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Research Article

DETERMINATION OF BEHAVIORAL ECOLOGY OF CHIMPANZEES (*PAN TROGLODYTES TROGLODYTES*) IN MEFOU PRIMATE SANCTUARY, YAOUNDE, CENTRE REGION, CAMEROON

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ABSTRACT

Living in groups can provide greater protection from predators, promote discovery, defense of food sources and improve access to mates. On the other hand, it can increase susceptibility to predators, pathogens, and competition for resources. Because of these trade-offs, social systems can display high levels of diversity, both on an evolutionary time-scale as well as in response to short-term variation in social and ecological pressures. This study was aimed at assessing the behavioral ecology of chimpanzees (*Pan troglodytes troglodytes*) in Mefou primate sanctuary in Yaounde ecological zone. The launching of a full-scale research data collection was considered at the end of the pilot study and lasted for four months. The habituated chimpanzee group consisting of 22 animals was observed for 10 hours each day and this was done for 10 days each month. Data collection on check-sheets started 8:00 am and ended 6:00 pm each day. During this period the animal group was followed, targeting either an adult male or adult female for focal data collection for the day. The focal data collection was done within an interval period of 15 minutes, during this period observations were recorded on this adult on feeding, moving, resting, grooming, aggression, and climbing. Secondly, the scan data collection, based on the entire animal group activity was done within an interval of 15 minutes. The ad-libitum and ecological data, such as weather type, food type, seasonality, photo-period, animal height from ground, and sex-class of animal were recorded simultaneously alongside the animal activity. The survey has shown a significant association between sex-class on animal-group activity and its position above the ground, X^2 =180.495 df=18, P=0.000 and X^2=19.328 df=12, P=0.081 respectively. Moreover, there was a significant link between group activity on photo-period and weather type, X^2= 87.741 df=12, P=0.000 and X^2 = 39.201 df=18, P=0.003 respectively. Group feeding recorded 22%, and whenever a food resource was met, each member of the group participated effectively in feeding and later moved to other areas. This study discovered that the group behavior of chimpanzees in Mefou primate sanctuary depends on various ecological changes.

Keywords: Behavioral ecology, Primate sanctuary, Chimpanzees, Animal activity, Group behavior.

INTRODUCTION

The study of chimpanzee (*Pan troglodytes*) behavior in an ecological context has been neglected relative to the number of long-term study sites that have provided information on social behavior (Pruetz, 2006). More recently, the importance of ecological studies has been recognized in facilitating chimpanzee conservation (Arnhem *et al*., 2008; Tweheyo & Babweteera, 2007).

Chimpanzees live in complex social groups composed of multiple females and males that fission and fusion daily into subgroups ranging in size from 2 to 140 individuals (Mitani *et al*., 2002). Grouping patterns vary depending on

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food availability (Anderson *et al*., 2002; Chapman & Chapman, 2000), female estrous (Anderson *et al*., 2002), seasonality, hunting success (Mitani & Watts, 1999; Stanford *et al*., 1994), predator interactions (Boesch, 1991) and location within the home range (core or periphery range) (Wrangham, 1999). At about 10 years of age females typically disperse from their natal community as they reach puberty (Pusey, 1979). In general chimpanzee society consists of a male dominated hierarchy system (Boesch & Boesch Achermann, 2000). Chimpanzees live in a variety of different habitat types, and their range extends from tropical forests to open grasslands, but they have mainly been described as a 'rainforest typical' species (Russak & McGrew, 2008; Stumpf, 2007).

The environment influences chimpanzee behavior on various levels. Thus, the general activity budget and habitat type use was studied in order to place diet in larger context. How an animal uses the physical or biological components within an area is described as habitat use. Chimpanzees live in a variety of habitat types, and generally their home ranges can contain several different vegetation classifications, defined as habitat type (Garshelis, 2000; Russak & McGrew, 2008; Stumpf, 2007). Habitat use by chimpanzees is suggested as influenced by fruit availability (Furuichi *et al*., 2001; Itoh & Nishida, 2007; Yamagiwa & Basabose, 2006), temperature or season (Takemoto, 2004), logging (Arnhem et al., 2008), access to water, and activity patterns (Tweheyo *et al*., 2004). Fongoli chimpanzees use patches of closed habitat types more often in the dry season, relating to temperature and water issues on a savanna. Seasonality and temperature have been shown to affect activity patterns for various chimpanzee populations. The Fongoli chimpanzees vary their activity patterns according to the wet and dry seasons. Activity patterns have been demonstrated to correlate with habitat use in chimpanzees in Budongo as well (Tweheyo *et al*., 2004). At most sites, feeding and foraging is the dominant chimpanzee activity during the day (Boesch & Boesch Achermann, 2000; Tweheyo *et al*., 2004). However, resting is the predominant activity of chimpanzees at Mahale, Tanzania (Huffman, 1990) as well as at Fongoli. Other behaviors that are components of the activity budget include traveling, social behaviors such as grooming and playing, and activities such as self-grooming, drinking, and nest building.

