

BEHAVIORAL STUDY OF CAPTIVE PRIMATES AND ROLE OF CENTRAL ZOO ON CONSERVATION AWARENESS



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Institute of Science and Technology

Tribhuvan University

Kirtipur, Kathmandu

Nepal

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DECLARATION

I hereby declare that the work presented in this thesis has been done by myself, and has not been submitted elsewhere for the award for any degree. All sources of information have been specifically acknowledged by reference to author(s) or institution(s).

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LIST OF ABBREVIATIONS

Abbreviated form

Details of Abbreviations

IUCN

International Union for Conservation of Nature

NTNC

National Trust for Nature Conservation

ABSTRACT

Zoos are built so that visitors can interact closely with the animals during brief visits and gain lifelong knowledge. There have been growing research on the effects of visitors on the well-being of captive animals but little research is found on whether zoo are being successful in providing conservation knowledge to visitors. It has been one of the common predictions that the zoo visitors foster certain changes in captive primate's behavior. Research has suggested that the physical and psychological wellbeing of captive primates has been affected by the zoo environment. This study aimed to provide additional data on primates' response in presence and absence of visitors in Central Zoo of Nepal, Jwalakhel from December 17, 2021 to April 15, 2022. Scan sampling method was applied for data collection and collected at every 10 minute interval from 7.00 am to 10.00 am in the morning and 12.00 pm to 3.00 pm. In addition, a questionnaire was performed to zoo visitors to evaluate the role of zoo in providing conservation education. The results of this study indicated that Rhesus Monkeys (*Macaca mulatta*) were found to alter their movement ($\chi^2 = 22.106$, $df = 1$, $P < 0.001$ in the presence and absence of visitors. In Mona (*Ceropithecus mona*), the increase in visitors appears to have induced restlessness ($\chi^2 = 4.7785$, $df = 1$, $P = 0.029$). Almost all of the zoo visitors were benefitted from zoo visits and get knowledge on national protection status of zoo animals after their zoo visits. Visitors were able to identify correctly the International Union for Conservation of Nature (IUCN) status of studied zoo animals except Greater One-horned Rhino (*Rhinoceros unicornis*). Data from this study indicates that primates are suffering from zoo visitors, therefore, this study recommends the installment of one way glass and strict rules against feeding, teasing and disturbing the primates to minimize the potential effects of zoo visitors. In addition, this study also recommends to design and place the sign boards with appropriate information.

INTRODUCTION

1.1 Background

Behavioral studies are typical examples of intrusive research methods used to assess the welfare of captive animals (Mallapur et al. 2005). Behavioral studies on captive animals have always been a crucial discovery to notable work in the field and laboratory (Burghardt 1975, Eisenberg 1975, Laughlin 1975, Moran and Sorensen 1984, Hosey and Druck 1987). Zoos are frequently required to house animals that have been confiscated, injured, orphaned, or trafficked into captivity (Cuarón Orozco 1991). For instance, between April and March 1987, the general public donated 276 wild mammals (of 36 species) to the Zoologico Miguel Alvarez del Toro (Cuarón Orozco 1991). Additionally, zoos serve as entertainment venues (AZA 2017). More than 183 million people visited zoos in the United States in 2017, according to the Association of Zoos and Aquariums (AZA 2017). Around 1.1 million visitors visit to the Central Zoo of Nepal each year (Himalayan Times 2020).

Thousands of monkeys are kept in captivity around the world, where they are robotically exposed to human visitors' sight and hearing (Snyder 1975). They are experiencing a detrimental enriching impact (Fa 1989, Cook and Hosey 1995, Wells 2005). This may cause changes in an animal's social interactions, possessive behavior, grooming, and feeding habits (Glatston et al. 1984). These animal behavioral changes had a negative impact on the context of animal welfare (Chamove et al. 1988). For instance, when guests are more engaged, certain primates display more audience-directed behaviors and more mobility (Hosey and Druck 1987, Mitchell et al. 1992, Perret et al. 1995, Roth and Cords 2020). In particular, they were less friendly, spent less time in contact with one another, were less fun, and displayed more antagonistic behavior when visitors were present (Glatston et al. 1984, Chamove et al. 1988). Not only in the primates, the effects of visitors are also found in other animals. For example, both male and female Captive Ostrich (*Struthio camelus*) turned their head many times towards visitors (Sharma et al. 2020). According to Carder and Semple (2008) at the Chester Zoo in the United Kingdom, big active groups of viewers elicited more human-directed behavior in zoo primates than small or large passive groups.

The zoo's management is primarily concerned with providing care for the animals and educational entertainment for visitors (Hutchins and Conway 1995). Zoos present greater details

about the characteristics, natural habitat, distribution, and state of conservation. Brief descriptions of the species' taxonomy, distribution, habitat, International Union for Conservation of Nature (IUCN) status, and other relevant information are displayed alongside the various animals that may be seen at the zoo for the benefit of zoo visitors (Tunnicliffe 1995). Zoos may play a significant part in animal conservation because the knowledge that visitors receive can be used to the conservation of wildlife in their natural habitat. Public attention is crucial because visitors are worried about what they see as strange behavior in zoo animals and respond favorably to enriched environments that foster species-typical behavior (Tunnicliffe 1995). As a result, there is a rise in public understanding, animal appreciation, and educational possibilities (Pecenko et al. 1997, Wood 1998, Tofield et al. 2003).

Zoos are typically built so that visitors can interact closely with the animals during brief visits and gain lifelong knowledge (Clayton et al. 2017). Zoos must demonstrate how visitors correctly understand and apply the zoo's specific conservation themes in order to claim that they are effective places for conservation education. Zoos strive to ensure that visitors' interpretations of their zoo experiences are focused on behavior change in order to lead to environmental protection as conservation organizations. Zoos frequently run into conflicts between their objectives, though. For instance, the chance to get up close and personal with animals makes a zoo more alluring to many people (Hosey 2005, Fernandez et al. 2009). If people are warned against or discouraged from approaching the local animals, there will be less traffic and less funding from the public. However, boisterous, excitable audiences have proven to be a source of strain for numerous animals, particularly primates, hurting both their welfare and the enjoyment of the visitor (Fernandez et al. 2009).

1.2 Objectives

1.2.1 General objective

The overall objective of the study was to identify the behavioral changes in captive primates in presence and absence of visitors, and role of zoo on wildlife conservation awareness.

1.2.2 Specific objectives

1. To analyze the variation in the behavior of captive primates in presence and absence of visitors.

2. To analyze the role of Central Zoo in disseminating the conservation knowledge to zoo visitors.

1.3 Significance of the study

Zoos play a significant role in the welfare of animals by serving as places of conservation, places of amusement, and centers for research and education about wildlife management and associated issues (Ahmad et al. 2015). Zoos primarily exhibit large-bodied vertebrates and fewer endangered species, which raises questions about their role in conservation (Balmford et al. 1995). Presentation of zoo animals is a critical issue on the effects of visitors on the behavior and well-being of exhibited animals. Traditional zoo exhibits and animals' passivity may cause some viewers to adopt unfavorable and destructive views (Fernandez et al. 2009). Similar to humans, primates occasionally exhibit visitor-induced stress in the form of increased scratching, displaced yawning, aggression, auto grooming, decreased tendency to mount, increased rest, or other behaviors indicative of learned helplessness (Roth and Cords 2020). The purpose of this study was to determine whether or not visitors to the central zoo have an impact on the captive primates there and whether one of the zoo's key objectives—educating visitors about conservation—can be accomplished. The data generated from this study can be used to develop a zoo management policy compatible to existing infrastructures. It can also be used to design appropriate enclosures for primates. Also, it can be used to formulate new plans and methods to provide conservation knowledge to visitors effectively.

