressive Behaviour** | |
|---|---|---|---|---|---|
| **Behaviour** | **Total Frequency** | **Behaviour** | **Total Frequency** | **Behaviour** | **Total Frequency** |
| Allo-groom | 125 | Avoid | 45 | Attack | 122 |
| | | Attack | 0 | | |
| Non-sexual Presenting | 44 | Chase | 15 | Stare | 47 |
| | | Flee | 36 | | |
| | | Stare | 36 | | |
| | **169** | | **132** | | **169** |

1.2 Mangabey Aggressive/Affiliative Behaviours and Visitor Absence/Presence

Figure 3 reveals that mangabey 'Aggressive Behaviours' tend to be higher ($X^2$ = 3,270, d.f. = 1, $P$ = 0,103) when visitors were present in contrast to when they were absent. With the absence of visitors, the 'Intra-group Aggressive Behaviours' were 1,39 episodes per hour. When visitors were present, the 'Intra-group Aggressive Behaviours' were 1,38 episodes per hour ($X^2$ = 1,800, d.f. = 1, $P$ = 0,271). However, the visitor-directed ones show a frequency per hour of 1,98. Therefore, the visitor-directed aggressions made about 60% of the 'Aggressive Behaviours' for the 'Visitor Presence' condition.

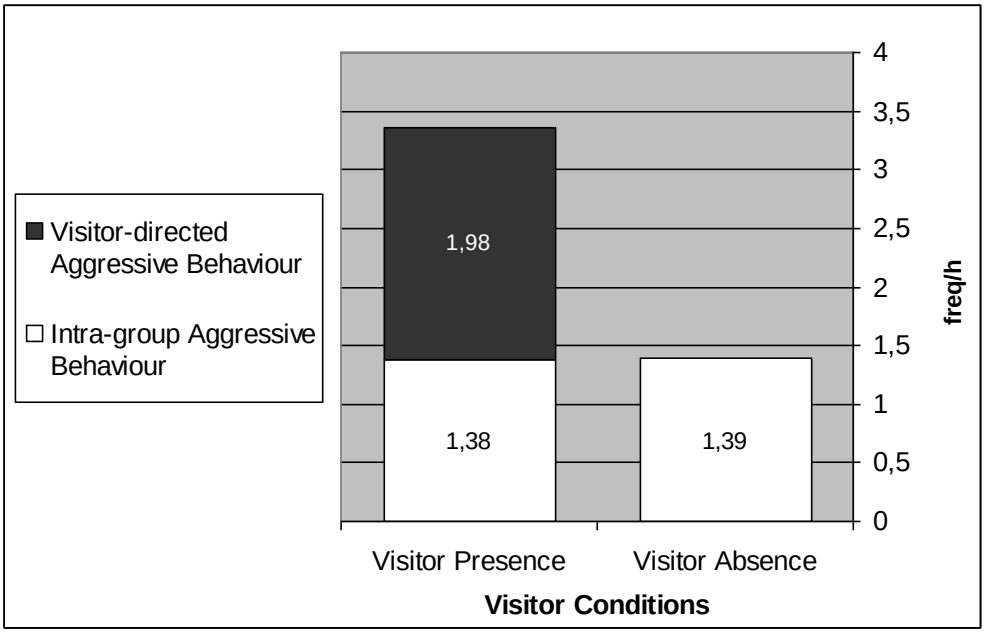


**Figure 3** – Frequency per hour of intra-group and visitor-directed aggressive behaviours in two conditions, when visitor were present and when visitors were absent.

The next diagram, in Figure 4, shows the frequencies of the managbeys' 'Affilitive Behaviours' in relation to visitor absence and presence. 'Affiliative Behaviours' tend to ocurred more often ($X^2$ = 1,385, d.f. = 1, $P$ = 0,340) when visitors were present (1,84 episodes per hour) than when they were absent (1,65 episodes per hour).

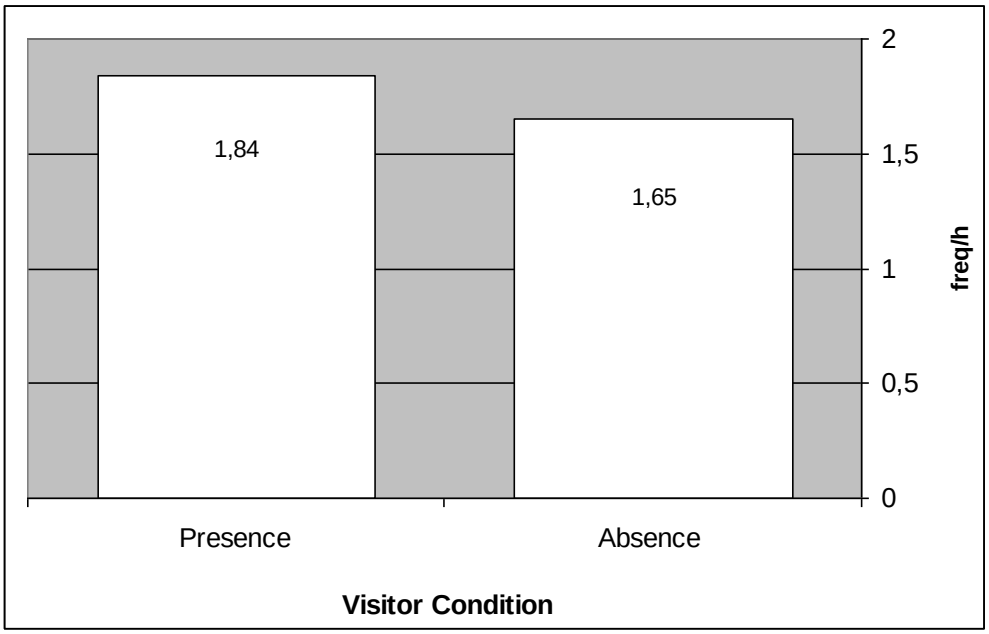


**Figure 4 –** Frequency per hour of 'Affiliative Behaviours' in two conditions, when visitor were present and when visitors were absent.

1.3 Mangabey Aggressive/Affiliative Behaviours and Visitor Cumulative Presence

Figure 5 shows that 'Aggressive Behaviours' increased significantly ($X^2$ = 63,061, d.f. = 2, $P$ = 0,000) with the increase of 'Visitor Cumulative Presence', reaching a peak of 4,68 episodes per hour with a high cumulative presence. More specifically, the visitor-directed aggressions increased significantly ($X^2$ = 103,285, d.f. = 2, $P$ = 0,000) with the raise of 'Visitor Cumulative Presence'. With a low cumulative presence, the aggressions towards visitors were 0,16 episodes per hour, while in the medium 'Cumulative Presence' condition, the 'Visitor-directed Aggressive Behaviours' indicated 1,31 episodes per hour, and finally, achieved a peak of 3,24 episodes per hour for the high cumulative presence. The 'Intra-group Aggressive Behaviours' show a not significant relation ($X^2$ = 2,516, d.f. = 2, $P$ = 0,314) with the cumulative presence levels of visitors. However, this kind of aggression tend to increase about 0,17 (1,27 – 1,44) episodes per hour from low to high 'Visitor Cumulative Presence'. From low to medium, the within-group aggressions decreased slightly in 0,2 episodes per hour, however, it tend to increase between medium and high 'Visitor Cumulative Presence', achieving 1,44 episodes per hour.

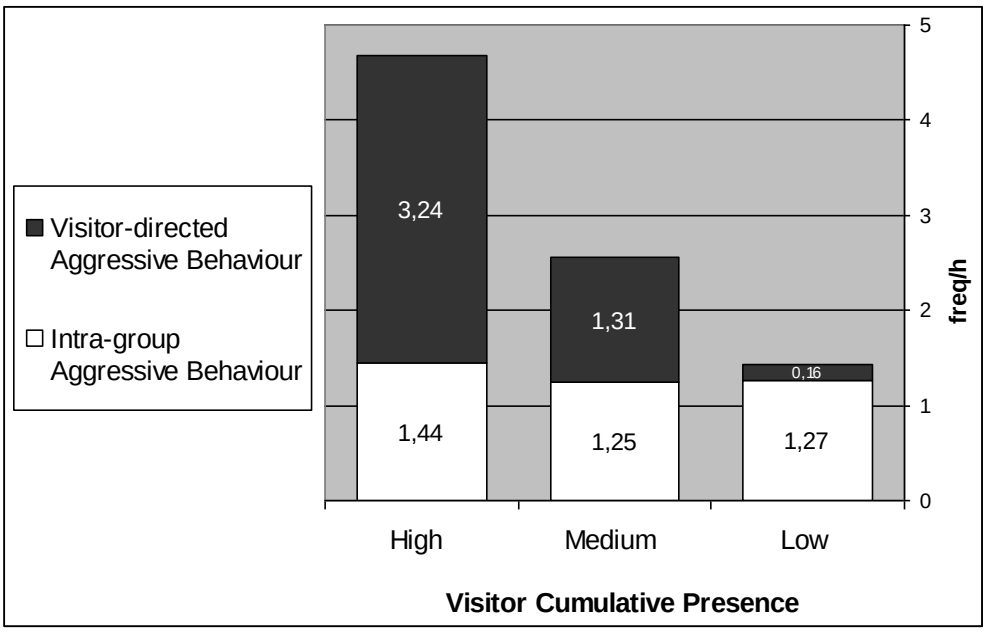


**Figure 5 –** Frequency per hour of intra-group and visitor-directed aggressive behaviours in three conditions, low, medium and high 'Visitors Cumulative Presence'.

Figure 6 shows that 'Visitor Cumulative Presence' had a significant effect ($X^2$ = 10,644, d.f. = 2, $P$ = 0.007) on the 'Affiliative Behaviours' in the mangabey group. In detail, the 'Affiliative Behaviours' exhibited had a frequency per hour of 1,33 when the 'Visitor Cumulative Presence' was low, raising to 1,75 episodes per hour with medium cumulative presence, and finally attained a peak of affiliative interaction (2,2 episodes per hour) when the 'Visitor Cumulative Presence' was high.

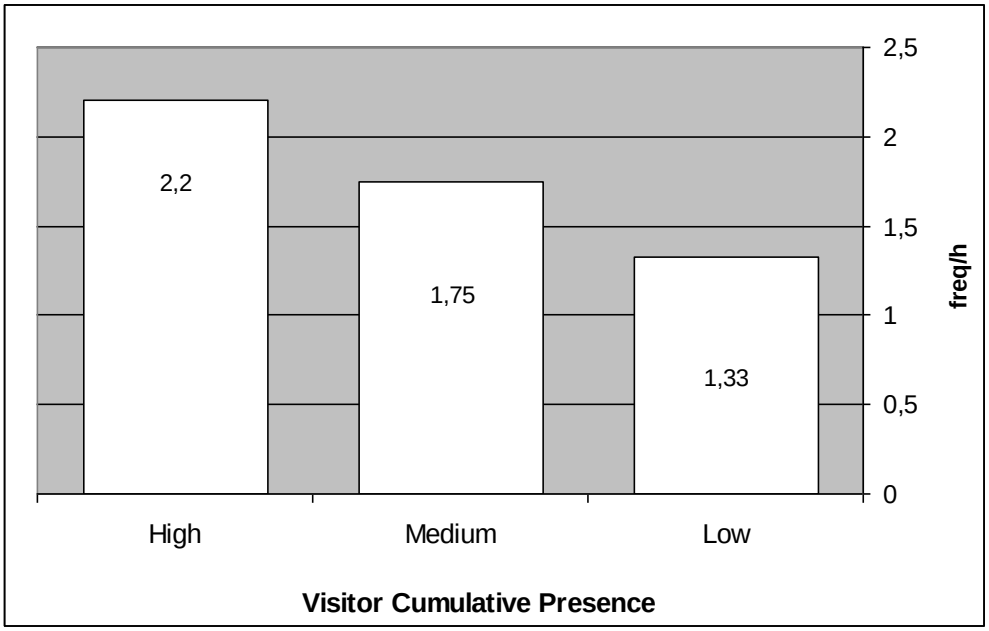


**Figure 6 –** Frequency per hour of 'Affiliative Behaviours' in three conditions, low, medium and high 'Visitors Cumulative Presence'.

1.4 Mangabey Aggressive/Affiliative Behaviours and Visitor Loudness

The diagram in Figure 7 show a significant increase ($X^2$ = 16,424, d.f. = 2, $P$ = 0,001) of 'Aggressive Behaviours' together with the 'Visitor Loudness'. More specifically, from low to high 'Visitor Loudness', the 'Aggressive Behaviours' increased from 2,06 to 6,45 episodes per hour.