The chimpanzee (*Pan troglodytesverus*) community at Bossou in Guinea, west Africa, is particularly well suited for examining responses to human disturbances and pressures. It has been rated as the most heavily impacted long-term chimpanzee research site (Wilson *et al*., 2014) and many aspects of chimpanzee ecology and behavior, as well as the practices and cultural beliefs of the local people, are well understood (Matsuzawa *et al*., 2011). Local people practice slash-and-burn agriculture, which has resulted in a highly heterogeneous anthropogenic landscape (Kimberley *et al*., 2006). The density and availability of chimpanzee wild foods vary across forest and anthropogenic habitat types (Bryson *et al*., 2016) and wild fruit availability is highly seasonal (Bryson Morrison *et al*., 2016; Kimberley *et al*., 2009). The chimpanzees regularly visit cultivated areas to forage on crops and cultivated fruit trees, particularly during seasonal wild fruit scarcity, although they consume some crops regardless of wild fruit availability(Kimberley *et al*., 2009). The chimpanzees crop forage at any time of the day, including occasions when local people are present (Hockings, 2007). The chimpanzees at this site are traditionally not hunted or killed because of the totemic beliefs of the local Manon people (Yamakoshi, 2011). However, chimpanzee incursions into cultivated fields are rarely tolerated, and farmers frequently chase them away using noise or by throwing stones (Kimberley *et al*., 2009). Two roads dissect the chimpanzees' home range and crossing both these roads is necessary, but risky for them because of the high presence of vehicles and pedestrians (Kimberley Jane Hockings, 2011). In response to these human-induced risks, Bossou chimpanzees display adaptive behaviors and increased frequencies of external signs of anxiety, i.e., rough-self scratching, when foraging in cultivated fields and crossing roads (Kimberley Jane Hockings, 2011; Kimberley *et al*., 2012).

The human social organization has contributed to the welfare of humans in all ramifications of life. However, the social life of most wildlife species and their ecological structure is among the important tools much needed in domestication. Nonetheless, this study was aimed at exploring the social behaviors of chimpanzees and their ecological impact. The important role played by some ecological factors like rainfall, sunlight, landscape, photo-period, and seasonality on the social behaviors of wildlife such as chimpanzees needs to be comprehensively studied in Cameroon, a country well known in wildlife species diversity. The unsustainable wildlife management practices in Cameroon have resulted to drastic population decline, extirpating some species in some protected areas.

MATERIALS AND METHODS

Description of the study area

Mefou primate sanctuary is located at the outskirt of Yaounde city between latitude 3°37'74´ N and longitude 11°34' 47 E. The study area is surrounded by four villages, Metet, Ndifidi, Oveng, and Ejsanna. The primate sanctuary covers a land-surface area of 1,044 hectares. However, due to its primate population richness and species diversity, it hosts a lot of wildlife tourists and primate researchers. Ecologically, this area is characterized with rainforest vegetation (Mefou Council, 2016). Additionally, the rainy season has a seven months (April-October) period while the dry season has five months (November-March). The average annual temperature and rainfall is 23.1℃ and 2188 mm respectively (Mefou Council, 2016).

Research Data Collection

The research data collection for this study in Mefou wildlife sanctuary on chimpanzee socio-ecology constituted

an intensive one month pilot study. The pilot study was aimed at testing the wildlife behavioral ecological methods designed for the research. During this period, a chimpanzee group of 22 individuals was chosen for the study. A brief habituation was done and it ended when the chimpanzee group became acquainted to the student researcher, and research data could be recorded at close proximity without the animals fleeing from the researcher. After this survey, adjustments were made on some variables, such as landscape, since the study area was not really undulating as expected.