1.4 Hypothesis

Primates are social animals and have been known to visit or live alongside human time and often so this study hypothesized that captive primates don't change in their behavior like feeding, resting, sleeping, playing, grooming, etc. in presence of visitors.

2 LITERATURE REVIEW

2.1 Behavioral study of captive primates

A visitor's presence can have one of three potential outcomes: it might be stressful (negative), enriching (good), or of no impact (Hosey 2000). Higher crowd numbers resulted in increased inactivity, movement, and some anxiety-related behaviors as well as a decrease in environment-related behavior and cage usage (Lewis et al. 2020). Cooke and Schillaci (2007) revealed that as visitor number increased, locomotive behaviors like brachiating, hanging, and bipedal walking decreased while communicative behaviors like looking at people and mouth-open displays has increased. Roth and Cords (2020) also found more time was spent on napping on days with higher mean visitor scores, which may indicate that primates had developed a habit of being helpless. Additional effects included an increase in activity and restlessness as well as an increase in aggressive behaviors were noticed in many captive animals (Hosey and Druck 1987).

Mitchell et al. (1992) found an increase in locomotary activity along with an increase in visitor numbers. Primates become less cooperative, more active, and hostile in response to visitors. There have been reports of abnormal behavior patterns in primates, such as begging from humans, floating limbs, stereotyped pacing, self-scratching, hair-plucking, inter-specific aggressiveness, and human-directed violence (Gupta et al. 2017). Chamove et al. (1988) similarly came to the conclusion that visitors are a source of stressful excitement rather than enrichment by noting that primates were less affiliate, more active, and more aggressive when visitors were present.

Additionally, some monkeys' responses to tourist crowds may change depending on the sex. In high crowd conditions, male contact aggression increased, but female contact aggression did not, according to Stoinski et al. (2012). Other behaviors like self-scratching, grooming, visual monitoring, reproductive behaviors, as well as some atypical and stereotyped behaviors, have been found to be affected by visitor presence. Carder and Semple (2008) discovered that the durations of self-scratching and visual monitoring were positively correlated with the number of visitors. Wells (2005) discovered that foraging, object use, playing, and grooming were all lowered in larger and more varied weekend crowds. Much more time was spent acting abnormally, displaying hostility toward conspecifics, and grooming themselves during times

when the crowd size was high, supporting the theory that crowds had a negative impact on primate's behavior. After the arrival of a big group of visitors, compared to smaller groups, primates covered their heads with paper sacks, while infants approached and clutched onto their mothers substantially more frequently (Birke 2002). Higher social and reproductive behaviors was displayed when zoos were closed to the public compared to when they were open (Mallapur et al. 2005). Goodenough et al. (2019) identified that the visitor numbers had a positive relationship with attentiveness and a negative relationship with feeding, foraging, and sunbathing. Todd et al. (2007) found that as visitor numbers increased, less time was spent grooming and resting and more time was spent playing and eating/chewing.

Stevens et al. (2008) found that visitors had no appreciable overall impact on aggressive behavior. In addition, play behavior remained unchanged. According to Collins et al. (2017) research, human interaction had a limited impact on primate's behavior and behavioral variation levels and have adapted effectively to the zoo environment and have grown accustomed to visitors. Choo et al. (2011) also discovered that the quantity of visitors had no appreciable impact on primate's behavior.

2.2 Role of Zoo

Actual zoo visitors appear to have a more positive perception of zoo animals and a greater awareness of the value of environmental enrichment than the general public outside of zoo environments (Reade and Waran 1996). Patrick et al. (2007) mentioned that the zoo's primary goals should be environmental education and conservation education. Also, they found that zoos also play a significant role in educating people about the need for conservation. Similar to this, Ahmad et al. (2015) found that most of the visitors had a positive opinion of the zoo's contribution to the conservation of endangered species. However, there were still some concerns regarding the administration of the zoo's methods for providing education and information. Carr and Cohen (2011) came to the conclusion that zoos were primarily portrayed as places to have fun rather than as places that promoted education and conservation. In addition, Clayton et al. (2017) discovered that individuals who had finished their tour performed better on tests of conservation knowledge, general concern about risks to biodiversity, and felt self-efficacy to

protect it. The study came to the conclusion that visiting a zoo had a good effect on knowledge and concern, and that by affecting self-efficacy, it may have an impact on future behavior. According to Falk et al. (2007) visit to zoos and aquariums has a positive impact on people's attitudes toward other animals.

Majority of the respondents are unaware that the zoo performs conservation initiatives according to Prajapati (2019).

3 MATERIALS AND METHODS

3.1 Study Area

The Central Zoo of Nepal (27.6733° N, 85.3107° E) is located at Jawalakhel, Lalitpur, Bagmati Province. It is one of the most well-liked recreational locations for locals and tourists and covers a six-hectare area. Prime Minister Juddha Shamsheer Rana initially founded it as a private zoo in 1932. From 1950 to 1995, the Central Zoo was governed by His Majesty's Government of Nepal; thereafter, the National Trust for Nature Conservation (NTNC) was given control of the zoo. The Central Zoo now houses 1026 creatures from 113 species, including 38 mammal species, 50 bird species, 15 fish species, and 10 reptile species (Central Zoo; July 15, 2022). Seven primate species are held in four cages at the Central Zoo, which has 38 different kinds of mammals (Central Zoo; July 15, 2022). The enclosure consists of an open area with a tiny, air-conditioned one-story building attached. A towering tree and plants cover the open area to create a natural scene. The area has been fixed with wooden logs, and it is made to fit their arboreal character.

3.2 Data Collection

3.2.1 Behavior of primates

Altogether, the activities of six primate species viz. Rhesus Monkey (*Macaca mulatta*; 8 individuals), Common Langur (*Semnopithecus schistaceus*; 6 individuals), Vervet Monkey (*Chlorocebus aethiops*; 3 individuals), Siamang (*Symphalangus syndactylus*; 2 individuals), Patas Monkey (*Erythrocebus patas*; 3 individuals) and Mona Monkey (*Ceropithecus mona*; 1 individuals) were recorded during this study period (Appendix 1). The behavior of six primate species was recorded from December 17, 2021 to April 15, 2022. Visitors are allowed to visit Central Zoo only at 10.00 am to 5.00 pm. Therefore, the study was designed to collect behavioral activities of primates in absence of visitors (7.00 am to 10.00 am) and in presence of visitors (12.00 noon to 3.00 pm). The data was collected following the scan sampling (Altmann 1974). The activities of the primates were observed in every 10 minutes interval for six hours four times a week for 52 days. The data was collected for a total of 988 scans. An ethogram including natural actions like moving, playing, resting, feeding, fighting, scratching, grooming, teasing, etc. was prepared to record those activities during the time period (Appendix 4). In addition, the number of visitors was also recorded during the time period.