Within the 'Aggressive Behaviours', the visitor-directed aggressions show a significant increase ($X^2$ = 23,558, d.f. = 2, $P$ = 0,000), at the same time as the 'Visitor Loudness' raised. More specifically, with low loudness the aggressions towards visitors had a frequency of 0.75 per hour, while in the transition to a medium loudness it increased to 3,05 episodes per hour, and finally reached a peak of 4,8 'Visitor-directed Aggressive Behaviours' per hour, when the loudness was high. The 'Intra-group Aggressive Behaviours' did not show a significant increase ($X^2$ = 4,455, d.f. = 2, $P$ = 0,152) from low (1,31 episodes per hour) to high (1,65 episodes per hour) 'Visitor Loudness', nonetheless the diagram also shows a slight decrease of about 0,02 episodes per hour, between low and medium 'Visitor Loudness'.

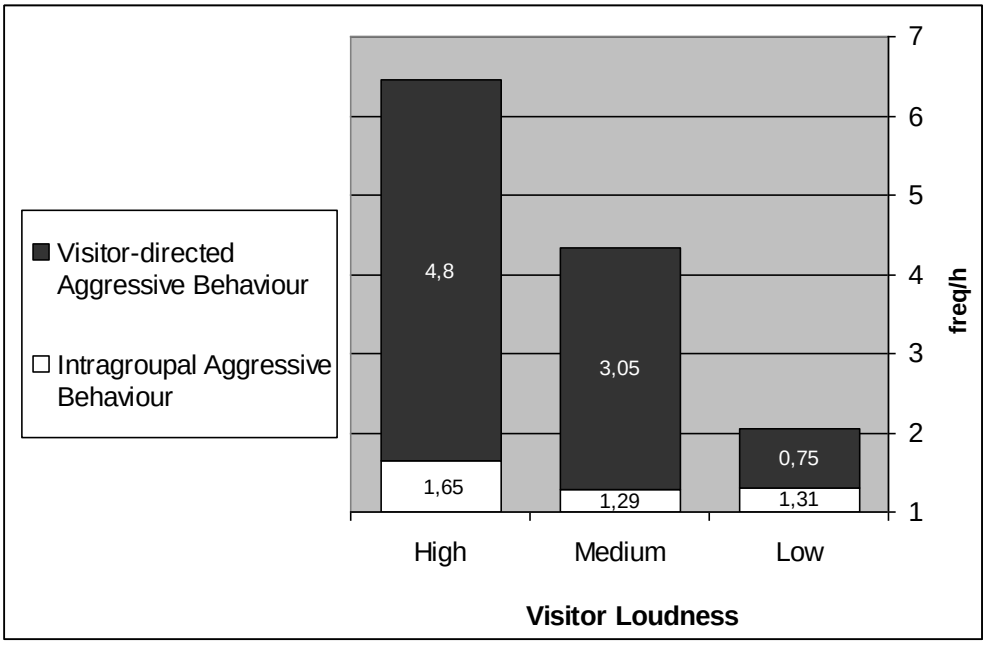


**Figure 7 –** Frequency per hour of intra-group and visitor-directed aggressive behaviours in three conditions, low, medium and high 'Visitor Loudness'.

'Affiliative Behaviours' also show a significant increase ($X^2$ = 12,318, d.f. = 2, $P$ = 0,003) in relation to 'Visitor Loudness'. The graph in figure 8 shows that 'Affiliative Behaviours' increased together with loudness, to approximately two times higher frequencies per hour. The 'Affiliative Behaviours' exhibited showed a frequency of 1,38 episodes per hour when the 'Visitor Loudness' was low, while it increased to 2,22 episodes per hour on medium loudness, and finally attained a peak of 3,6 episodes per hour when the loudness was high.

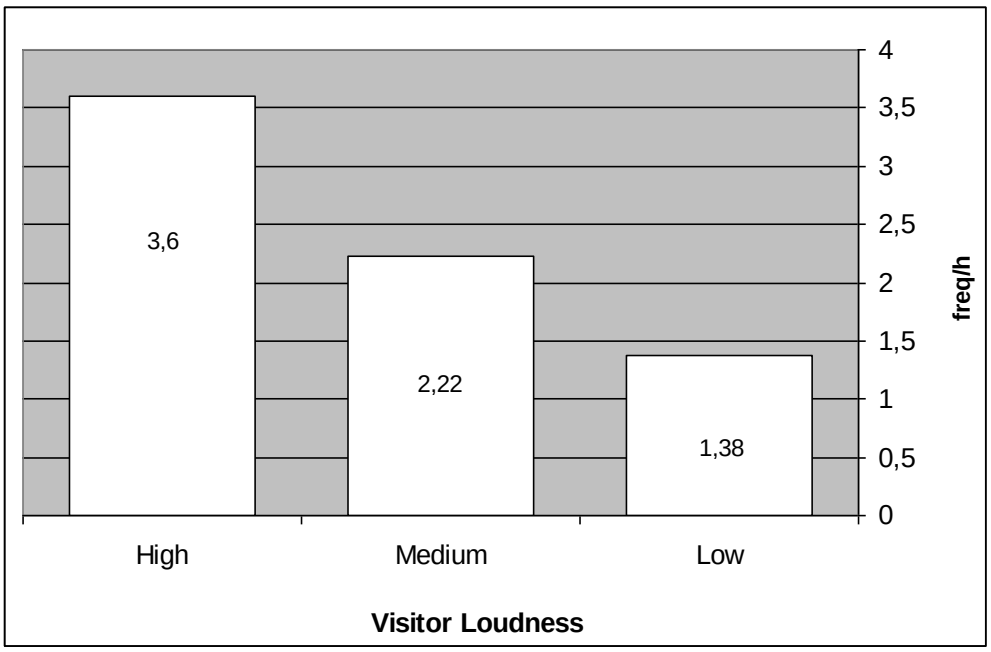


**Figure 8 –** Frequency per hour of 'Affiliative Behaviours' in three conditions, low, medium and high 'Visitor Loudness'.

## 2. Visitors' Behaviour - V-Part

Tables 4 and 5 indicate, respectively, the total frequencies of mangabey behaviours and the total occurrences of visitors' behavioural categories that were considered for the subsequent analysis.

**Table 4 –** Total frequency of mangabey affiliative and aggressive behaviours

| Intra-group Aggressive Behaviour | Visitor-directed Aggressive Behaviour |
|---|---|
| 33 | 89 |

**Table 5 –** Total frequency of visitors' behaviours

| Personal Behaviours | Invasive Behaviours | Attract Attention Behaviours |
|---|---|---|
| 560 | 88 | 1107 |

## 2.1. Active/Inactive Visitors and Mangabey Aggressive Behaviours

As Figure 9 shows, the frequency of mangabey 'Aggressive Behaviours' were significantly higher ($X^2$ = 26,797, d.f. = 1, $P$ = 0,000) when visitors were active compared to their inactivity. More specifically, the 'Visitor-directed Aggressive Behaviours' show a significant increase ($X^2$ = 45,082, d.f. = 1, $P$ = 0,000), in fact, from a frequency of 0,12 to 2,32 episodes per hour when the visitors were active as opposed to their inactivity. In addition, the 'Intra-group Aggressive Behaviours' do not show a significant difference ($X^2$ = 0,800, d.f. = 1, $P$ = 0,517) between visitors activity and inactivity, although they decreased in 0.84 episodes per hour when visitors were active compared to their inactivity.

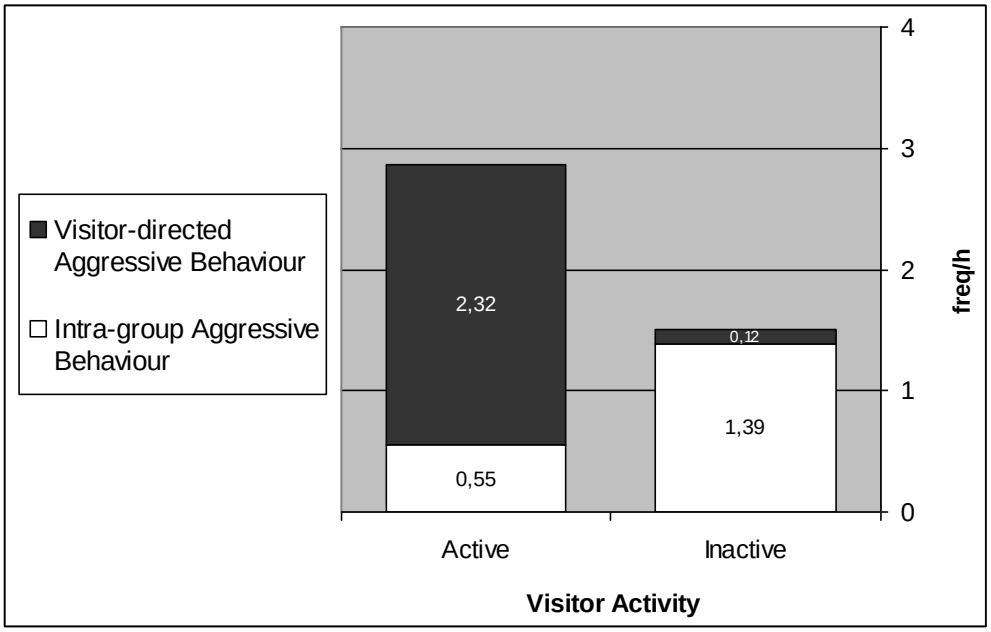


**Figure 9 –** Visitor activity and inactivity and the frequency per hour of intra-group and visitor-directed aggressive behaviours of the mangabey group.

Figure 10 shows a significant increase ($X^2$ = 83,622, d.f. = 3, $P$ = 0,000) of 'Aggressive Behaviours' at the same time as the activity of the visitors raised, nevertheless, the visitor-directed aggressions and the intra-group aggression show distinct tendencies.

The 'Visitor-directed Aggressive Behaviours' show a significant increase ($X^2$ = 51,594, d.f. = 2, $P$ = 0,000) together with the raise in the 'Visitor Activity'. Aggressions towards visitors were 0,12 episodes per hour with 'Visitor Inactivity', and raised to 1,04 episodes per hour when the activity was low, while between low and medium activity, the aggressions towards visitors increased in 0,91 episodes per hour. Finally, the visitor-directed aggressive displays attained a peak of 5,78 episodes per hour, when the activity level was high.

Intra-group aggression show a not significant difference ($X^2$ = 3,600, d.f. = 3, $P$ = 0,450) with regard to the 'Activity Levels' of the visitors. There tend to be more frequent when visitors were inactive, with 1,39 episodes per hour, nevertheless they decreased to 0,68 episodes per hour when the activity was low and to 0,37 episodes per hour when the activity was medium. However, between medium and high activity the 'Intra-group Aggressive Behaviours' increased very slightly, to a total of 0,49 episodes per hour.

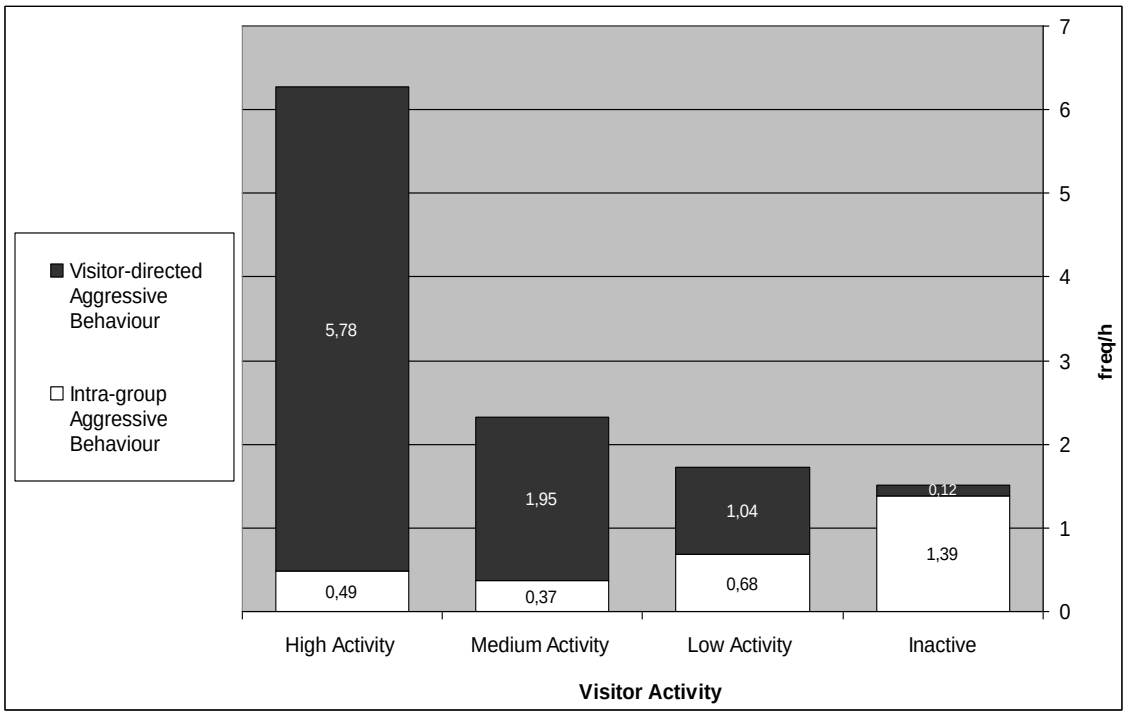


**Figure 10 –** Visitor's activity levels (inactive, low, medium and high) and the frequency per hour of intra-group and visitor-directed aggressive behaviours of the mangabey group.