The launching of a full-scale research data collection was considered at the end of the pilot study and lasted for four months. The habituated chimpanzee group consisting of 22 animals was observed for 10 hours each day and this was done for 10 days each month. Data collection on check-sheets started 8:00 am and ended 6:00 pm each day. During this period the animal group was followed, targeting either an adult male or adult female for focal data collection for the day. The focal data collection was done within an interval period of 5 minutes, and during the period, observations were recorded on this adult on feeding, moving, resting, grooming, aggression, and climbing. Secondly, the scan data collection, based on the entire animal group activity was done within an interval of 15 minutes (Bates, 2005; Sakura, 1994). The ad-libitum and ecological data, such as weather type, food type, seasonality, photo-period, animal height from ground, and sex-class of animal were recorded simultaneously alongside the animal activity.

Research Data Analysis

The research data analysis was done by the use of SPSS and excel. The chimpanzee behavioral activity like feeding, moving, grooming, aggression, resting, and climbing were tested upon ecological variables like weather, photo-period, and seasonality. The purpose of this was to know whether these ecological parameters affect the behavioral activity of the chimpanzee group. Chi-square (X^2) and Pearson correlation (r) were the main statistical models used for inferential analysis, while the assessment of activity and ecological frequency was done on exploratory statistical models.

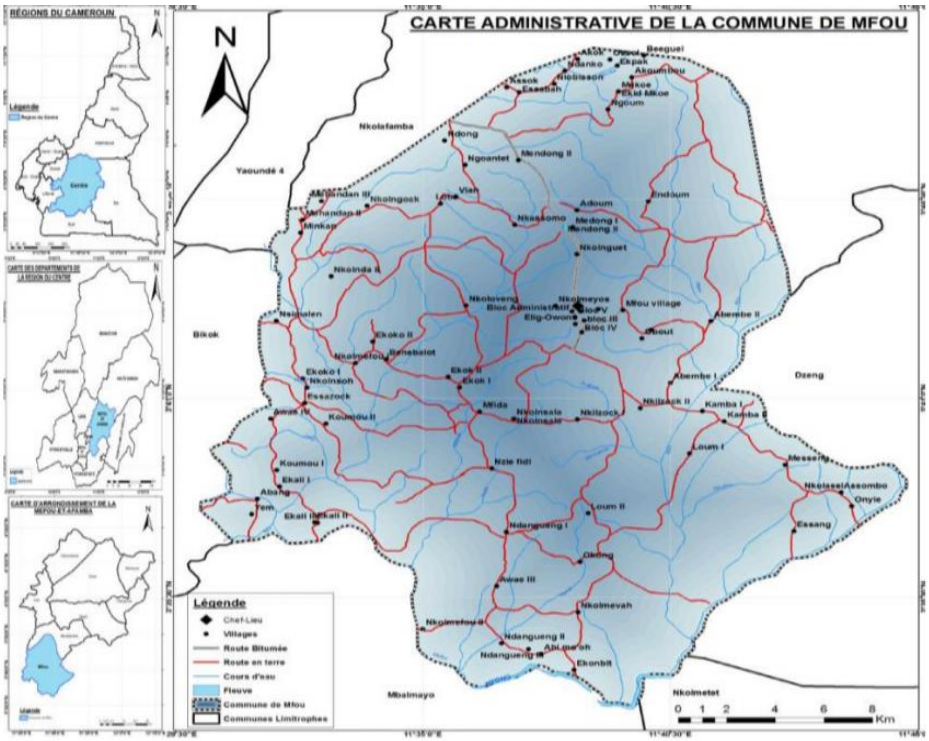

Figure 1. Map of Mefou (Source: MefouCouncil, 2016).

RESULTS AND DISCUSSION

The survey has shown a significant association between sex-class on animal-group activity and its position above the ground, X^2 = 180.495 df = 18, P=0.000 (Figure 2), and X^2=19.328 df=12, P=0.081 (figure 3) respectively. Chimpanzees (*Pan troglodytes troglodytes*) are social animals, and their group formation and organization is among the most advanced in the animal kingdom, especially in wildlife. Group-living in wildlife is aimed at surviving intra-group aggressions, food location and other Social, as

well as individual needs in the forest habitat. Group coordination is the responsibility of an adult male, known as the dominant male who defends the group, maintains

discipline, and mates with the adult females during ovulation for procreation. This study recorded the inclusion of all the members in social activities, such as feeding, moving, playing, grooming, resting, aggression, and climbing. Movement recorded the highest activity frequency (26%), while climbing the least (5%) (Figure 4). Chimpanzees (*Pan troglodytes troglodytes*), like most other wildlife are very mobile animals searching for healthy feeding locations. The mobility rate in Chimpanzees might be mainlyto determine food locations. Movement reduced whenever a healthy food location was met in a safe area. Group feeding recorded 22%, and whenever a food resource was met, each member of the group participated effectively in feeding, and later moved to other areas.