3.2.2 Role of zoo

The data on the knowledge gained by the visitors from the Central Zoo visit was collected by questionnaire survey (Appendix 5). Interview was taken only visitors who had never visited Central Zoo before this questionnaire. There was no discrimination between educated and uneducated visitors, male and female, ethnic group, religion and age. Both demographic data such as age, gender, education and occupation of respondents was taken during the questionnaire survey. The central Zoo has displayed the characteristics of animals, their habitats and protection status in the display board to provide knowledge to the visitors. Therefore, the visitors were asked about these information before they visit the animals and their knowledge after their visits. Before zoo visit, the visitors were asked to recognize the major animals of zoo in the provided pictures. In addition, the respondents were asked whether they knew the common name, IUCN threatened status, National protection status of the animals in the provided pictures. Furthermore, the respondents were asked whether they knew the habitat of species, their diet, and other behavior. Same questionnaire except demographic data was performed to the same visitor after zoo visit. These questionnaires were performed at the entrance and exit gate of Central Zoo, and the respondents were not given any hints for second interview. A total of 151 visitors were involved in this questionnaire.

3.3 Data Analysis

To analyze if there's any relationship between captive primate's behavior in presence and absence of visitors, and to assess whether the zoo disseminate the conservation information to visitors a Chi-square test was performed. Only state behaviors were analyzed in the chi-square test.

4 RESULTS

4.1 Study of behaviors of Captive primates in presence and absence of zoo

In general, the resting behavior was recorded as a most dominant behavior among the captive primates, and followed by moving, playing, feeding, grooming, auto-grooming and scratching (Figure 1; Appendix 2). Calling was observed only in Siamang (Figure 1; Appendix 2).

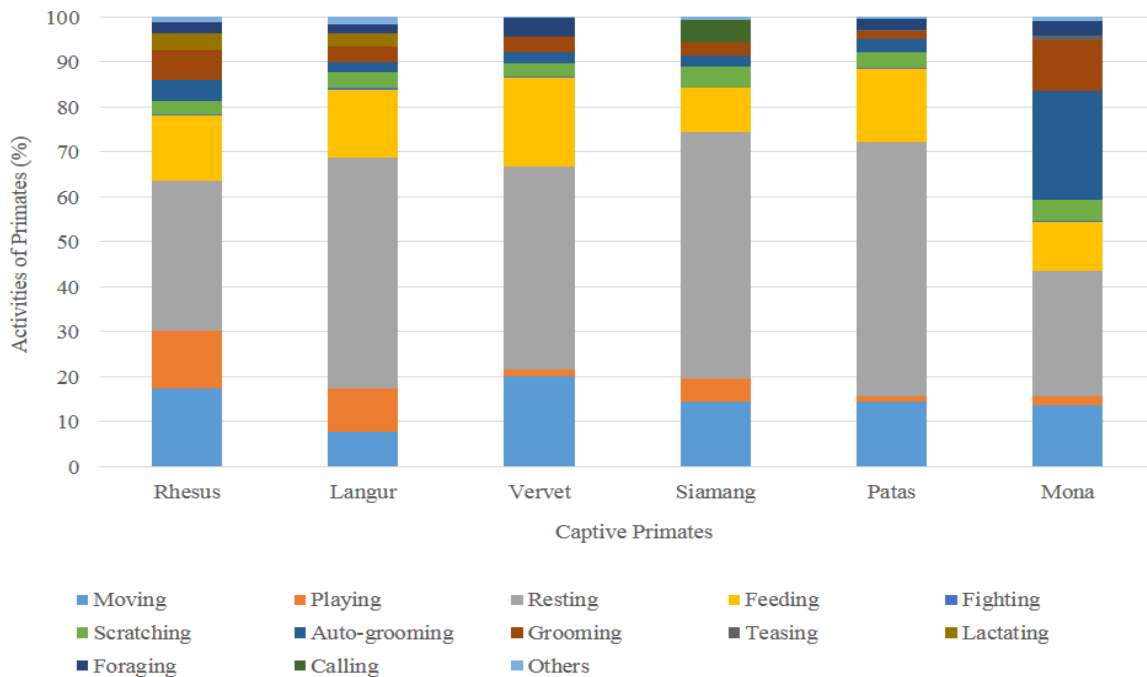


Figure 1: Behavioral activities of Captive Primates from December 2021 to April 2022

Out of 15,808 events of all behaviors, resting was accounted to 33.50% (n = 5295) in Rhesus Monkey of the total events, followed by moving (17.43%; n = 2756), feeding (14.44%; n = 2283), playing (12.75%; n = 2015), grooming (6.77%; n = 1070), auto-grooming (4.56%; n = 721), lactating (3.58%; n = 566), scratching (2.97%; n = 470), foraging (2.42%; n = 383) and remaining 1.58% (n = 246) on the other behaviors like defecating, mating, self-biting, masturbating, banging on the cage wall, etc. (Figure 1; Appendix 2). Similarly, Common Langur had 11,856 events of behavior during the study period. In Common Langur, the highest number

of activities was noticed for resting i.e., 51.48% of the total events (n = 6103), followed by feeding (15.08%, n = 1788), playing (9.48%; n = 1124), moving (7.85%; n = 931), scratching (3.56%, n = 422), grooming (3.42%, n = 405), lactating (3.01%, n = 357), auto-grooming (2.08%, n = 247), foraging (1.91%; n = 226) and remaining 2.13% (n = 253) on the other behavior like defecating, mating, self-biting, teasing, banging on the cage wall (Figure 1; Appendix 2).

Out of 5928 events of all behaviors, resting was accounted to 20.18% (n = 1196) in Vervet of the total events, followed by moving (20.18%; n = 1196), feeding (19.79%; n = 1173), foraging (4.03%; n = 239), grooming (3.58%; n = 212), scratching (2.92%; n = 173), auto-grooming (2.48%; n = 147) and remaining 1.15% (n = 116) on the other behaviors like teasing, begging, playing, and masturbating (Figure 1; Appendix 2). Similarly, Siamang had 3952 events of behavior during the study period. In Siamang, the highest number of activities was noticed for resting i.e., 54.71% of the total events (n = 2162), followed by moving (14.35%; n = 567), feeding (10.07%; n = 398), playing (5.26%; n = 208), calling (4.88%; n = 193), scratching (4.45%, n = 176), grooming (3.06%; n = 121) and remaining 3.22% (n = 127) on the other behavior like teasing, auto-grooming, foraging, begging etc. (Figure 1). Out of 5928 events of all behaviors, resting was accounted to 56.58% (n = 3354) in Patas of the total events, followed by feeding (16.33%; n = 968), moving (14.47%; n = 858), scratching (3.44%; n = 204), auto-grooming (3.04%; n = 180), foraging (2.55%; n = 151), grooming (1.86%; n = 110), playing (1.13%, n = 67) and remaining 0.6% (n = 36) by teasing, begging, self-biting, etc. (Figure 1; Appendix 2). Similarly, Mona had 1976 events of behavior during the study period. In Mona too the highest number of activities was noticed for resting i.e., 27.88% of the total events (n = 551), followed by auto-grooming (24.34%; n = 481), moving (13.61%; n = 269), grooming (11.34%; n = 224), feeding (10.78%; n = 213), scratching (4.66%; n = 92), foraging (3.34%; n = 66), playing (2.07%; n = 41) and remaining 1.98% (n = 39) on teasing, begging, defecating (Figure 1; Appendix 2).