2.2 Visitor Behaviours and Mangabey Aggressive Behaviours

The following pie chart (Figure 11) shows the proportion of time in which visitors were either active or inactive, while observing the mangabeys. In total, visitors were more often active, 76% of the time, then they were inactive, 24% of the time.

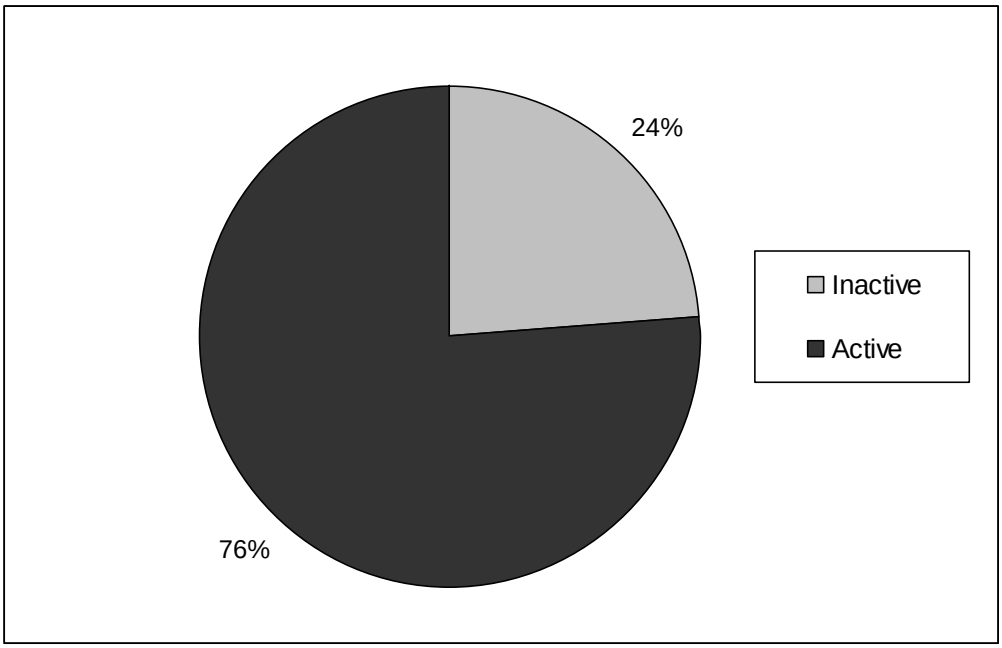


**Figure 11 -** Proportion of active and inactive visitors.

The pie chart below (Figure 12) shows the percentage of visitor behaviours accordingly to three categories. The ‘Attract Attention Behaviours’ were the most exhibited behaviours by the visitors, with 63% half less often occurred the ‘Personal Behaviours’, with 32%; and finally, the ‘Invasive Behaviours’ take place in 5% of the cases.

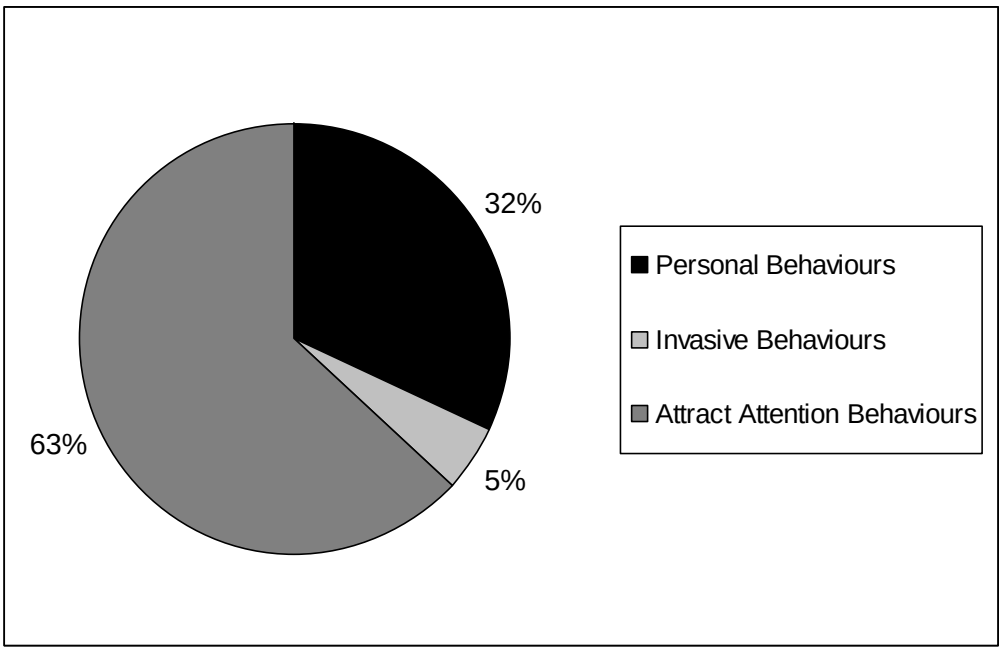


**Figure 12 -** Proportion of the three visitor behavioural categories: ‘Personal’, Behaviours’, ‘Invasive’ and ‘Attract Attention’ Behaviours.

Figure 13 indicates the total occurrences in percentage of the single visitor behaviours within the category ‘Invasive Behaviours’. The behaviour ‘feed/throw leafs’ happened in 75% of the cases. In contrast, ‘feed personal food’ occurred 14%, and ‘throw item’ 11%.

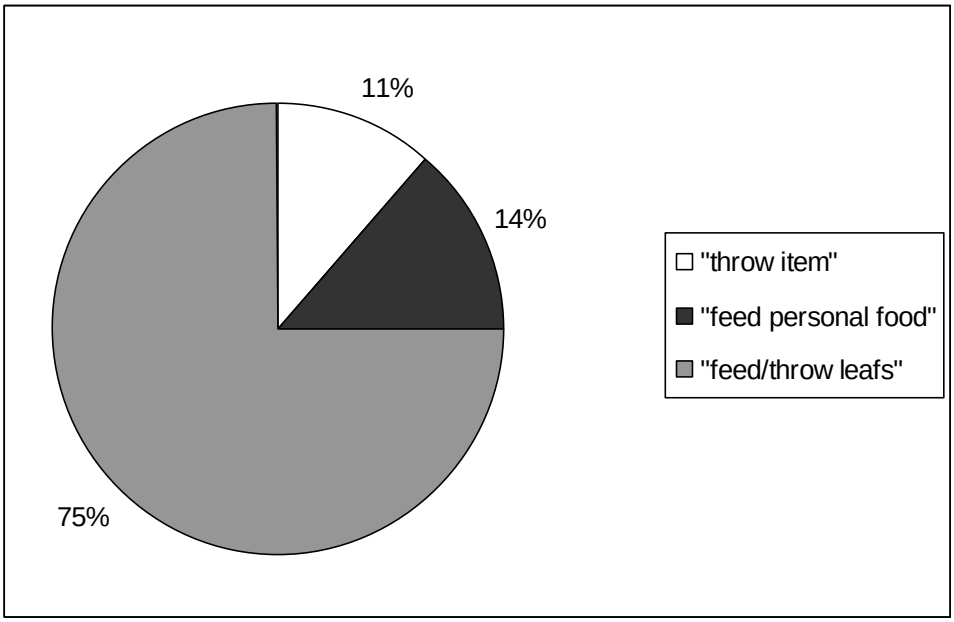


**Figure 13 –** Propotion of the three behaviours within the visitor behavioural category ‘Invasive Behaviours’

The next pie chart (Figure 14) indicates the proportion of visitor behaviours included in the category ‘Personal Behaviours’. The behaviour ‘take child up in arms’ is the one that occurred most often with a total of 70%; followed by ‘eating’ with 16%; and the last most practiced ‘invasive behaviour’ was ‘climb on fence’ with 14%.

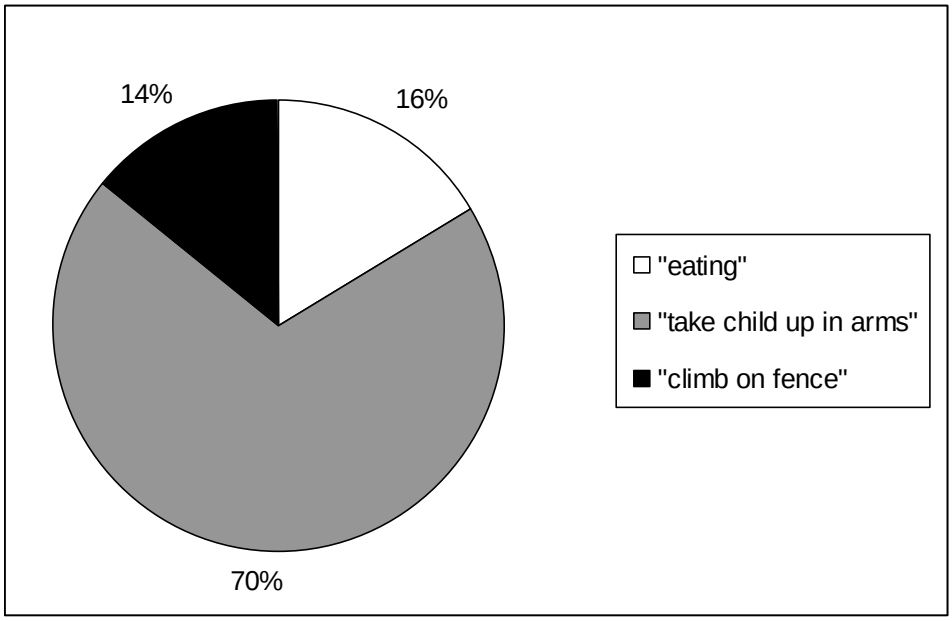


**Figure 14 –** Propotion of the three behaviours within the visitor behavioural category ‘Personal Behaviours’.

Figure 15 shows the proportion of the single ‘Attract Attention Behaviours’. The most practiced was ‘attract attention vocally’ with 42%, the second highest frequency had ‘attract attention with gestures’ with 26%, and the two less practiced were ‘bang on viewing window’ with 18%, and ‘attract attention with object’ with 14%.

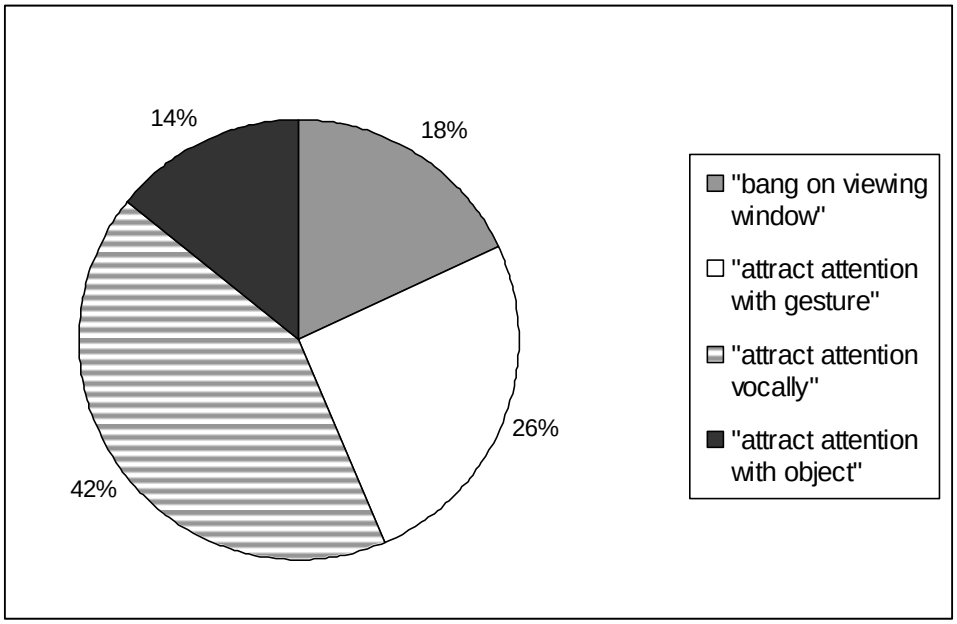


**Figure 15 –** Propotion of the three behaviours within the visitor behavioural category ‘Attract Attention Behaviours’.

Figure 16 indicates that there was a significant difference ($X^2$ = 13,348, d.f. = 2, $P$ = 0,002) of the ‘Aggressive Behaviours’ between the three visitor behavioural categories. ‘Aggressive Behaviours’ were most frequent, with 7,1 episodes per hour, when ‘Invasive Behaviours’ occurred, and only half those high were the frequencies of ‘Aggressive Behaviour’ in relation to ‘Attract Attention Behaviours” and ‘Personal Behaviours’.