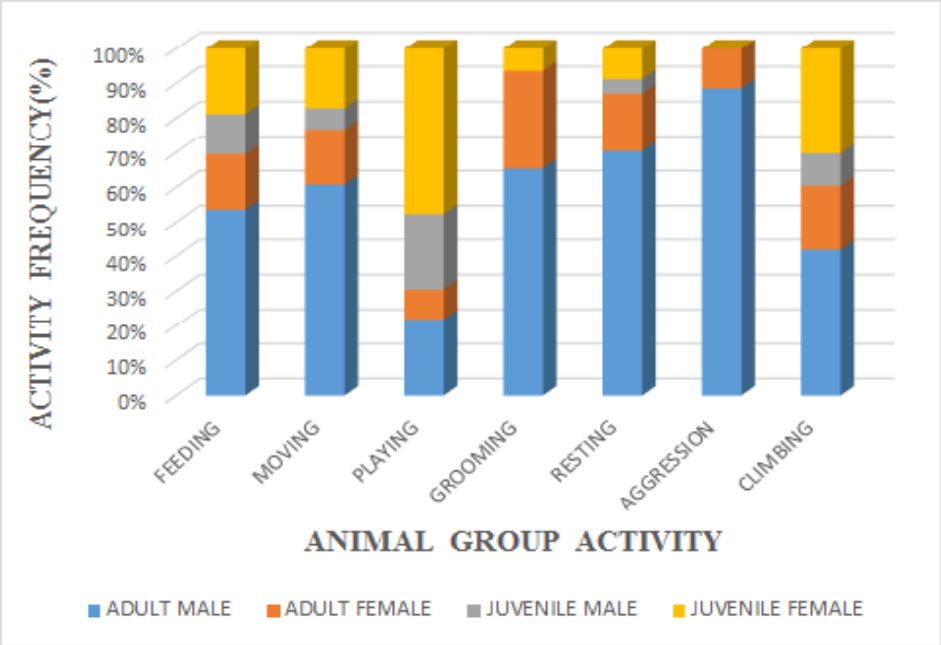

Figure 2. Sex-class and animal group activity.

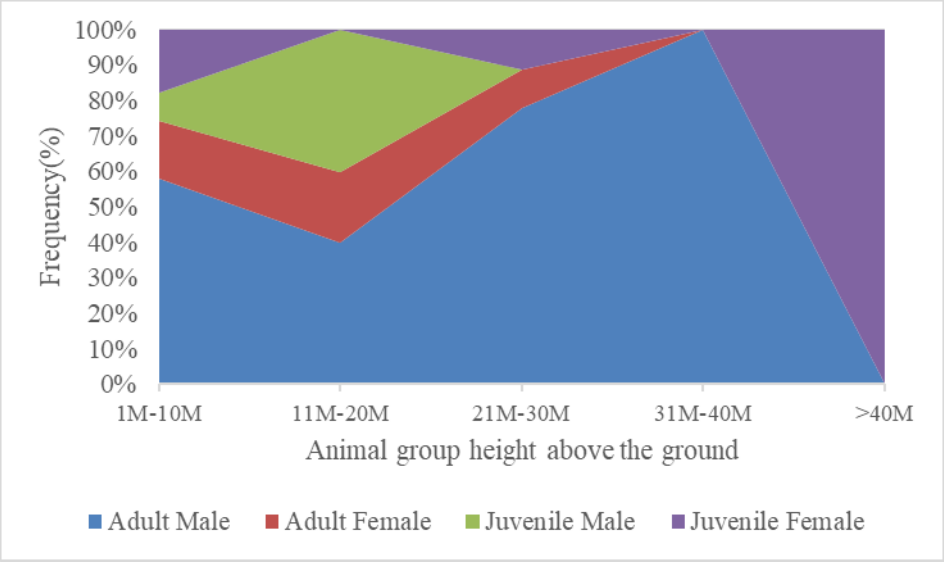

Figure 3. Sex-class and animal group height above ground.