Percent difference in the behavior was noticed in Rhesus Monkey in absence and presence of visitors. Moving 50.58% (n = 1394) was observed in absence of visitors and 49.42% (n = 1362) in presence of visitors (Figure 2; Appendix 2). Similarly, difference was found in other behaviors like playing (no visitors = 49.63%; n = 1000, with visitors = 50.37%; n = 1015), resting (no visitors = 55.66%; n = 2947, with visitors = 44.34%; n = 2348), feeding (no visitors = 17.87%; n = 408, with visitors = 82.13%; n = 1875), fighting (no visitors = 28%; n = 14, with visitors = 72%; n = 36), scratching (no visitors = 55.32%; n = 260, with visitors = 44.68%; n = 210), auto-grooming (no visitors = 62.27%; n = 449, with visitors = 37.73%; n = 272), grooming (no visitors = 63.18%; n = 676; With visitors = 36.82%; n = 394), defecating (no visitors = 61.82%; n = 34, with visitors = 38.18%; n = 21), lactating (no visitors = 78.80%; n = 446, with visitors = 21.20%; n = 120), mating (no visitors = 90.91%, n = 446, with visitors = 9.09%; n = 2), foraging (no visitors = 64.75%; n = 248, with visitors = 35.25%, n = 135) and banging on the cage wall (no visitors = 63.34%; n = 7, with visitors = 36.36%, n = 4).

Begging (100%; n = 108) and teasing (100%; n = 2) was only observed during the presence of visitors. Masturbating (100%; n = 1) was recorded only time during the absence of visitors.

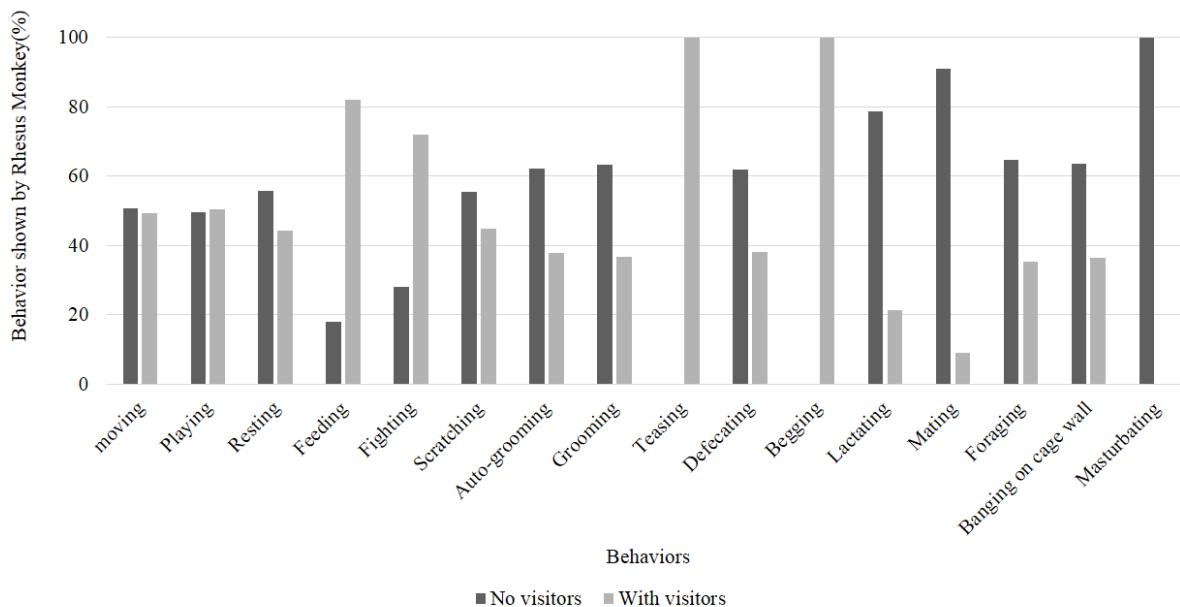


Figure 2: Behavioral activities of Rhesus Monkey in absence and presence of visitors from December 2021 to April 2022

Difference in percent of behavior was noticed in Common Langur in absence and presence of visitors. Moving 50.27% (n = 468) was observed in absence of visitors and 49.73% (n = 463) in presence of visitors (Figure 3; Appendix 2). Similarly, difference was found in other behaviors like playing (no visitors = 49.20%; n = 553, with visitors = 50.80%; n = 571), resting (no visitors = 59.02%; n = 3602, with visitors = 40.98%; n = 2501), feeding (no visitors = 18.85%; n = 337, with visitors = 81.15%; n = 1451), fighting (no visitors = 58.14%; n = 25, with visitors = 41.86%; n = 18), scratching (no visitors = 56.64%; n = 239, with visitors = 43.36%; n = 183), auto-grooming (no visitors = 51.82%; n = 128, with visitors = 48.18%; n = 119), grooming (no visitors = 33.33%; n = 135; with visitors = 66.67%; n = 270), teasing (no visitors = 33.33%; n = 2, with visitors = 66.67%, n = 4), defecating (no visitors = 69.05%; n = 29, with visitors = 30.95%; n = 13), lactating (no visitors = 69.75%; n = 249, with visitors = 30.25%; n = 108) and foraging (no visitors = 54.87%; n = 124, with visitors = 45.13%, n = 102).

Begging (100%; n = 122) was only observed during the presence of visitors. Masturbating (100%, n = 1), banging on the cage wall (no visitors = 100%; n = 3) and mating (no visitors = 100%, n = 18) was only recorded during the absence of visitor.

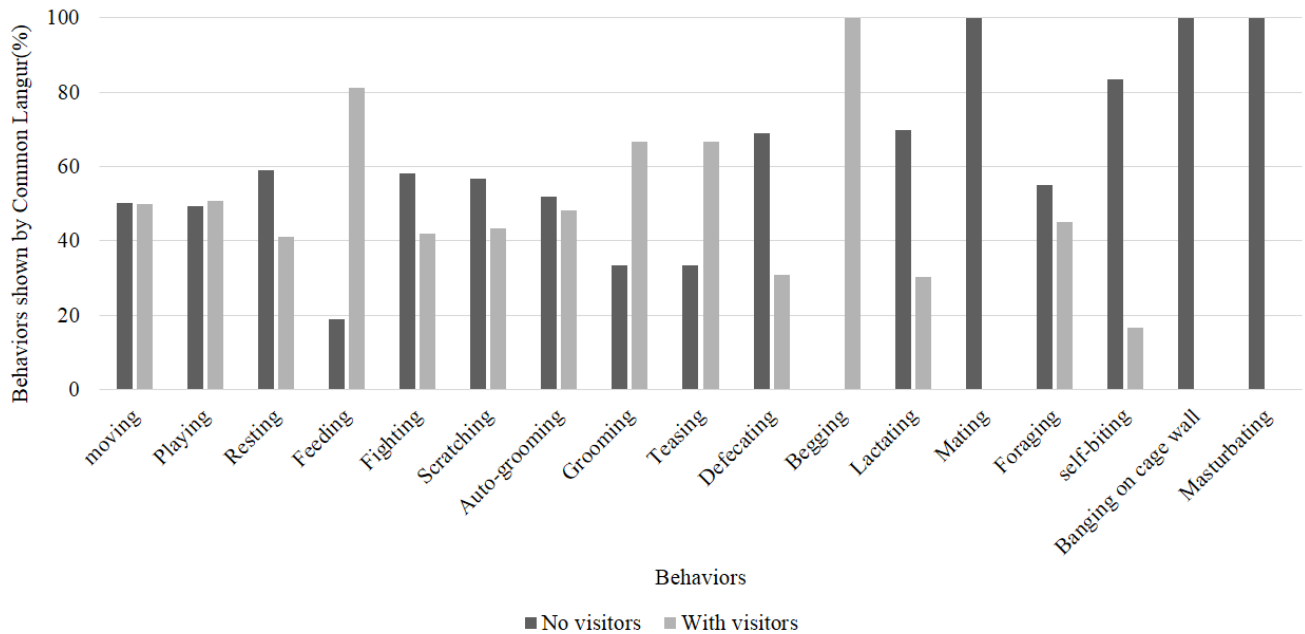


Figure 3: Behavioral activities of Common Langur in absence and presence of visitors from December 2021 to April 2022