More specifically, the 'Visitor-directed Aggressive Behaviours' show a significant association ($X^2$ = 12,426, d.f. = 2, $P$ = 0,003) with the three visitor behavioural categories. When 'Invasive Behaviours' occurred, the aggressions towards visitors were the most frequent, with 6,61 episodes per hour; with 'Attract Attention Behaviours' the visitor-directed aggressions had a occurrence of 2,65 episodes per hour; and finally, in relation to 'Personal Behaviours', the aggressive behaviour towards visitors were 2,63 episodes per hour high. The 'Intra-group Aggressive Behaviours', were not statistically significant ($X^2$ = 0,286, d.f. = 2, $P$ = 1,000) in relation to the categories of the visitor behaviours. Intra-group aggressive frequency tend to be the highest in relation to 'Personal Behaviours', with 0,56 episodes per hour; followed by 0,58 within-group aggression when 'Attract Attention Behaviours' occurred; and finally, the less frequent conspecific-directed aggression, with 0,49 episodes per hour, took place when 'Invasive Behaviours' were practiced by the visitors.

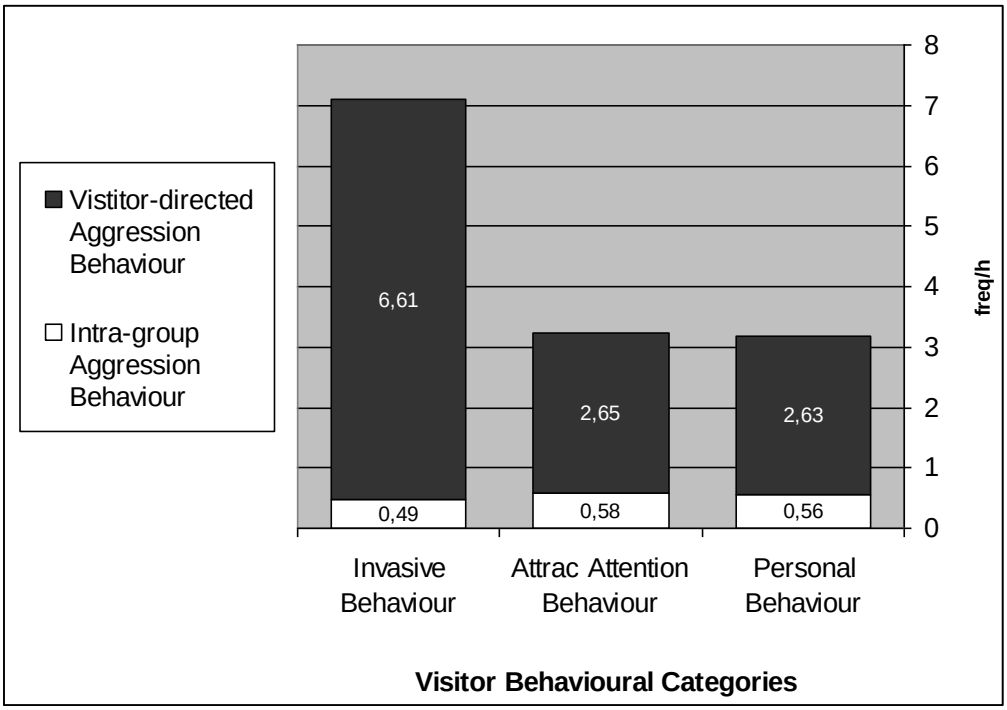


**Figure 16 –** 'Invasive Behaviours', 'Attract Attention Behaviours' and 'Personal Behaviours' and the frequency per hour of intra-group and visitor-directed aggressive behaviours of the mangabey group.

The subsequent diagram (Figure 17) shows the rates of ‘Aggressive Behaviours’ in association with single visitor behaviours included in the category ‘Invasive Behaviours’. The most frequent aggressive manifestations (10,14 episodes per hour) tend to occurred towards the visitor behaviour ‘feed/throw leafs’. These aggressive episodes were exclusively visitor-directed. The second most frequent aggressive response (5,55 episodes per hour) tend to be in relation to the visitor behaviour ‘throw item’, which was also only directed to visitors. Finally, with ‘feed personal food’, the ‘Aggressive Behaviours’ attained 2,4 episodes per hour, subdivided into 1,6 ‘Intra-group Aggressive Behaviours’ per hour and 0,8 ‘Visitor-directed Aggressive Behaviours’ per hour.

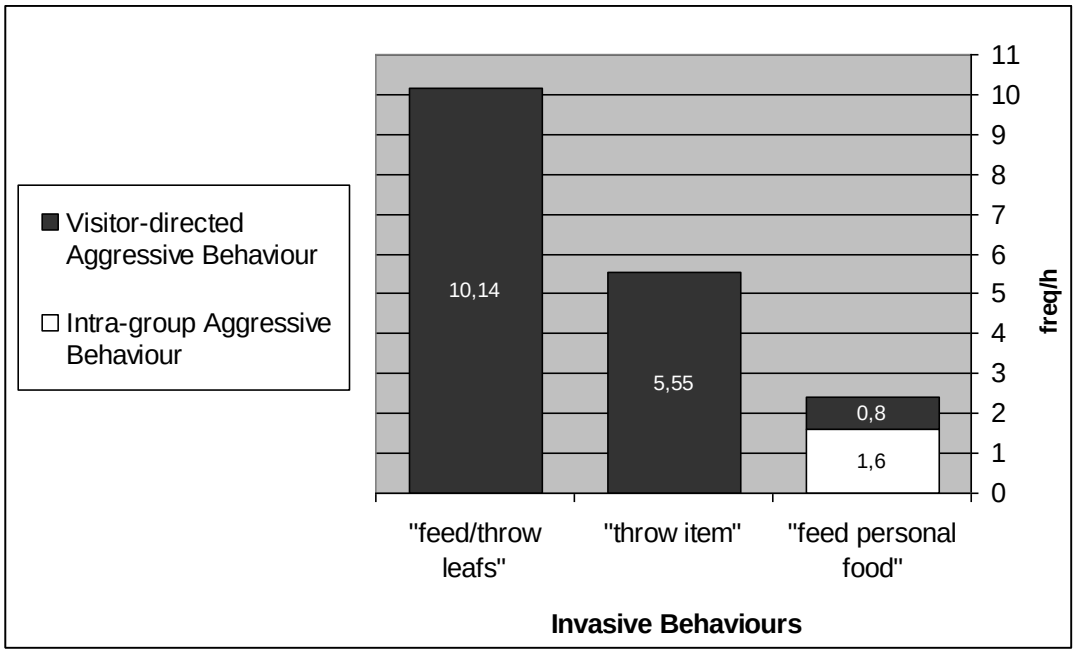


**Figure 17** – ‘Invasive Behaviours’ and the frequency per hour of intra-group and visitor-directed aggressive behaviour of the mangabey group.

The next graph (Figure 18) reveals that, when ‘climb on fence’ were practiced by the visitors, the ‘Aggressive Behaviours’ by the mangabeys tend to attained a frequency of 5,19 episodes per hour, from which 0,34 were within the group and the remaining 4,87 were visitor-directed. The behaviours ‘eating’ and ‘take child up in arms’ show less frequent aggressive responses. With ‘eating’, 0,37 within group and 3,43 visitor-directed aggressions per hour occurred. Finally, when ‘take child up in arms’ was practiced by the visitors, 3,79 mangabey ‘Aggressive Behaviours’ per hour occurred, from which 0,69 were towards group members and 2,95 towards the visitors.

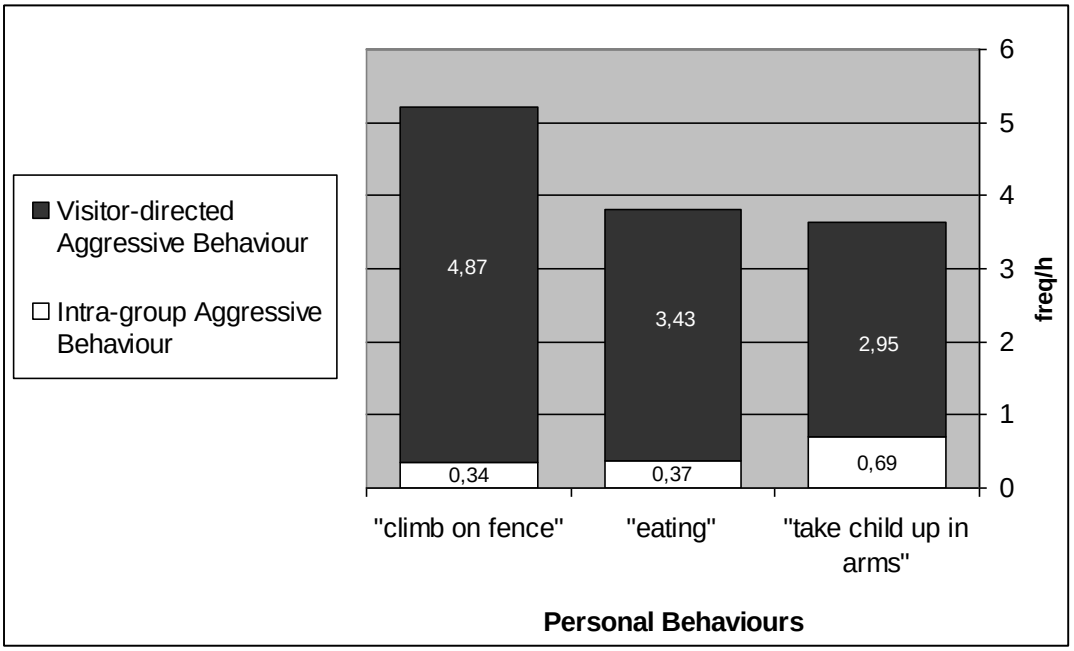


**Figure 18** – ‘Personal Behaviours’ and the frequency per hour of intra-group and visitor-directed aggressive behaviour of the mangabey group.

The last figure (Figure 19) shows the mangabey aggressive responses towards the visitor behaviours included in the category 'Attract Attention Behaviours'. The behaviour 'attract attention with object' tend to have the highest aggressive responses, from which 98% were visitor-directed and the other 2% within the group. The second highest 'Aggressive Behaviours', with 3,89 episodes per hour, tend to occurred in relation to 'attract attention with gestures', from which 3,63 were visitor-directed and 0,26 intra-group. In the third place, with the visitor behaviour 'attract attention vocally', 2,57 aggressive episodes per hour tend to take place, from which 88% were visitor-directed aggression and the remaining, 0,32 episodes per hour, within the group. Fourth, the less frequent 'Aggressive Behaviours' occurred in association with the visitor behaviour 'bang on glass', from which 0,27 episodes per hour were 'Visitor-directed Aggressive Behaviours' and 0,12 episodes per hour were 'Intra-group Aggressive Behaviours'.

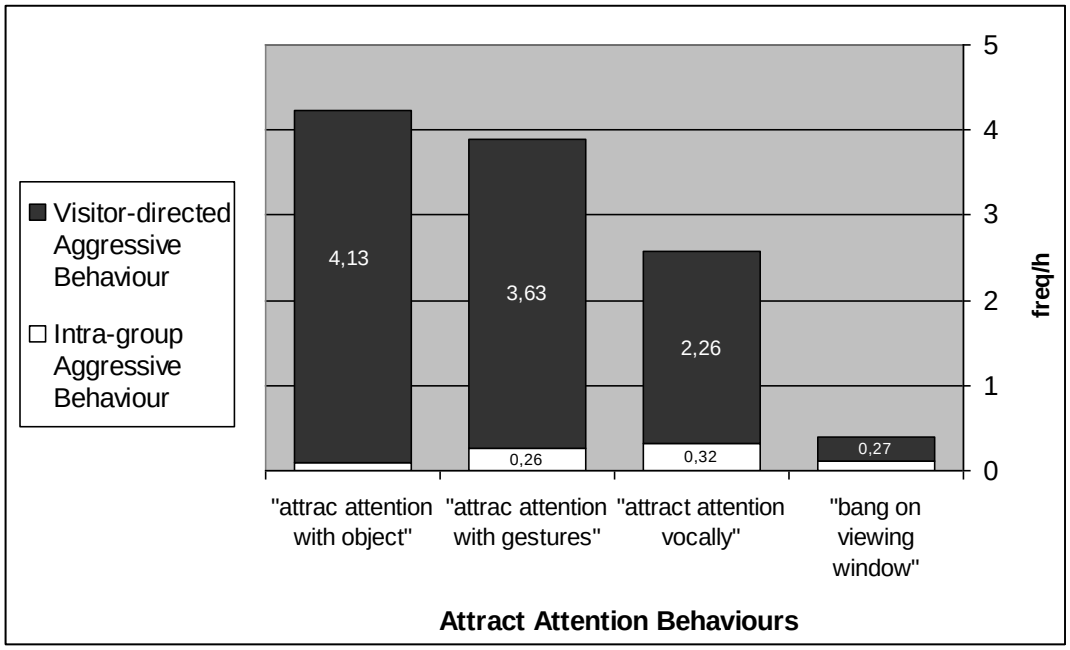


**Figure 19** – 'Attract Attention Behaviours' and the frequency per hour of intra-group and visitor-directed aggressive behaviour of the mangabey group.