Chimpanzees (*Pan troglodytes troglodytes*) are not very arboreal as compared to the guenon monkeys that are lighter in body weight. The 5% activity recorded in group-climbing confirms that chimpanzees in Mefou primate sanctuary are more ground dueling. This might be due to fruit-tree scarcity in the area, one of the main reasons for tree-climbing as observed by this study. Almost all group-activities were observed on the ground; even movement from one area to another was restricted to the ground. Although chimpanzees have the characteristic of hooping

on trees, however, a situation in which fruit-trees are scarce, their ground-dwelling adaptation to access food might be given a high activity budget. Moreso, the tree-climbing behavior as observed by this study was more associated with the adult males. Adult females made the least climbing as most of them were observed with juveniles, an additional weight that may hinder their arboreality.

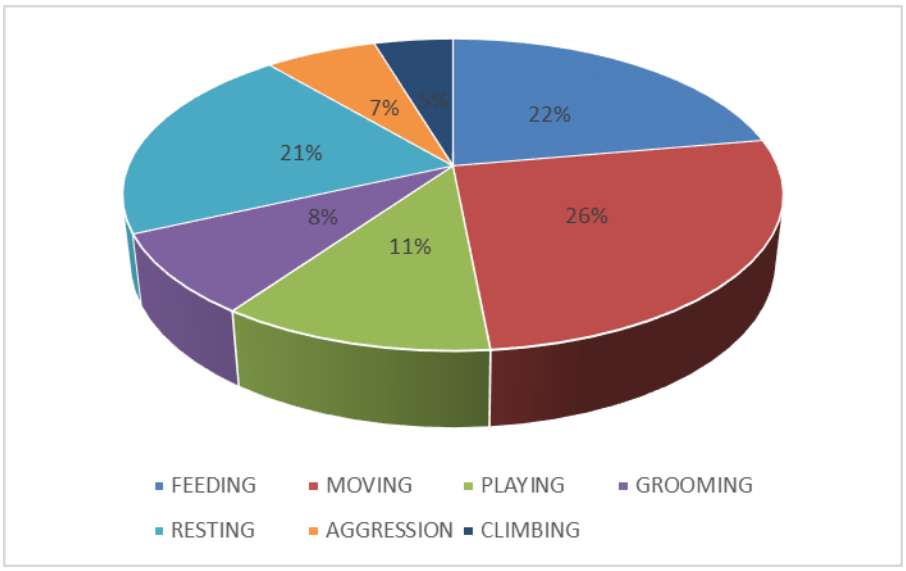

Figure 4. Animal group activity frequency.