Percent difference in the behavior was noticed in Vervet in absence and presence of visitors. Moving 57.27% (n = 685) was observed in absence of visitors and 42.73% (n = 511) in presence of visitors (Figure 4; Appendix 2). Moving was observed 57.27% (n = 685) in absence of visitors and 42.73% (n = 511) in presence of visitors. Similarly, difference was seen in other behaviors like playing (no visitors = 72.22%; n = 65, with visitors = 27.78%; n = 25), resting (no visitors = 55.99%; n = 1496, with visitors = 44.01%; n = 1176), feeding (no visitors = 27.02%; n = 317, with visitors = 72.98%; n = 856), fighting (no visitors = 64.29%; n = 9, with visitors = 35.71%; n = 5), scratching (no visitors = 50.87%; n = 88, with visitors = 49.13%; n = 85), auto-grooming (no visitors = 55.78%; n = 82, with visitors = 44.22%; n = 65), grooming (no visitors = 34.91%; n = 74; with visitors = 65.09%; n = 138), defecating (no visitors = 27.27%; n = 3, with visitors = 72.73%; n = 8) and foraging (no visitors = 60.67%; n = 145, with visitors = 39.33%, n = 94) (Figure 4; Appendix 2).

Begging (100%; n = 1) was recorded only one time during the presence of visitors.

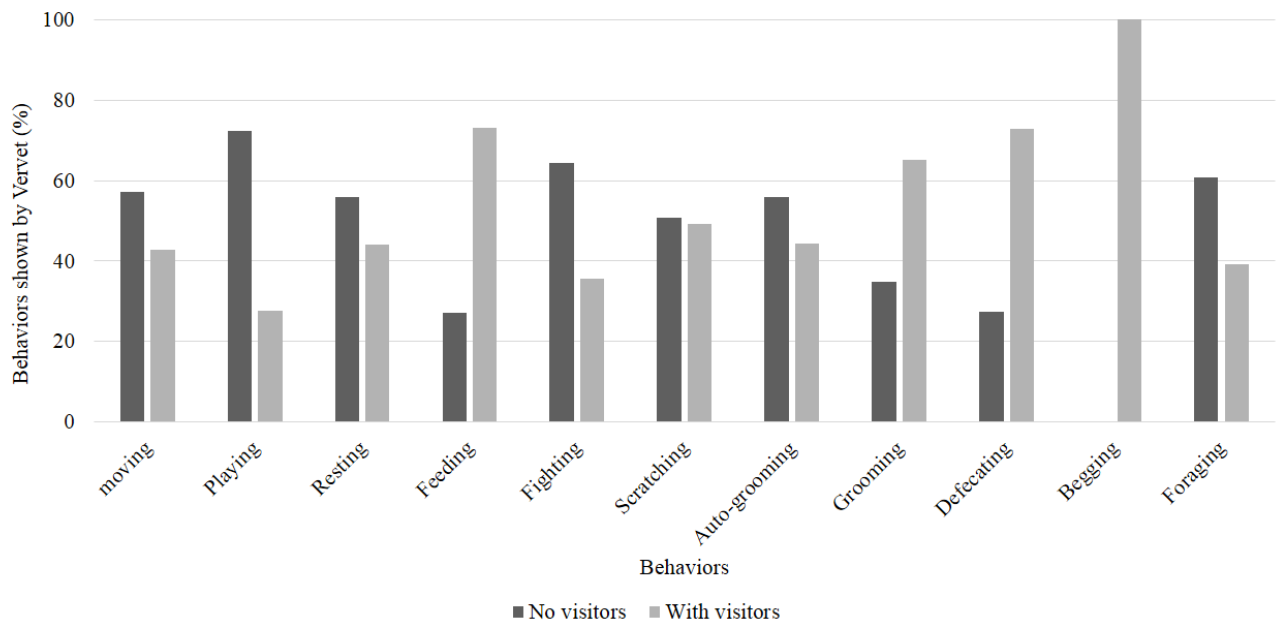


Figure 4: Behavioral activities of Vervet in absence and presence of visitors from December 2021 to April 2022

Percent difference in the behavior was noticed in Siamang in absence and presence of visitors. Moving 46.03% (n = 261) was observed in absence of visitors and 53.97% (n = 306) in presence of visitors (Figure 5; Appendix 2). Similarly, difference was found in other behaviors like playing (no visitors = 26.44%; n = 55, with visitors = 73.56%; n = 153), resting (no visitors = 57.72%; n = 1248, with visitors = 42.28%; n = 914), feeding (no visitors = 7.04%; n = 28, with visitors = 92.96%; n = 370),scratching (no visitors = 43.18%; n = 76, with visitors = 56.82%; n = 100), auto-grooming (no visitors = 59.60%; n = 59, with visitors =40.40 %; n = 40) and grooming (no visitors = 42.98%; n = 52; with visitors = 57.02%; n = 69).

Begging (100%; n = 22) and teasing (no visitors = 100%; n = 3) was only observed during the presence of visitors. Defecating (100%; n = 1) and foraging (100%, n = 1) both were observed only during the presence of visitors but both were recorded only time. Other behaviors like Calling (100%, n = 193) was observed only during the absence of visitors. Fighting (100%; n = 1) was also observed only one time, that too in the absence of visitors.