# IV. Discussion of the Results

The main aim of the present research was to determine if the behaviour of the white-crowned mangabey group of ZSL London Zoo is influenced by the visitors. In addition, the research plan was to understand how the visitors cause such an effect, in the case that such preposition was confirmed. The mangabey aggressive and affiliative behaviours were analysed to explore if this primate specie were somehow affected in relation to the following visitors' conditions: 'Visitor Absence/Presence', 'Visitor Cumulative Presence' and 'Visitor Loudness'. This was complemented by the analyse of 'Visitor Activity/Inactivity', 'Activity Levels' as well as particular forms of activity, namely 'Personal Behaviours', 'Attract Attention Behaviours' and 'Invasive Behaviours', concerning the mangabey aggressive behaviours.

The results show that visitors indeed influenced behaviours in the mangabey group. Increased aggression in relation to 'Visitor Cumulative Presence', 'Visitor Loudness', as well as in relation to specific 'Visitor Behaviours' was found in the mangabey group. The exception was with regard to 'Visitor Absence/Presence', although it was verified an increased tendency of the mangabey 'Aggressive Behaviours', in this case was not statistically significant. These outcomes will be presented and discussed next. The discussion will start by giving attention to 'Aggressive Behaviours' of the white-crowned mangabey group in response to the visitor conditions, which were taken into consideration. The 'Affiliative Behaviours' will also be discussed in view of the fact that they also show variations according to such conditions. This will be followed by some considerations with regard to specific visitor behaviours, when they are in front of the mangabey's enclosure. Then, such specific behaviours will be related with the aggressive ones of the mangabeys. At last, the tendencies of aggressive-type behaviours that have been included within the 'Aggressive Behaviours' will be focused since they show some variations according to visitor conditions and behaviours.

# 1. Activity Budget, Effects of Visitor Conditions on the Mangabey Behaviours

The Activity Budget of the mangabey group indicates that the individuals pass the majority of their time on activities related with aliments, such as preparing, searching or eating. 'Nutrition' is followed by 'Resting/Observing Visitors' and 'Locomotion'. From all behavioural patterns, 'Social Behaviours' have the smallest proportion. Within the social interactions, the non-agonistic interactions are approximately three times higher then the agonistic ones. This behavioural distribution is in concordance with the activity budget of free-ranging mangabeys as it was confirmed, for instance, by McGraw (1998 in Gron, 2008). The author refers that they pass the majority of their time with feeding and foraging, followed respectively by resting, travelling and finally social activities. It is within this small social context in which mangabeys engage that our discussion is integrated.

The results confirm that the mere presence of visitors tend to influence the mangabeys' behaviour, which indicates a tendency to their total 'Aggressive Behaviours' increase. This results are in agreement with other studies, for instances Chamove et al. (1988), Maki et al. (1987), Lambeth et al. (1997), Wormell et al. (1996), in which increased agonistic behaviours were measured in non-human primates when visitors were present, compared to their absent. In addition, when visitors were present, the 'Visitor Cumulative Presence' indicator shows that mangabeys aggressions were influenced by the concentration of visitors in front of the enclosure since this behaviour raised together with an increase of the cumulative presence of visitors. This suggests that the mangabey group somehow experienced high concentrations of visitors at the enclosure. A positive association between visitor attendance at the cage and captive non-human primates aggressions was also found in other studies such as the ones by Wells (2005), Glatson et al. (1984), Chamove et al. (1988), Simpson (2004) and Mitchell et al. (1990, 1991, 1992c). In Mitchell et al. (1991, 1992c), for instance, it was confirmed an increase in aggression of captive golden-bellied mangabeys at medium and high visitor attended cages, compared to low attended ones.

Besides the cumulative presence of visitors, the 'Visitor Loudness' indicator shows that loudness were found to positively influence increased aggressions in the

mangabeys. Other findings were also discovered elsewhere, in which visitor noise levels and captive non-human primates behavioural changed together. Such was the case of Cook and colleagues (2007) who found an increase of hanging, brachiating, bipedal walking, look at public and open mouth behaviours in white handed gibbons, or Brike (2002 in Fernandez et al., 2009) who shows that orangutans' looking at public and approaching public behaviours increased when they were exposed to high noise levels. In comparison, the effect of visitor conditions on the mangabeys shows that visitor noise levels did induce higher rates of 'Aggressive Behaviours' in the mangabeys than the 'Visitors Cumulative Presence' did.

Apart from the rates of 'Aggressive Behaviours', affiliative interactions between mangabey individuals also rose together with the same visitor conditions, namely 'Visitor Cumulative Presence' and 'Visitor Loudness', and also tend to increase in relation to 'Visitor Presence/Absence'. Also within "Visitor Effects" studies some authors found similar results (Birke, 2002 in Farrand, 2007; Perret, 1995 in Davey, 2006 and in Hosey, 2005). Nonetheless, this is not a topic of agreement, since other authors also mention that affiliative behaviours may decrease (Chamove et al., 1988; Glatston et al., 1984; Wormell et al., 1996), or even stay un-affected (Mitchell et al., 1991) under visitor conditions.

Additionally we found that 'Affiliative Behaviours' tend to be higher when associated with 'Visitor Loudness' then with the cumulative presence of visitors. As well in Birke's study, duration in affiliative interactions was found to increase under the high noise levels of visitors. The author argued that noise levels could be understood as a stimulus for the orangutans group (Birke, 2007 in Farrand, 2007). In our case, we found, interestingly, that 'Affiliative Behaviours' rose in parallel with 'Aggressive Behaviours', for instances both aggressions and affiliations tend to be higher in relation to 'Visitor Loudness' than in relation to the 'Visitor Cumulative Presence'. An explanation for this could be that an increase of aggressions under these visitor conditions, may be the fact that the visitors were somehow seen as a stressor by the captive study subjects. Therefore, when affiliative interactions, namely 'allo-grooming' and 'non-sexual presenting' increased under these visitor conditions, this could be seen as a strategic behaviour of the mangabeys to relieve distress in the individuals. For instances, there is a vast amount of scientific evidences confirming that social grooming reduces tension and stress either in the groomee as in the groomer (Boccia, 1989a;

Boccia et al., 1989; Keverne et al., 1989; Gust et al., 1993; de Waal and Aureli, 1997; Aureli et al., 1999; Judge et al., 2006; Shutt et al., 2007 all in Reinhardt & Reinhardt, 2008; Aureli & Yates, 2009; Terry, 1970; Schino et al., 1988). In addition, the behaviours of reconciliation above all serve to decrease the possibility of a renewed attack and re-establish social relations between the victim and the aggressor, which in turn may also help to reduce stress (Aureli et al., 1989 in Gust & Gordon, 1993; Aureli & vanSchaik, 1991; Silk, 2002).

## 2. Visitor Behaviours while observing the mangabeys

According to one of the main aims of this study, we have tried to go beyond the general visitor conditions by focusing on some visitor activities to give further insights about both how the visitors behave when observing the mangabeys, and over all, how these specific behaviours affect the mangabeys behaviour (aggressive behaviour). The former will be approached now and the latter in the next part.

In three quarters of the time that visitors were present, they were active. This means that they did express themselves throughout 'Attract Attention Behaviours', 'Personal Behaviours' or 'Invasive Behaviours'. Within these ones, the most practiced behaviours were the ones under the category 'Attract Attention Behaviours', with 63% when visitors were active. More than half of the time when visitors were considered to be active, they were trying to catch the attention of the mangabeys through gesticulating (as for example waving or aping), making noises, banging on the viewing window and so forth. These behaviours may suggest that visitors were trying to see something more in the mangabeys then they were actually "offering" to them, probably more activity and movement. This supposition is based on the theory that the relationship between captive animals and visitors is not unidirectional (Maragulis et al., 2003), which means that the animal behaviour can also have an influence on the visitors behaviour (Hosey, 2000; Mitchell, et al., 1992b), conceived as the "visitor attraction model" (Maragulis et al., 2003). In this sense, animals being active can be immediately linked with visitor's entertainment and satisfaction at an exhibit, since it was found a positive relation between animal activity and visitor interest in the exhibit (Maragulis et al., 2003;

Altman, 1998 all in Fernandez et al., 2009). In contrast, when animals are inactive people interest in the species may decrease. Therefore, they may try to bring some movement into the captive animals, or entertain themselves, on their own terms. Through which they may try to make themselves notice (Fernandez et al., 2009; Fielder and Wheeler, 1985 in Kerger & Mensch, 1995), for example, by " (…) imitating the animals, making animal like sound, waving hands at the animals, jumping up and down, snapping fingers, clapping (…), making faces (…)" (Mitchell et al., 1992b: 108). Although these kinds of visitor behaviours can be stressful for the animals (Birke, 2002 in Fernandez et al., 2009; Mitchell et al., 1992a; Nimon & Dalziel, 1992), most people may not notice that they are behaving incorrectly to them, since these kinds of behaviours, usually, are not explicitly interdict by zoos. In turn, this could possibly be attributed to a lack of scientific evidence, which would confirm the visitor effect on the animals, regarding such kind of visitor behaviour.

Apart from these kinds of visitor behaviours, others occur that are usually prohibited by the zoos, those are the ones designated by 'intrusive' visitor behaviours. By 'intrusive' it is meant behaviours such as visitors passing the barrier that exists between them (the viewing area) and the animals (the enclosure), visitors throwing objects or food into the cage, or, in the worst but fortunately rare cases, visitors doing acts of vandalism (Kerger & Mensch, 1995), damaging part of the enclosure or even injure the animals. Although most of them are not allowed, 'intrusive' visitor behaviours still take place, fortunately, in low rates (Kerger & Mensch, 1995). Within these kinds of 'intrusive' behaviours, feeding is probably the most common. Zoos usually do not encouraged visitors feeding the animals, and signs around animal enclosures informing about the harmful consequences that feeding can have for the health of the captive animal are usually found. Feeding "(…) can be seen as a token presented from the visitor, who hopes to establish a bond with the animal." (Bostock, 1993 in Kerger & Mensch, 1995). Normally through feeding, the visitor gets a direct individual response from the animal (Kerger & Mensch, 1995) and therefore it is the maximum of interaction that people can get with animals in a (non-interactive) zoo setting. Also in the context of the present study this 'intrusive' visitor behaviour was not encouraged by the zoo. Through either, volunteers pointing out to people that they should not feed the animals and a number of warnings with the said: "Please don't feed our animals, as this may harm or even kill them". Still, 'Invasive Behaviours', such as

‘feeding personal food’, ‘throw object’ and ‘feed/throw leafs’ occurred in 5 % of the time that visitors were active. Although these behaviours were rare when compared to the other visitor behaviours, the few times it happened comes to support the idea that visitors feeding the mangabeys or sending objects into the cage was not for the animals benefit, but possibly to satisfy the visitors desire to feed them (Mullan & Marvin, 1999), relate to them (Bostock, 1993 in Kerger & Mensch, 1995) or to produce movement in them (Fernandez et al, 2009).

Besides the attempts to interact with the mangabeys, some other sort of behaviours was also practiced by the visitors. ‘Personal Behaviours’ such as ‘eating’, ‘taking children up into arms’ and ‘climbing on the fences’, which were not directed to the captive primates, however, they happened in 35% of the time that visitors were active, which seemed to provoke a reaction in the mangabeys. Since this is a major concern of the present study, it will be discussed in what follows.

## 3. Effects of Visitor Behaviours on Aggressive Mangabey Behaviours

To start with, we found that when visitors were active the mangabeys were two times more aggressive than when they were inactive. In addition, mangabey ‘Aggressive Behaviours’ increased together with the raise of ‘Visitor Activity Levels’, with highly active visitors provoking the highest rates of aggressions in the mangabeys. This association, between visitor activity and primate behavioural changes, was also found in other studies. For instance, Hosey and Druck (Hosey & Druck, 1987 in Mitchell et al., 1992b), and Mitchell and colleagues (1992b) found high aggression levels in a variety of primate species when exposed to active visitors. In addition, Nimon and Dalziel (1992) and Chamove and colleagues (1988) also concluded that an association between visitor activity and distress in captive primates could occur.