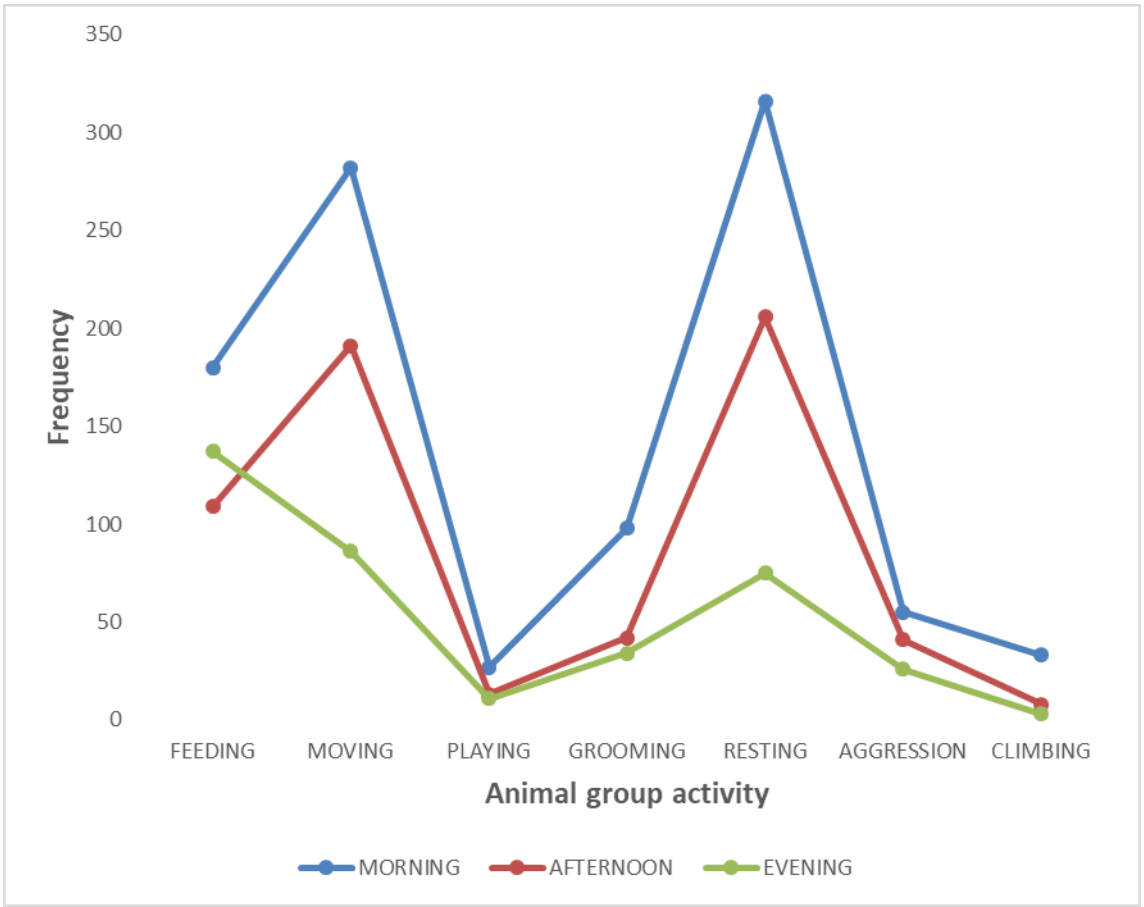

Figure 5. Animal group activity and photo-period.

There was a significant link between group activity on photo-period and weather type, X^2= 87.741 df=12, P=0.000 (Figure 5) and X^2 = 39.201 df=18, P=0.003 (figure 6) respectively. Chimpanzees (*Pan troglodytes troglodytes*), and other wildlife species are characterized with a group activity profile that various with different periods. This study discovered that the animal group was very active during the morning hours of the day, average mid-day, and slightly increased during the evening period. This kind of activity profile is common with most primate species, taking advantage of the morning period to intensify activities such as feeding due to moderate temperature. By mid-day, between 12.00am-2.00pm resting behavior dominated the activity profile due to the atmospheric temperature increase. The evening periods also witnessed a gradual activity increase, following the atmospheric temperature decrease. Activity intensity was experienced on feeding and movement towards the evening periods, preparing the animal-group for night-rest. The sunny weather was another determining factor to the social behavior, rain and wind recorded the least social activities, while a cloudy environment experienced moderate socialization. A moderate environmental tropical temperature in rainforest biome accommodates wildlife socialization more than the arid temperature in hot deserts areas. However, sunny weather recorded movement and resting behaviors higher than any other social activity.

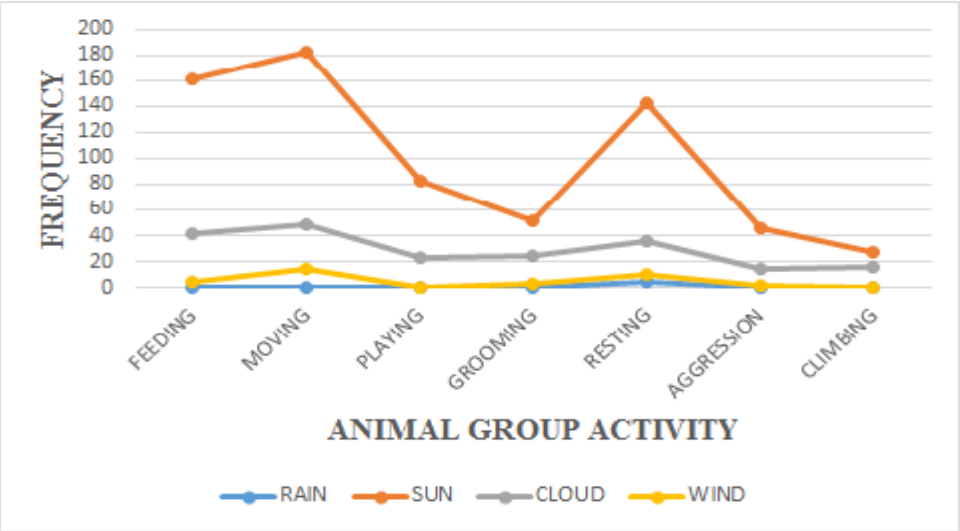

Figure 6. Animal-group activity and weather type.