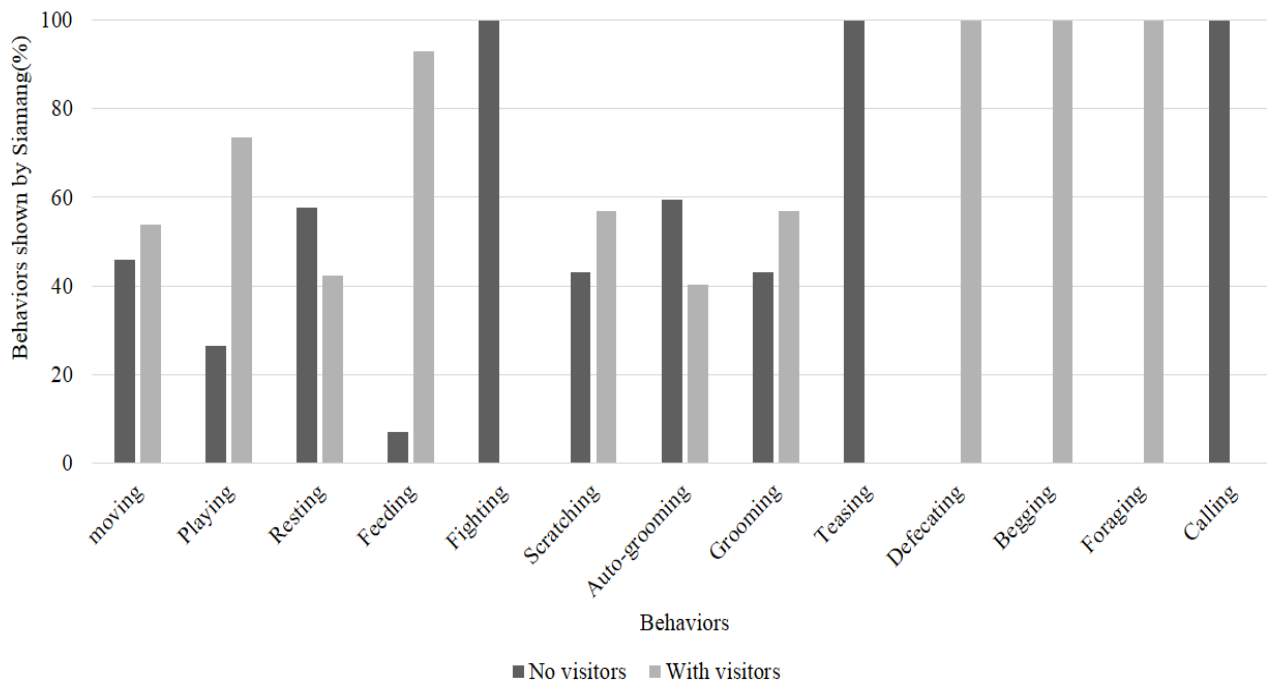


Figure 5 : Behaviors activities of Siamang in absence and presence of visitors from December 2021 to April 2022

In presence and absence of visitors, percent difference in behavior was seen in Patas. Moving was observed 45.10% (n = 387) in absence of visitors and 54.90% (n = 471) in presence of visitors (Figure 6; Appendix 2). Similarly, difference was seen in other behaviors like playing (no visitors = 62.69%; n = 42, with visitors = 37.31%; n = 25), resting (no visitors = 59.66%; n = 2001, with visitors = 40.34%; n = 1353), feeding (no visitors = 21.07%; n = 204, with visitors = 78.93%; n = 764), fighting (no visitors = 33.33%; n = 3, with visitors = 66.67%; n = 6), scratching (no visitors = 40.69%; n = 83, with visitors = 59.31%; n = 121), auto-grooming (no visitors = 50.56%; n = 91, with visitors = 49.44%; n = 89), grooming (no visitors = 52.73%; n = 58; with visitors = 47.27%; n = 52), defecating (no visitors = 56.25%; n = 9, with visitors = 43.75%; n = 7), self-biting (no visitors = 57.14%; n = 4, with visitors = 42.86%; n = 3) and foraging (no visitors = 52.98%; n = 80, with visitors = 47.02%, n = 71)

Begging (100%; n = 2) was only observed during the presence of visitors. Other behaviors like masturbating (100%, n = 1) and teasing (100%, n = 1) was recorded only one time in absence of visitors.

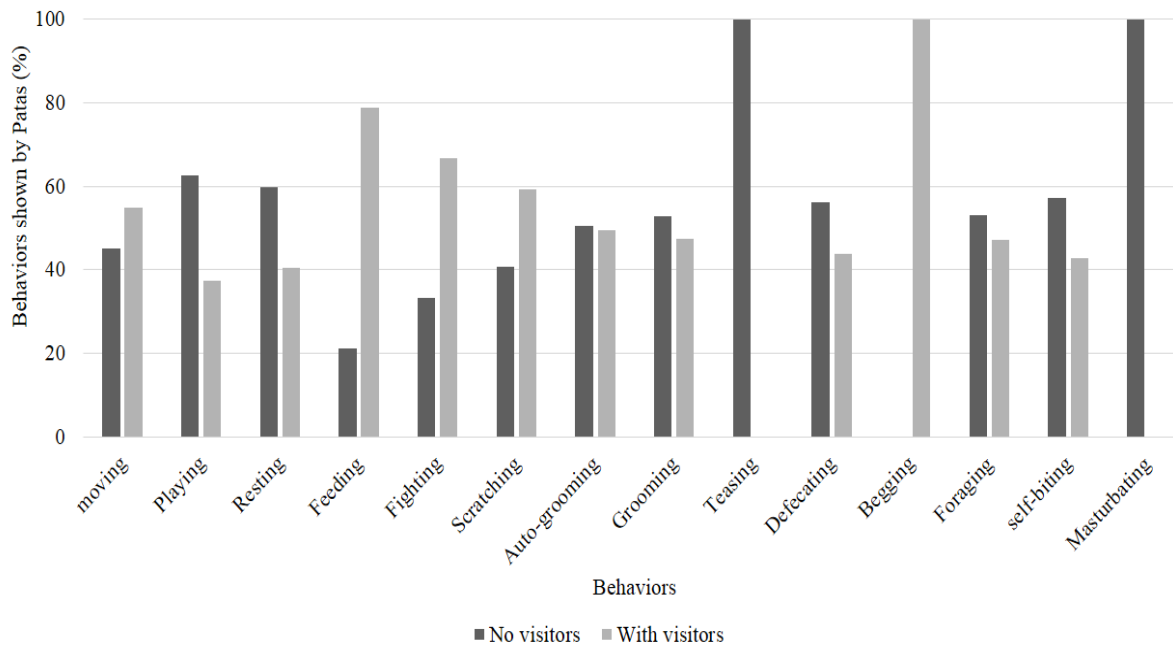


Figure 6 : Behaviors activities of Patas in absence and presence of visitors from December 2021 to April 2022

In Mona, difference in percent behavior was seen in presence and absence of visitors. Moving was observed 49.07% (n = 132) in absence of visitors and 50.93% (n = 137) in presence of visitors (Figure 7; Appendix 2). Similarly, difference was seen in other behaviors like playing (no visitors = 36.59%; n = 15, with visitors = 63.41%; n = 26), resting (no visitors = 62.79%; n = 346, with visitors = 37.21%; n = 205), feeding (no visitors = 23.94%; n = 51, with visitors = 76.06%; n = 162), fighting (no visitors = 33.33%; n = 2, with visitors = 66.67%; n = 4), scratching (no visitors = 50%; n = 46, with visitors = 50%; n = 46), auto-grooming (no visitors = 47.61%; n = 229, with visitors = 52.39%; n = 252), grooming (no visitors = 62.50%; n = 140; with visitors = 37.50%; n = 84), defecating (no visitors = 33.33%; n = 1, with visitors = 66.67%; n = 2), and foraging (no visitors = 39.39%; n = 26, with visitors = 60.61%, n = 40).

Begging (100%; n = 14) and teasing (100%, n = 16) was only observed during the presence of visitors.