Moreover, the association with specific visitor behaviours should give further insights into this matter. Actually, the less practiced visitor behaviours observed, namely ‘Invasive Behaviours’, were by far the ones which contribute to the highest rates of ‘Aggressive Behaviours’ in the mangabey. In more detail, this means that within the ‘Invasive Behaviours’, it was when visitors ripped out leafs and threw them into the

cage (‘feed/throw leafs’), mostly in an attempt to feed the mangabeys, that the highest rates of aggression tend to emerge, with a total of 10 displays per hour. This specific visitor behaviour was also the most practiced within the ‘Invasive Behaviour’, occurring in almost half of the time when visitors were ‘invasive’. The two other ‘invasive’ behaviours when compared to ‘feed/throw leafs’, show that ‘throw an item’ only tend to be provoked half of those high aggressions, and that only three quarters were in response to ‘feed personal food’. One possible explanation for the tendency of high rates of aggression in relation to ‘feed/throw leafs’, when compared to the others, may rely on the mangabeys’ curiosity, regarding each ‘invasive’ situation. This is to say that when visitors threw unfamiliar objects (zoo paper-maps, pens, ice-sticks, hats) or unfamiliar food (crisps, candy, nuts) this may have stimulated the curiosity of the mangabeys, and so they were more interested on the objects/food. While when visitors threw leafs, in contrast, leafs were not only familiar as the mangabeys could also and did often get them by themselves. Although there were differences in the rates of aggressive responses towards the three ‘invasive’ behaviours, together, they provoked the highest rates of aggressions in the mangabeys, which could lead to the conclusion that mangabeys felt threaten and/or stress when visitors were intrusively throwing something to their enclosure.

The response to the other two visitor behavioural categories, ‘Attract Attention Behaviours’ and ‘Personal Behaviours’, show half of those high aggressive behaviours when compared to the ‘Invasive Behaviours’. Nonetheless, from both categories it were the behaviours through which the visitors had tried to interact with the mangabeys that stimulated slightly more the primates’ aggressive behaviours. More specifically, ‘attract the attention with object’ and ‘attract attention with gestures’ tend to be the ones to which the mangabeys more responded within the visitors ‘Attract Attention Behaviours’, with approximately 4 aggressive episodes per hour. These are followed by a smaller amount of aggression with regard to ‘attract attention vocally’. And lastly, visitors banging on the viewing windows seemed to have a small impact on the non-human primate group, compared to all other visitor behaviours. Actually, ‘banging on the viewing window’, compared to any other visitor behaviour, corresponds to a very low rates of mangabey aggressions, which may be explained through two points. First, through the volunteers’ intervention, since volunteers usually intervene when visitors were banging on the viewing window, warning them that such behaviour could harm

the animals. Thereby, visitors did not insist and the banging was of short duration, which may had less impact on the mangabeys. The other explanation can be that banging on the viewing windows does not distress the mangabeys, as much as the other visitor behaviours to which mangabeys tend to respond with far higher aggression rates. Again, these are only two suggested hypotheses that need to be further analysed.

To finish, from all visitor behavioural categories, 'Personal Behaviours' is the one less often related with mangabey aggressions. Within this one, the behaviour that tends to excite the highest rates of aggressions was 'climb on fence', which was also the less practiced 'Personal Behaviour' by the visitors. In contrast, although 'take child up in arms' is the one that happened most often, it only matches the fewest aggressive displays of the mangabeys. Similar to this one, 'eating' also seemed to be less stressful for the mangabeys then 'climb on fence', but still it also indicates a tendency for considerably high related rates of aggressions, actually between 3 and 4 episodes per hour.

Resuming, the visitor behaviour 'feed/throw leafs' can be considered the one that tend to provoked the highest rates of aggressions. Therefore, this one is perhaps the most significant visitor behaviour for the mangabeys, and maybe the most stress-related one. With less aggressive episodes, 'throw item' is the second one, followed by 'climb on fence' and 'attract attention with object'.

## 4. Effects of Visitor Conditions on Aggressive-type Behaviours

So far the attention was only drawn on 'Aggressive Behaviours' in general, while in the subsequent part the aim is to look in more detail to the two different aggressive-type behaviours that were included in the 'Aggressive Behaviours', namely 'Intra-group Aggressive Behaviours' and 'Visitor-directed Aggressive Behaviours'. The results show that 'Visitor-directed Aggressive Behaviours' increased when associated to the visitor conditions analysed ('Visitor Absence/Presence', 'Visitor Cumulative Presence', 'Visitor Loudness' and 'Visitor Activity', 'Visitor Activity Levels' as well as 'Visitor Behaviours'). The 'Intra-group Aggressive Behaviours', however, show a different tendency and changed to different degrees.

The intra-group aggressions did not show a discrepancy between the visitors' absence and presence. However, 'Aggressive Behaviours' in general tend to be highest when visitors were present, which is given by the fact that the 'Visitor-directed Aggressive Behaviours' occurred in 60% of the time visitors were present. Although a slightly increase in the intra-group aggressions related to a high level of 'Visitor Cumulative Presence' was observed, the cumulative presence of visitors also emphasise that while visitor-directed aggressions gradually increased, the intra-group aggressions decreased between both low and medium cumulative presence levels of visitors. A similar difference between the two types of aggressive behaviours was also verified within visitor noise levels ('Visitor Loudness'). The different degrees to which the two aggressive-type behaviours can change were even more evident in relation to visitor activity. When visitors were inactive, intra-group aggressions correspond to 92% of the total aggressive behaviours, while when visitors were active, intra-group aggression match only 19% and the remaining 81% of aggressions were visitor-directed.

In concordance with these results, other studies also show an increase in visitor-directed aggression, in relation to visitor density (Mitchell et al., 1992b) and activity (Mitchell et al., 1992b; Chamove et al., 1988), or increased visitor-directed behaviours in association with visitor noise levels (Birke**,** 2002 in Fernandez et al, 2009; Cooke et al., 2007). However, in contrast to the results of the present study, it was also found elsewhere that intra-group aggressions can also increase with non-human primates expose to visitors (Wells 2005; Glatston et al., 1984)

These different degrees, to which the two types of aggressive behaviours changed, regarding different visitor conditions, come to meet the arguing of Mitchell et al. (1992c), that not all types of aggressive behaviours vary equally when the study subjects are exposed to visitors. Mitchell et al. (1991; 1992c) found that aggressive displays towards non-human primates neighbours decreased in cages with high visitor attendance compared to medium and low attended cages, while in contrast, the within-group and visitor-directed aggressions increased in high attended cages compared to medium and low attended ones. Therefore, Mitchell et al. (1992c) brought two interesting suggestions that could explain these discrepancies to which aggressive-type behaviours differ when related to certain visitor conditions. We are going to discussed them with regard to the results of the present study considering the two aggressive-type behaviours.

One of the suggestions is that the "(….) pattern of change in aggressive-type behaviours can indicate the nature of the "stress" in an animal's captive environment (Modie and Chamove, 1990 in Mitchell et al., 1992c: 257). According to this, it is suggested that the intra-group aggressions in the mangabeys studied, as a factor that may cause stress, are not as dependent on the visitor conditions as the visitor-directed aggressions seemed to be. Since, on one hand, visitor-directed aggression are positively associated with: the visitor presence when compared to their absence, visitor activity compared to inactivity and a raised in both the cumulative presence and loudness levels; while, on the other hand, the intra-group aggression did not varied that much between the absence and presence of visitors, and did not changed much with the cumulative presence and loudness levels of visitors. Moreover, intra-group aggressions were higher when visitors were inactive compared to active. Therefore, in view of these results, it could be suggested that intra-group agonism, compared to the visitor-directed one, may not be influenced by the mangabeys' exposition to visitors.

Additionally, in Mitchell et al. (1992c), it is further suggested that since the neighbour directed aggressive type studied do not vary much with visitor condition(s), it is not a stress-related behaviour, and that it could rather occur under normal conditions. In our study, intra-group aggressions seemed to show a similar pattern, however, attention should be given to the "normal conditions", since in a zoo setting various other factors, apart from the visitors, could be the stress elicitors of this aggressive-type behaviour. For instances, behavioural changes may emerge from factors concerning the space, the feeding routine, group composition, and so forth (Hosey, 2005) Therefore, to suggest that this intra-group aggression is not stress-related can be premature. Thus, this is also to say that within-group aggressions need to be further analysed to determine if they are dependent on any other factor of the zoo setting besides the visitor conditions that were tested here.

Apart from the suggestions that were done from Mitchell et al. (1992c), another suggestive explanation could rely on an association between 'Affiliative Behaviours' and the decrease of within-group aggressions. As the results have shown, affiliative interactions were more frequent when visitors were present, in contrast to their absence, and that affiliative interactions increased together with the raise in cumulative presence and loudness levels of the visitors. Besides 'Affiliative Behaviours', also visitor-directed aggressions increased in relation to these visitor conditions, but in contrast,

intra-group aggressions did stay almost unchanged (according to 'Visitor Absence/Presence') or only slightly decreased (between low and medium cumulative presence and loudness levels of the visitors). As increased 'Affiliative Behaviours' could have worked as a strategy to decrease distress in the mangabey individuals, the suggestion is that affiliative interactions could have stabled or even contribute to a slightly decreased in within-group aggressions, by increase tolerance and reconciliations within the group through elevated rates of 'allo-grooming' and 'non-sexual presenting' behaviours.

Although we have tried to bring explanations about the possible reasons for the unchanged or slight decrease in intra-group aggression when exposed to different visitor conditions, it is important to keep in mind that with high levels of cumulative presence, loudness and activity, this intra-group aggression tend to increase. This trend let us further suggest that the high levels of these visitor conditions had the most evident impact on the mangabeys, as both visitor-directed and intra-group aggressions did attain a peak in aggressive episodes per hour.

## 5. Effects of Visitor Behaviours on Aggressive-type Behaviours

We have come to discuss the tendencies of two aggressive-type behaviours (intra-group and visitor-directed) in view of the visitor presence/absence, cumulative presence levels, loudness levels, activity/inactivity and activity levels. In the subsequent part, the distribution of these aggressive-type behaviours with regard to specific behaviours of the visitors will be focused. Aggressive displays in response to 'Visitor Behaviours' were predominantly visitor-directed, with only a few of them within-group aggressions. We verified that by comparing the aggressive-type behaviours in relation to three visitor categories, that is, 'personal', 'invasive' and 'attract attention' behaviours, it was clear that the intra-group aggressions were similarly low in relation to all of them. In contrast, the visitor-directed aggressions reach 80% of the 'Aggressive Behaviour' when related with both 'personal' and 'attract attention' visitor behaviours, and even 93% with regards to 'invasive' visitor behaviours.

Within the visitors' 'invasive' behaviours, which as was mention above (in the part 'Effects of Visitor Behaviours on Aggressive Mangabey Behaviours') is the category that tend to create more aggressive reactions from the mangabeys, 'feed/throw leafs' and 'throw item' only show visitor-directed aggressive responses from the mangabeys. Yet, 'feed personal food' shows a different distribution, with around 70% of the aggressions being conspecific-directed and the remaining 30% visitor-directed. It seems interesting to discuss this last point a little further since the tendency from the mangabeys to 'Intra-group Aggressive Behaviours' being higher when related to food provided by the visitors is unique according to our results, in which the propensity is towards visitor-directed aggressions being higher as a response to visitor behaviours.

One possible explanation for that could rely on an increased competition between the individuals over the food, according to the distribution type. To explain this idea it is useful to briefly mention the socioecological model of vanShaik that explains the evolution of social systems in non-human primates (vanShaik, 1989 in Stahl & Kaumanns, 2003). As the author suggests, predation is the ultimate factor on group life like competition about food is the ultimate factor of the inner social structure. The latter factor can exist in two forms, scramble competition (when food resources are dispersed) and contest competition (when food resources are clumped). When food is clumped, aggressive behaviour ordered who can feed and who cannot. In regard to mangabeys, from research on wild living sooty mangabey we know that the access to scarce food resources is granted by high ranking animals, for instances, high ranking females indicate less foraging time in their activity budgets since they have easier access to food and a great effort is not needed (Range et al., 2007). Additionally, within captivity sooty mangabeys, Stahl & Kaumanns (2003) tested the access of females to dispersed and clumped food distribution in which the results show that the access to food was rank dependent with clumped distribution, in contrast to dispersed distribution. The access to food was ultimately determined by male aggressive behaviours against lower ranking females, which in turn provided higher-ranking females with a higher feeding success. During our research, the mangabeys were fed by the animal keepers through a dispersed food distribution, possibly to avoid intra-group aggressions. However, when the mangabeys received food from the visitors, it can be said to occur in a clumped food distribution, since it was single pieces of food thrown to one place. In these situations, the intra-group aggressions increased to establish who could feed and who could not.

This is a possible explanation to why the visitor behaviour ‘feed personal food’ was the only behaviour that provoked more intra-group aggressions and less visitor-directed ones. Possible triggered by the high-ranking adult male (Luca), the aggressions between individuals were predominant in these situations.