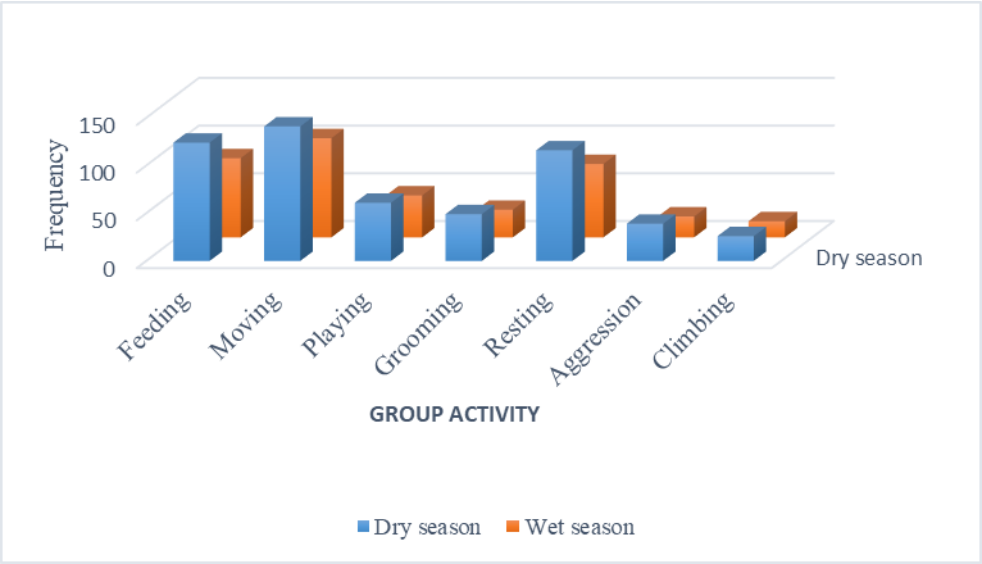

Figure 7. Animal group activity and season.

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Additionally, the study recorded a weak significance on social activity and seasonality, $X^2 = 1.379$ df=6, $P<0.05$ (Figure 7). Seasonality is one of the major ecological factors determining social behaviors in some wildlife species in sub-Saharan Africa, however, in this study the chimpanzee group showed a lower association. The subsidized primate-feeding strategy included by the authorities to the management of this sanctuary has played a serious role on food availability for the chimpanzees, reducing the possibility of food scarcity. This food subsidy is considered as one of the contributors reducing aggression frequency within the animal group in the sanctuary.

In the last decades, primate populations have suffered great demographic declines (Brooks *et al*., 2006), as well as a pronounced reduction in area with suitable environmental conditions (Junker *et al*., 2012). These declines are due to several reasons, all having human activities and/or infectious disease epidemics as their core basis (Walsh *et al*., 2003). Poaching, pet trade, slash-and-burn agriculture, deforestation associated with logging and agricultural activities, large-scale agricultural plantations, introduction of exotic plant species and natural changes, explain the biodiversity loss and fragmentation of primate habitats worldwide (Isabirye Basuta & Lwanga, 2008; Rainer *et al*., 2014). Some of these human activities, such as poaching and illegal hunting (Gates, 1996) affect primate populations directly, while others, such as deforestation and slash-and-burn agriculture (Devos *et al*., 2008), do so indirectly.

Chimpanzees provide an appropriate model species to test socio-ecological adaptations to anthropogenic habitats as they (1) exhibit ecological flexibility that allows them to exploit areas of human agricultural development (Yamakoshi, 1998), (2) occur extensively in areas of anthropogenic influence throughout Africa (Hockings, 2009), and (3) exhibit fission and fusion dynamics (Nishida, 1968) which allows responses to social and ecological change to be assessed over very short timescales (Aureli *et al*., 2008). Some research suggests that chimpanzee party size increases during periods of high fruit availability (Mcgrew & Marchant, 1996; Wrangham, 2000). However, other factors also influence subgroup (or party) size, including social factors such as the presence of sexually receptive females, demographic factors such as community size and sex ratio, and potential threats including predators (Anderson *et al*., 2002; Mitani *et al*., 2002; Reynolds, 2005). However, studies of animal-group living in 'natural' environments show variable associations between food availability, subgroup size and travel costs (Asensio *et al*., 2009; Doran, 1997), with ecological factors sometimes influencing age and sex classes differently (Chapman *et al*., 1995).