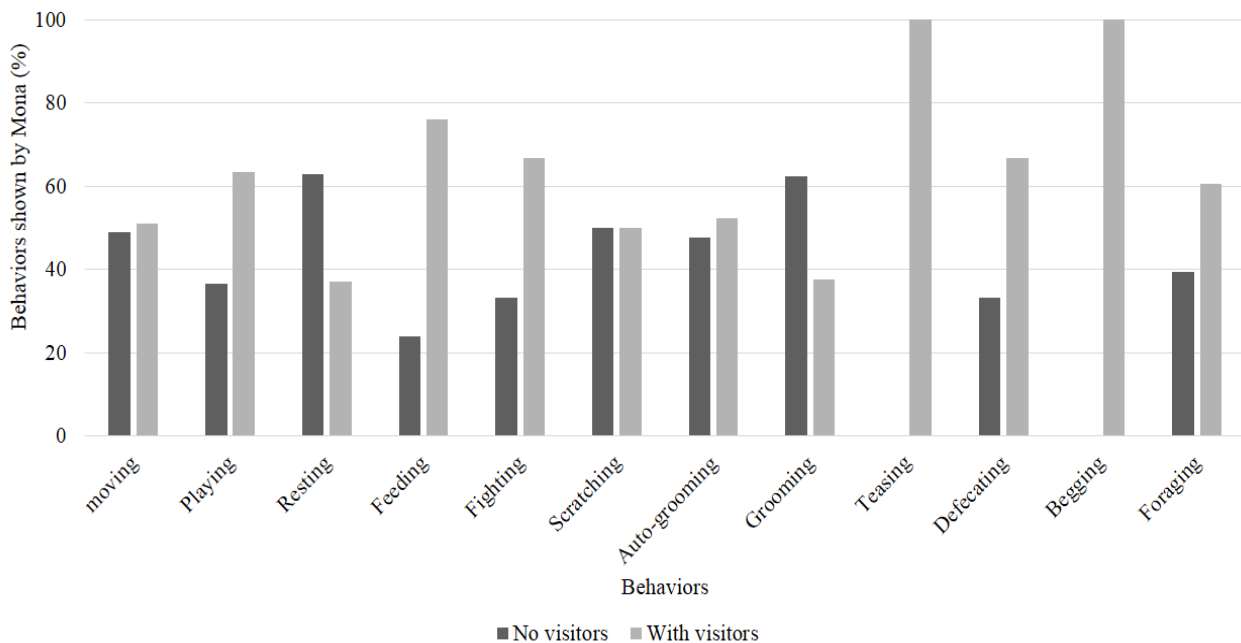


Figure 7: Behaviors activities of Mona in absence and presence of visitors from December 2021 to April 2022

The variation on the behavior of Rhesus Monkey in presence and absence of visitors was found on moving ($\chi^2 = 22.106$, $df = 1$, $P < 0.001$). In absence of visitors, 17.64% ($n = 1394$) events of moving was seen and 12.23% ($n = 1362$) in presence of visitors.

Similarly, variation was found on the resting of Mona ($\chi^2 = 4.7785$, $df = 1$, $P = 0.02882$) in presence and absence of visitors. 35.02% ($n = 346$) of resting was seen in absence of visitors and 20.75% ($n = 205$) in presence of visitors.

Table 1: Comparison of behaviors in presence and absence of visitors

S.N	Behavior	In absence of visitors (%)	In presence of visitors (%)	Test
1	Rhesus Monkey			
	Moving	17.64	12.23	$\chi^2 = 22.106$, $df = 1$, $P < 0.001$
2	Mona			
	Resting	35.02	20.75	$\chi^2 = 4.779$, $df = 1$, $P = 0.029$

4.2 Knowledge of visitors before and after Zoo visits

Altogether, a total of 151 visitors were interviewed for this study. Among them 68.21% (n = 103) interviewee were male and 31.79% (n = 48) were female. The average age of interviewee was 22 years (range: 9 to 83 years old). The majority of the interviewees had at least a high school diploma or equivalent education (36.42%; n = 55), followed by intermediate level education (29.80%; n = 45), bachelor's degree education (15.23%; n = 23), and master's degree education (3.31%); 15.23% (n = 23) of the respondents were uneducated and had no formal education. Most of the respondents were students 41.72% (n = 63), and followed by housewife (7.28%, n = 11), farmers (5.29%, n = 8), business persons (1.99%, n = 3) and others included drivers, electricians, lecturer, etc. (7.95%, n = 12).

Table 2: Comparison of knowledge of visitors before and after zoo visit from December 2021 to April 2022

Animals	Categories	Before visit (%)	After visit (%)	Test
Asian Elephant	National protection status	39.07	68.87	$\chi^2 = 36.906$, df = 1, P <0.001
	IUCN status	13.91	49.01	$\chi^2 = 18.769$, df = 1, P <0.001
Rhesus Monkey	Common name	98.67	100	$\chi^2 = 143.11$, df = 1, P <0.001
	National protection status	12.58	33.11	$\chi^2 = 34.152$, df = 1, P <0.001
	IUCN status	26.49	58.28	$\chi^2 = 36.656$, df = 1, P <0.001
	Habitat status	40.39	35.76	$\chi^2 = 91.769$, df = 1, P <0.001
	Feeding status	18.54	17.88	$\chi^2 = 102.12$, df = 1, P <0.001
Tiger	National protection status	49.67	71.52	$\chi^2 = 67.502$, df = 1, P <0.001
	IUCN status	32.45	60.93	$\chi^2 = 35.164$, df = 1, P <0.001
	Habitat status	64.24	68.21	$\chi^2 = 106.74$, df = 1, P <0.001

Himalayan Black Bear	National protection status	29.14	60.26	$\chi^2 = 38.316$, df = 1, P <0.001
	IUCN status	15.23	25.83	$\chi^2 = 15.301$, df = 1, P <0.001
	Habitat status	57.62	71.52	$\chi^2 = 72.129$, df = 1, P <0.001
	Feeding status	25.17	30.46	$\chi^2 = 72.678$, df = 1, P <0.001
Greater One-horned Rhino	National protection status	49.67	71.52	$\chi^2 = 51.288$, df = 1, P <0.001

There was variation on the knowledge of interviewee ($\chi^2 = 36.906$, df = 1, P <0.001) on the protection status of Asian Elephant before and after zoo visit. Approximately, 39% (n = 59) of interviewee correctly identified the national protection status of Asian Elephant before zoo visit and 68.87% (n = 104) visitors after zoo visit (Table 3; Appendix 3). Similarly, variation was found on the IUCN status of the respondents ($\chi^2 = 18.769$, df = 1, P <0.001) before and after zoo visit. Approximately, 14% (n = 21) of the interviewee correctly identified the IUCN status of Asian Elephant before zoo visit and 49.01% (n = 74) after zoo visit (Table 3; Appendix 3).

Similarly, there was variation was seen in the recognition of common name ($\chi^2 = 143.11$, df = 1, P <0.001) Rhesus Monkey before and after zoo visit. Approximately, 98.67% (n = 149) of interviewee correctly identified the common name of Rhesus Monkey before zoo visit and 100% (n = 151) visitors after zoo visit (Table 3; Appendix 3). There was variation on the knowledge of interviewee ($\chi^2 = 34.152$, df = 1, P <0.001) on the national protection status of Rhesus Monkey before and after zoo visit. Approximately, 12.58% (n = 19) of interviewee correctly identified the national protection status of Rhesus Monkey before zoo visit and 33.11% (n = 50) visitors after zoo visit (Table 3; Appendix 5). Similarly, variation was found on the IUCN status of the respondents ($\chi^2 = 36.656$, df = 1, P <0.001) before and after zoo visit. Approximately, 26.49% (n = 40) of the interviewee correctly identified the IUCN status of Rhesus Monkey before zoo visit and 58.28% (n = 88) after zoo visit (Table 3; Appendix 3).