In what concerns the visitor behaviours included in the ‘Attract Attention Behaviours’, visitor-directed aggressions occurred between 80% and 98% of the total of aggressions in response to it. For instances, ‘attract attention with object’ shows the major discrepancy between the distribution of the two aggressive-type behaviours, with 98% visitor-directed aggression and only 2% within-group ones. A similar distribution between these two aggressive-type behaviours was also verified with regard to ‘Personal Behaviours’. For instances, the behaviour ‘climb on fence’ that tend to the highest aggressive response of the mangabeys, and also indicates the biggest dissimilarities of distribution between visitors-directed aggressions and intra-group aggression, respectively with 93% and 7%.

An interesting tendency that could be identified, when the aggressive-type behaviours are matched with each of the visitor behaviours analysed, is that the visitor-directed aggression were the highest, and intra-group the lowest, in response to the visitor behaviours that tend to show, in total, the highest aggression rates. For example, the highest aggression rates tend to be towards the visitor behaviour ‘feed/throw leafs‘, and here the aggressions were exclusively visitor-directed. Also in relation to ‘throw item’, the aggressive responses were only towards visitors. And also in relation to ‘climb on fence’, 93% of the aggression were visitor-directed, and ‘attract attention with object’ shows a total of 98% visitor-directed aggression. These tendencies show that the visitors may be perceived as the target of the mangabeys, in the sense that they responded aggressively to them. In some cases, however, when the mangabeys adopted visitor-directed aggressions, visitors may have not directed their actions at the mangabeys. This comes to meet the assumption that cercopithecids are very inclined to threat visitors, even if they are not threatening them (Mitchell et al., 1992a). Nevertheless, in most situations when visitors were actively observing the mangabeys, they did actually direct their behaviours (‘invasive’ and ‘attract attention’) towards the mangabeys and did possibly harass them. In other words, we found that mangabeys show visitor-directed aggression in cases where visitors did not harass the mangabeys, but the highest rates of visitor-directed aggression tend to be related with visitors

directing their behaviours at the mangabeys and sometimes with the purpose of provoking them. This draws to the assumption, that visitors, when active, triggered the highest aggressive displays in the mangabeys, although without assuming here both that visitors had actually good or bad intentions towards the mangabeys and that such match between visitor behaviour and mangabey aggressions are clearly a devise for the animals feeling distressed.

# V. Conclusion

During three months it was observed and collected data regarding the relation between the white-crowned mangabeys and their visitors at the ZSL London Zoo. In a wider sense, our study can be seen as part of an ongoing research in anthropology that intent to comprehend the relation between humans and animals. A relation that not always is as good for both parts as it is desired. In a more narrowed and practical sense, our study aimed to understand such relation throughout a primatologist approach, in which the relation between the white-crowned mangabeys and their visitors, occurring in a zoo setting, was explored according to the development of a branch of research designated as 'Visitor Effects' studies. To accomplish such task, we aimed to understand if visitors have an effect on the primate specie, and what exactly that may mean to the latter ones. That is, how visitors affected the mangabeys. In more general terms, we aimed to give a small contribution to the zoo, which has the responsibility, as an institution devoted to wild animals in urban areas, to improve the wellbeing of their animals while it works as a mediator between public and animals, according to their conservation and education programs.

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The results show that visitor's activity/inactivity and their low, medium and high levels of cumulative presence, loudness and activity is positively related with an increase of aggressiveness in the mangabeys' behaviour. Within such behaviours, it was found that different types of aggressions change to different degrees when associated with the visitor conditions tested. While high visitor-directed aggressions had corresponded positively towards such visitor conditions, intra-group aggression did not show a positive correspondence to all of them, and only tend to increase with the high level of cumulative presence, loudness and activity of the visitors. High noise levels and high concentration of visitors were probably the most significant for the mangabeys, since both intra-group and visitor-directed aggressions reach their highest peaks of aggressive episodes per hour together with these visitor conditions. However, in relation

not just to the high level but to all noise levels, as well as to the activity of the visitors, the rates of aggression tend to be higher when compared to the levels of the cumulative presence. In addition to aggressive behaviours, also affiliative interactions show a change in relation to some visitor conditions tested, namely, their cumulative presence and loudness. Moreover, affiliative and aggressive mangabey behaviours increased together (although, with different rates) in relation to visitor noise levels and cumulative presence levels, in which both behaviours show higher rates with regard to the former in contrast to the latter. This tendency let us suggest that increased levels of affiliative interaction may have been a strategy to alleviate the individuals from the high rates of aggressions, if such aggressions are understood as a factor that may provoke distress in the animals.

Apart from the mangabey's behaviours, it was found that visitors were predominantly active, in most of the time they stayed in front of the enclosure, and that more then half of their active time was expressed throughout behaviours intended to attract the primates attention. Therefore, visitors had passed most of their time trying to interact with the mangabeys while observing them. In contrast, visitors did not show much tendency to behaviours that can be considered 'invasive'. In fact, those were the less practiced behaviours, although it was also found that they were the ones which, by far, elicited the highest rates of aggression in the mangabeys. Within the 'invasive' visitors' behaviours, it was feed or throw leafs that that tend to provoke the highest aggression rates on the mangabeys. In contrast, banging on the window was the visitor behaviour to which mangabey aggressive responses were the lowest, not just within the invasive behaviours but from all visitor behaviours.

Furthermore, different types of aggressive behaviours had also been observed with regard to some visitors' behaviours in which the visitor-directed aggressions tend to be predominant, and only a few of them were intra-group aggressions. With the exception to this tendency, on the distribution of the aggressive-type behaviours, being when visitors feed the mangabeys with their personal food, in which intra-group aggressions tend to be higher. The visitors' behaviours, to which the highest aggressive mangabey responses were associated, are also the ones that show a tendency for the highest visitor-directed aggression and the lowest or even un-existent intra-group aggressions.

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It is important to have in mind that the research presented here is a case study with a limited sample size. This research brought some aspects about the mangabey-visitor relation in the London zoo which, we hope, may have contribute to the development of this field of studies as well as to the zoo professionals, focused on ameliorate the wellbeing of the mangabeys as much as the visitors experience. Even if it is a small contribution, we have tried to provide some reference data on this matter to the 'Visitor Effects' studies, as much as we also have tried to elucidate some points related to some frictions that may emerge within the visitor-mangabey relation, which in turn may generate conflicts and/or may cause stress to the white-crowned mangabeys (such as the ones that provoke the highest rates of aggression). To finish, we would like to add some suggestions.

Considering some visitor conditions, the results show that high levels of visitor's cumulative presence have a great impact on the mangabeys' aggressive behaviours. In addition, the loudness levels of the visitors seemed to have an even bigger impact. Therefore, to find a way to control these two conditions is recommended, since they may interfere with the welfare of the mangabeys. This could be done by controlling the entries into the Gorilla Kingdom, which can also bring benefits to other non-human primates located within this area. Moreover, besides the volunteers that walk around the Gorilla Kingdom, alerting to visitors that too much noise can have consequences on the mangabey's wellbeing; relocate the sings may also be helpful. There are four signs around the mangabey's enclosure, which call people's attention to be quiet and to not feed the animals; nonetheless, during our observations we notice that some signs were rarely read by the visitors. At the 'InA viewing area', although there is one sign with an attractive and pedagogical form of calling people's attention, its message seemed to be hardly perceived by most of the visitors, probably because its location is not immediately visible. This sign is located on one lateral wall in the front area of the 'InA viewing area'. When a small number of visitors concentrate in front of this viewing window the sign is quickly covered, which in turn makes the sign unnoticed to the ones that will follow. In addition, on each side of the viewing area at the outdoor enclosure there are also signs. The one on the 'ExA viewing area', for instance, do not seem well located since it is on the sidewall opposite to the direction that visitors usually walk by.

To give a second thought on this matter would be of value. People tend to look first into the enclosure, searching for the animals. Thus, one possible way of calling people's attention more efficiently could be to locate this kind of information inside the enclosure. For example, in attractive and visible letters at the frontal wall inside the indoor enclosures, somehow integrated in the exhibit design and visible for all visitors.

Another issue to be considered concerns certain visitor behaviours that have an impact in what concerns the mangabeys aggressive behaviours, which in turn are mostly directed towards the visitors. 'Feed/throw leafs' tend to be the one that is more critical. In almost all cases these leafs were picked by the visitors from one and the same shrub, that grows at the 'ExA viewing area'. It is suggested to restrict the visitors access to these shrub leafs, perhaps by covering it with a tightly netting, so that leafs stay inside of the netting only. The three other behaviours that follow this one, which tend to elicit aggressive reactions in the mangabeys, are respectively 'throw item', 'climb on fence' and 'attract attention with objects'. Besides the signs in visible places already mentioned, in what concerns the 'climb on fence' behaviour another suggestion will follow. This behaviour only occurred at the fence located in one site of the outdoor enclosure, at the 'ExC viewing area'. Attaching a plaque board in front of the fence, hiding the part of the fence where the visitors put their feet to climb on it, may help to constrain this behaviour. In addition, while de-motivating visitors to climb on the fence, this procedure can also help to reduce visitors from climbing over the fence to have more proximity to the mangabeys. This physical change of the fence is a low cost procedure which may constrain some of the visitor behaviours that tend to provoke the highest rates of aggression in the mangabeys, and so, it would enhance the mangabey-visitor relation.

At last, to finish our suggestions, we would like to note how important it is to conduct further researches, not just to complement the present case study, but also to develop our understanding on the visitor-captive animal relation, in general. With regard to the present studies, the elimination of potential confounding variables would be useful to better understand the white-crowned mangabeys living in the London zoo. This could be done by researching which are the long term effects that visitors may have on the primate species, or if the period of the year in which this study was conducted have a specific influence on the mangabey behaviour, or given the fact that they have a new born infant, if this somehow could be reflected on the behaviours of the

rest of the group. To complement this kind of studies with others that look to the visitor-captive animal relation the other way around (focusing on the perceptions of the visitors regarding the animals) also seems useful to further explore these matters.

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# Contents of Figures and Tables

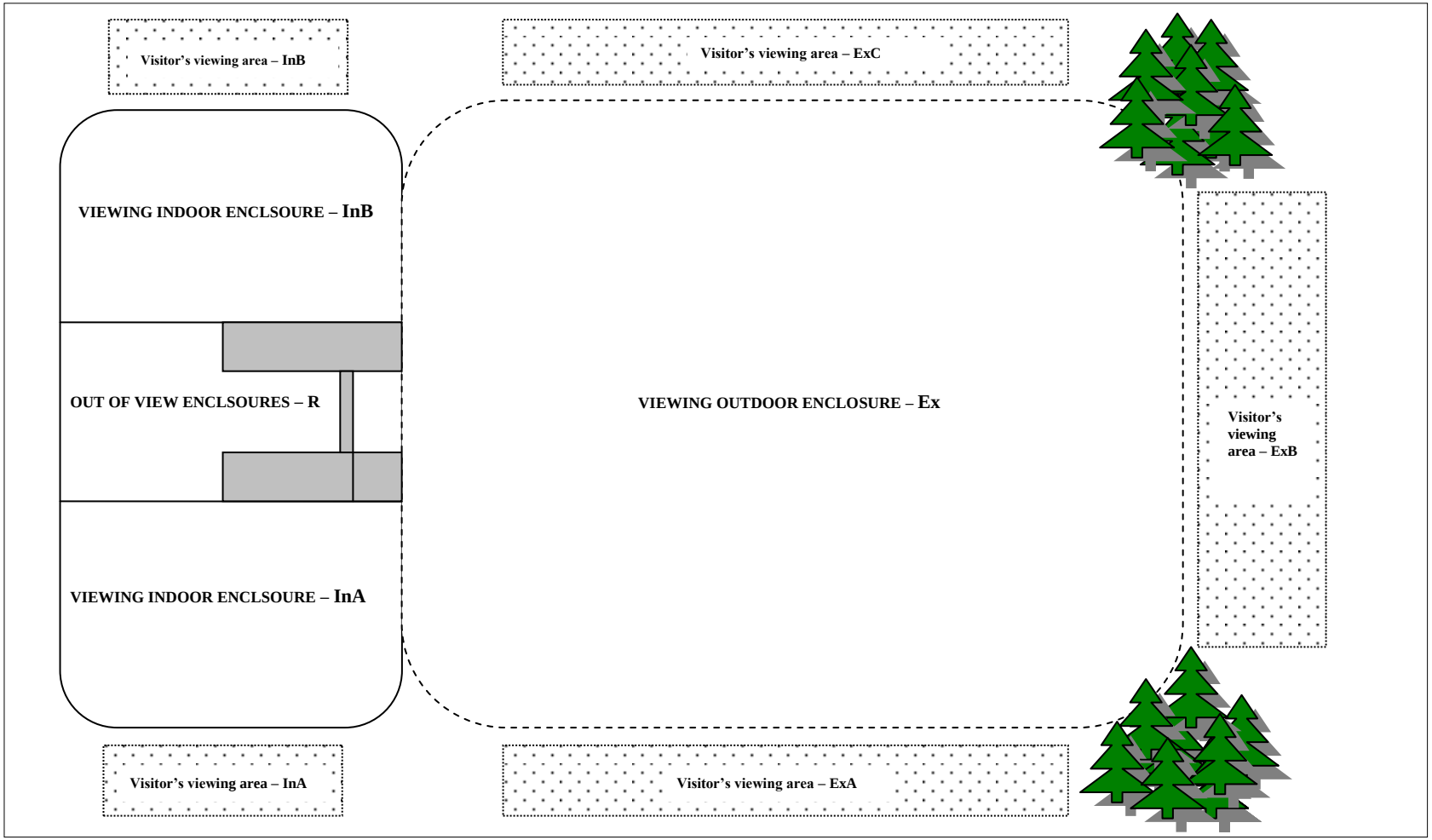


**Figure 1 -** A simple and linear sketch of the white-crowned mangabey enclosure with the respective areas. On the left site of the 'Viewing Indoor Enclosure – InA' are the Diana monkeys; and in front of the 'Visitor's viewing areas InA and ExA' are the western lowland gorillas.