Many primate species use their ranges strategically to offset the risk of predation with food acquisition (Hill, 2016). Feeding is a risky behavior, and where individuals choose to feed can impact fitness and survival as much as what they choose to feed on (Lambert & Rothman, 2015). It is likely that primates inhabiting anthropogenic landscapes aim to use habitats in such a way as to balance nutritional requirements with avoiding potential risks associated with human-induced pressures. Such risks can include negative interactions between farmers and primates due to cultivar foraging (Kimberley *et al*., 2013; McLennan & Asiimwe, 2016), hunting pressure (Blake *et al*., 2007; Poulsen *et al*., 2009), and risks from collisions with vehicles during road crossing (Cibot *et al*., 2015; McLennan & Asiimwe, 2016). Chimpanzees, in particular, show a variety of adaptive behaviors in response to perceived risks associated with anthropogenic environments, many of which have been likened to predator avoidance strategies (Kimberley J Hockings *et al*., 2006; Takemoto, 2002). When foraging on cultivars, chimpanzees may increase group cohesiveness and vigilance behaviors (Kimberley J Hockings *et al*., 2012), vocalize less (Wrangham *et al*., 2007), and forage at night to reduce the risk of detection by farmers (Krief et al., 2014). Chimpanzees also adapt their grouping patterns and behavior before and during road crossings (Cibot *et al*., 2015; Kimberley Jane Hockings, 2011). Recent studies have demonstrated that primates display signs of anxiety and stress when faced with anthropogenic pressures (Kimberley Jane Hockings, 2011) some populations also show an increase in cortisol, a hormone that is released to buffer individuals in the short term from the effects of acute stress (Cyr & Romero, 2008; Wingfield & Romero, 2010). Prolonged exposure to increased levels of anxiety and stress has negative impacts on fitness (Sapolsky *et al*., 2000).

Intraspecific, population-level variation in sociality may stem from a variety of factors, including genetic differences at the subspecies level, differences in ecological environments, differences in demographic makeup, and differences in individual temperaments(Schradin, 2013). For nonhuman primates (henceforth primates) in particular, socioecological theory was developed to understand and predict variation in social organization and behavior. This theory postulates that the structure of primate social organizations, emerging from the relationships among their members, can be understood as ecologically and phylogenetically determined (Thierry, 2008; Wrangham, 1980). The possibility that intraspecific variation in primate sociality may in part emerge through social learning has been explored experimentally in marmosets (Koski & Burkart, 2015; Watson *et al*., 2014) and chimpanzees (Cronin, Van Leeuwen, Vreeman, & Haun, 2014). In response to prerecorded affiliative calls of familiar conspecifics, marmosets were found to temporarily increase their overall levels of affiliative behavior (Watson *et al*., 2014). In another study, the same species was shown to exhibit group-level differences in individual boldness produced by social effects (Koski & Burkart, 2015). Chimpanzees were observed to differ at a population level in the extent to which they tolerated each other's presence around valuable food resources (Cronin *et al*., 2014). These experimental studies opened up the possibility that the

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observed behavioral patterns might be best explained in terms of local cultures, although alternative could not be ruled out.

CONCLUSION

Primates attract attention of many researchers because they are closely related to human in terms of human social behavior. More so, they are social animals and most of them interact with each other in their species. Studies have shown that primate ' social behavior is more or less similar to human behavior such as eating, playing, fighting, keeping the baby and others. Understanding the social behavior of primates such as chimpanzees in a natural ecological system is important in the study of human evolution. Due to our genetic relatedness and morphological similarities, non-human primates have been a major source of information in the attempt to better understand human evolution. However, the importance of ecological factors in determining social behavioral changes in chimpanzees is very helpful in conservation. Additionally, sustainable conservation of chimpanzees and other wildlife species needs a comprehensive understanding of their socio-ecological structure. Many primate populations inhabit anthropogenic landscapes, understanding their long-term ability to persist in such environments and associated real and perceived risks for both primates and people is essential for effective conservation planning. Chimpanzees provide an appropriate model species to test socio-ecological adaptations to anthropogenic habitats.

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