# Appendix A: Ethogram

This ethogram was conceived during the habituation period of the research. Some literary sources[1] were consulted to construct it. Although it was given attention, during the observation period, to all the behavioural patterns pointed below, to the data analysis only some of them were used.

## Mangabeys' Behaviour - M-Part

→White-crowned mangabey

### Social Behaviour

**1. Non-agonistic Interactions**

- **Allo-grooming (AllGro)** Individual A uses fingers, lips or teeth, through fur of individual B, using a pick behaviour.
- **Non-sexual Presenting (Pre)** Individual A is facing individual B with its callosities, while crouching and looking repeatedly over the shoulder to the opponent. The presenter may move slightly back and forth.
- **Alloparental carrying of the Infant (CI)** Individual A (not the mother) carries infant in a ventral-ventral position.
- **Approach (App)** Individual A observes individual B and moves in the direction of the latter until reaching it. This behaviour is mostly followed by one affiliative behaviour, with individual A being the actor.

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[1] Chalmers, N., R. (1968). The visual and vocal communication of free living mangabeys in Uganda. *Folia Primatologica*, 9: 258-280

Pabst, L. (2008). The Callicam (*C. jacchus*) Sample Ethogram. In <http://pin.primate.wisc.edu/callicam/ethogram.html> Accessed 2010 January 24

Wallis, S., J. (1981). The Behavioural Repertoire of Grey-checked Mangabey (*Cercocebus albigena johnstoni*). *Primates*, 22(4): 523-532

**- Begging (Beg)** Individual A inspects, visually and olfactory, the mouth of individual B (possibly because the latter is chewing an eatable item or material).

**- Embrace/Social-rest (ScR)** Individual A approximates individual B and hugs it, both stay in a mutual ventral-ventral contact.

**- Social Play (SPly)** Two individuals are involved in a non-aggressive physical contact by lunging, grappling, wrestling or chasing each other, and showing almost always a play face.

**- Grooming presenting (GroP)**: Individual A stands in front or beside individual B, all four limbs are straight and the tail is held vertically. This posture is held for about 90 seconds, if grooming is not initiated the presenter goes away. If grooming is initiated the animal may remain in the posture for 3 minutes or longer.

**2. Sexual Interactions**

**- Sexually Mounting and Copulation (MC)** The male approaches the female, gasps her hips with his hands, his hind feet are placed on the claves of the female, which slightly flexes her hind-limbs in order to allow the male to stand on her calves. The male starts moving forth and back and the female emits specific vocalizations.

**- Sexual Presenting (SPres)** The sexually swollen female stands facing the male with her callosities, her tail is held vertically and curled over her back. The female does not look at the male.

**3. Agonistic Interactions**

**- Attack (Att)** Individual A lunge out aggressively on individual B and may hit him with hand(s) or foot(feet).

**- Avoid (Av)** Individual A avoid quickly individual B, while the latter one is approaching and observing the former.

**- Chase (Cha)** Individual A follows individual B quickly, with one or both animals displaying aggression and/or submission.

**- Flee (Flee)** Individual A runs away from individual B, while the latter is aggressively pursuing the former.

**- Stare (Sta)** One individual leans forward on tense arms, and crouches several times up and down, as a preparatory movement for springing forward; while it is staring straight at its opponent; at the same time that it is raising and lowering the eye-brows, and may

also has the mouth slightly open, with the lip corner brought forward. This behaviour may be followed by an attack and/or chase behaviour.

## Solitary Behaviour

**- Solitary Play (Ply)** Individual moving (rolling, jumping, running) alone or with an un-animated object, may show a play face.

**- Auto groom (Gro)** Individual using fingers, lips and/or teeth through his own fur with a pick behaviour.

**- Scan Environment (ScE)** Individual standing/seating, and moving its head and/or eyes to observe the environment.

**- Resting (Rest)** Individual standing/lying or seating, without showing any type of movement or activity.

- **Regurgitate** (**Reg**) Individual ejects material and/or food, out of its stomach through the mouth, and may ingest the ejected once again.

**- Foraging (For)** Individual searching, with help of his hand(s) and/or foot (feet), for edible items, while it does intake founded aliments through the mouth.

**- Alimentation (Al)** Individual standing, seating or lying while it is preparing and taking in aliments.

**- Locomotion (Loc)** Individual moving, such as climbing, walking, and/or swinging.

**- Masturbation (Mast)** The male engages in a rhythmic rubbing of the erect penis with his hands, resulting in ejaculation.

## Visitor-directed Behaviour

### 1. Neutral Behaviour

**- Observing Visitors (ObV)** Individual staying, lying or seating and observing the visitors or one specific visitor.

### 2. Aggressive Behaviour

**- Threat Visitors (ThV)** Individual staring aggressively at the visitor(s), while it crouches several times as a preparatory movement for springing forward, may be accompanied by an emitted alarm vocalization and may result in attack of the visitor(s).

**- Attack Visitors (Att)** Individual lunge out against the visitor(s), by jumping against the viewing window (indoor) or the fence (outdoor) and simultaneously displaying a threat face (staring). Individual may additionally display its canines and emit an alarm vocalization.

# Visitors' Behaviour - V-Part

→White-crowned Mangabey

## Social Behaviour

**- Affiliative (Aff)** Individual A is involved with individual B in one of the non-aggressive interactions explained above (see White-crowned Mangabeys' – Non-agonistic Interactions).

**- Agonistic (Agg)** Individual A is involved with individual B in one of the agonistic interaction explained above (see White-crowned Mangabeys' – Agonistic Interactions).

## Solitary Behaviour

**- Solitary Play (Ply)** Individual moving (rolling, jumping, running) alone or with an un-animated object, may show a play face.

**- Auto groom (Gro)** Individual using fingers, lips and/or teeth through his own fur with a pick behaviour.

**- Scan Environment (ScE)** Individual standing/seating, and moving its head and/or eyes to observe the environment.

**- Resting (Rest)** Individual standing/lying or seating, without showing any type of movement or activity.

**- Regurgitate** (**Reg**) Individual ejects material and/or food, out of its stomach through the mouth, and may ingest the ejected once again.

**- Foraging (For)** Individual searching, with help of his hand(s) and/or foot (feet), for edible items, while it does intake founded aliments through the mouth.

**- Alimentation (Al)** Individual standing, seating or lying while it is preparing and taking in aliments.

**- Locomotion (Loc)** Individual moving, such as climbing, walking, and/or swinging.
**- Masturbation (Mast)** The male engages in a rhythmic rubbing of the erect penis with his hands, resulting in ejaculation.

## Visitor-directed Behaviours

**- Observing Visitors (ObV)** Individual staying, lying or sitting and observing the visitors or one specific visitor.
**-Visitor-directed Aggressive Behaviour (VisAgg)** Individual shows visitor-directed aggression through threats or attack behaviours as explained above (see White-crowned Mangabeys' – Visitor-directed Aggressive Behaviours)

→Visitors

## Invasive Behaviours

**- Throw item (ti)** Visitor(s) throwing material (e.g. pens, zoo maps, ice stick.) through the fence into the mangabey enclosure, while standing, seating or crouching at the outdoor enclosure.
**- Feed personal food (ff)** Visitor(s) throwing personal food (e.g. crisps, candy, nuts.) through the fence into the mangabey enclosure, while standing, seating or crouching at the outdoor enclosure.
**- Feed/throw leafs (fl)** Visitor(s) throwing leafs (picked from the bushes and trees around the enclosure) through the fence into the mangabey enclosure, while standing, seating or crouching at the outdoor enclosure.

## Attract Attention Behaviours

**- Attract attention gestures (ah)** Visitor(s) direct(s) one of the following behaviours towards the mangabey(s): snapping fingers, clapping hands, waving hands or imitating physically and vocally "monkey-like" behaviours, while standing, seating or crouching in front of the mangabey enclosure (indoor or outdoor).

**- Attract attention with object (aobj)** Visitor(s) moving an object (e.g. umbrella, zoo maps, pens, mobiles), in the attempt to catch the attention of the mangabey(s), while standing, seating or crouching in front of the mangabey enclosure (indoor or outdoor).
**- Attract attention vocally (av)** Visitor(s) emitting vocal noises (e.g. "psch psch", "boohoo", "auuuu") in the attempt at to catch the attention of the mangabey(s), while standing, seating or crouching in front of the mangabey enclosure (indoor or outdoor).
**- Bang against window (bw)** Visitor(s) knocking and/or hammering against the viewing glass in the attempt to catch the attentions of the mangabey(s), while standing, seating or crouching in front of the mangabey enclosure (indoor).

## Personal Behaviours

**- Eating (ea)** Visitor(s) eating personal food, while standing, seating or crouching in front of the mangabey enclosure (indoor and outdoor).
**- Climb on fence (cf)** Visitor(s) climbing on the fence or over the fence at the outdoor enclosure.
**- Take child up in arms (ta)** Visitor(s) taking a child up in the arms standing, seating or crouching in front of the mangabey enclosure (indoor and outdoor).

# Other Variables

Besides visitor's behaviours, other variables were considered for data collection. Below is their descriptions.

## Visitors

All people observing the captive primates (not just passing by) that stayed more or less within 1 meter from the mangabey enclosure.

## Activity

-**Inactive visitor:** Visitor(s) that were not adopting any kind of behaviour besides standing, seating or crouching in front of the mangabey enclosure (indoor and outdoor).
- **Active visitor:** Visitor(s) that were adopting a particular kind of behaviour besides standing, seating or crouching in front of the mangabey enclosure (indoor and outdoor). From the habituation period we came up with the following categories for the visitor's behaviours: 'personal', 'invasive' or 'attract attention'.

## Visitor Loudness

**- Quiet:** Visitor(s) not emitting any noise or just whispering, while standing, seating or crouching in front of the mangabey enclosure (indoor or outdoor).
**- Voice loud:** Visitor(s) talking in an usual voice volume, while standing, seating or crouching in front of the mangabey enclosure (indoor or outdoor).
**- Loud:** Visitor(s) emitting loud noises when talking or when screaming, crying, singing and/or laughing, while standing, seating or crouching in front of the mangabey enclosure (indoor or outdoor).

## Appendix B: Model of the Check Sheet used in the Managabey's Behaviour – M-Part

Date:

Individual:

Enclosure/Weather Notes:

| **Mangabey Focal sampling** | | | | **Special Notes** | | **Visitor Scan sampling** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | | | Focus | Mangabeys | Visitors | Time | Loudness | | | Nr | | | |
| h | min | sec | | | | hh:00 | sl | vl | l+ | 0 | 1-5 | 5-10 | 10+ |
| | | | | | | | | | | | | | |
| | | | | | | hh:02 | | | | | | | |
| | | | | | | hh:04 | | | | | | | |
| | | | | | | hh:06 | | | | | | | |
| | | | | | | hh:08 | | | | | | | |
| | | | | | | hh:10 | | | | | | | |

## Appendix C – Model of the Check Sheet used in the Visitors' Behaviour –V-Part

| Date:<br>Enclosure/Weather Notes: | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time&Place | Attract Attention Behaviours | | | | Invasive Behaviours | | | Personal Behaviours | | | Special Notes | | ♂ | ♂ | ♀ | ♀ | ♀ |
| | gestures | vocally | object | bang | item | food | leafs | climb | eat | child | Visitors | Mangabeys | a | j | a | m | j |
| hh:00 | | | | | | | | | | | | | | | | | |
| hh:01 | | | | | | | | | | | | | | | | | |
| hh:02 | | | | | | | | | | | | | | | | | |
| hh:03 | | | | | | | | | | | | | | | | | |
| hh:04 | | | | | | | | | | | | | | | | | |
| hh:05 | | | | | | | | | | | | | | | | | |
| hh:06 | | | | | | | | | | | | | | | | | |
| hh:07 | | | | | | | | | | | | | | | | | |
| hh:08 | | | | | | | | | | | | | | | | | |
| hh:09 | | | | | | | | | | | | | | | | | |