There was variation on the knowledge of interviewee ($\chi^2 = 67.502$, df = 1, P <0.001) on the national protection status of Tiger before and after zoo visit. Approximately, 49.67% (n = 75) of

interviewee correctly identified the national protection status of Tiger before zoo visit and 71.52% (n = 108) visitors after zoo visit (Table 3; Appendix 3). Similarly, variation was found on the IUCN status of the respondents ($\chi^2 = 35.164$, df = 1, P < 0.001) before and after zoo visit. Approximately, 32.45% (n = 49) of the interviewee correctly identified the IUCN status of Tiger before zoo visit and 60.93% (n = 92) after zoo visit (Table 3; Appendix 3). Likewise, variation was found on the habitat status of the respondents ($\chi^2 = 106.74$, df = 1, P < 0.001) before and after zoo visit. Approximately, 64.24% (n = 97) of the interviewee correctly identified the IUCN status of Tiger before zoo visit and 68.21% (n = 103) after zoo visit (Table 3; Appendix 3).

Likewise, there was variation on the knowledge of interviewee ($\chi^2 = 38.316$, df = 1, P < 0.001) on the national protection status of Himalayan Black Bear before and after zoo visit. Approximately, 29.14% (n = 44) of interviewee correctly identified the national protection status of Himalayan Black Bear before zoo visit and 60.26% (n = 91) visitors after zoo visit (Table 3; Appendix 3). Similarly, variation was found on the IUCN status of the respondents ($\chi^2 = 15.30$, df = 1, P < 0.001) before and after zoo visit. Approximately, 15.23% (n = 23) of the interviewee correctly identified the IUCN status of Himalayan Black Bear before zoo visit and 25.83% (n = 39) after zoo visit (Table 3; Appendix 3). Likewise, variation was found on the habitat status of the respondents status ($\chi^2 = 72.129$, df = 1, P < 0.001) before and after zoo visit. Approximately, 57.62% (n = 87) of the interviewee correctly identified the habitat status of Himalayan Black Bear before zoo visit and 71.52% (n = 108) after zoo visit (Table 3; Appendix 3). In the same manner, variation was found on the feeding status of the respondents status ($\chi^2 = 72.678$, P < 0.001) before and after zoo visit. Approximately, 25.166% (n = 38) of the interviewee correctly identified the feeding status of Himalayan Black Bear before zoo visit and 30.46% (n = 46) after zoo visit (Table 3; Appendix 3).

There was variation on the knowledge of interviewee ($\chi^2 = 51.288$, df = 1, P < 0.001) on the national protection status of Greater One-Horned Rhino before and after zoo visit. Approximately, 50% (n = 75) of interviewee correctly identified the national protection status of Greater One-Horned Rhino before zoo visit and 71.52% (n = 108) visitors after zoo visit (Table 3; Appendix 3).

From questionnaire survey, a total of 151 respondents 84.77% (n =128) were educated and 15.23% (n = 23) uneducated (Figure 8).Visitors who had received any form of education and were able to read and write were considered educated and uneducated visitors considered to those visitors who could not read and write at all.

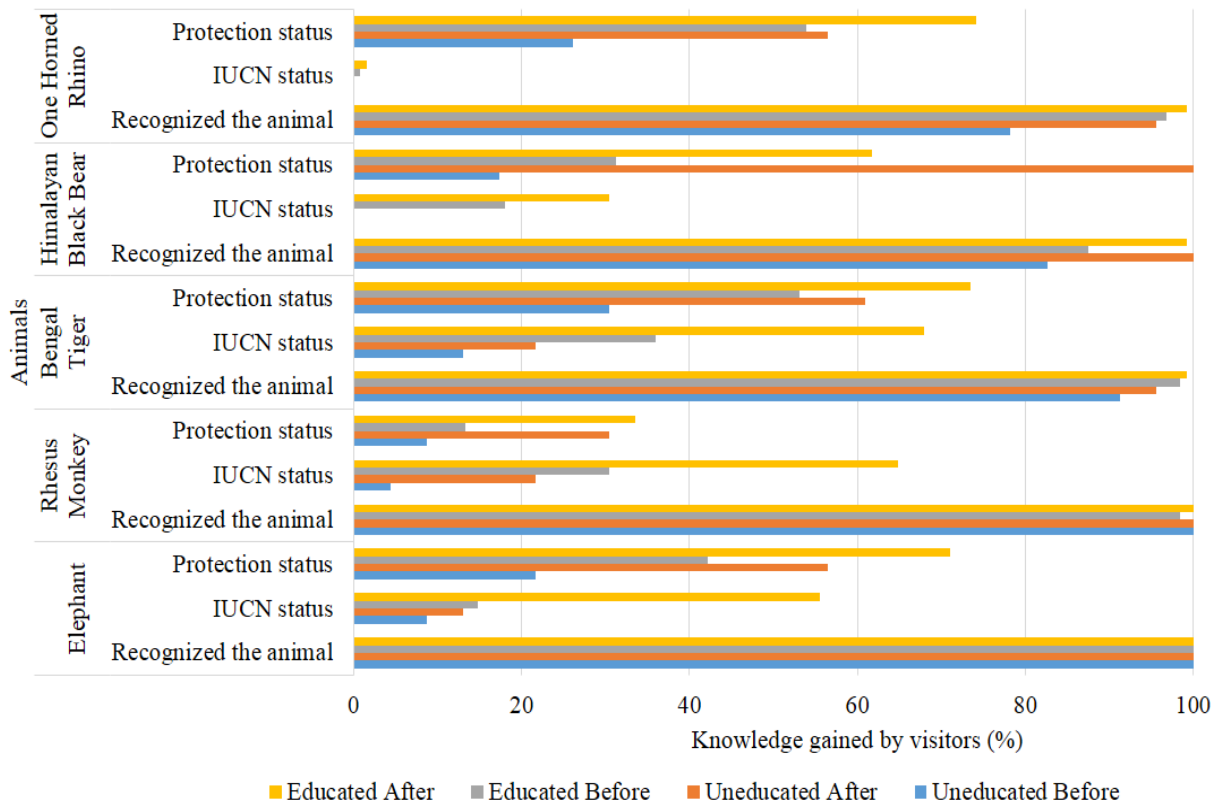


Figure 8: Knowledge gained by educated and uneducated visitors before and after zoo visit from December 2021 to April 2022

All uneducated visitors were able to identify Elephant and Rhesus Monkey correctly before zoo visit. However, 91.30% (n = 21) uneducated visitors were able to identify Tiger correctly, and 82.61% (n = 19) identified Himalayan Black Bear and 78.26% (n = 18) identified Greater One-horned Rhino before zoo visit. However, after visiting zoo, 95.65% (n = 22) of the respondents identified Tiger, 100% (n = 23) Himalayan Black Bear and 95.65% (n = 22) identified Greater One-horned Rhino. All educated visitors were also able to identify Elephant correctly before zoo visit but not Rhesus monkey which 98.43% (n = 126) were able to identify before zoo visit. However, 98.43% (n = 126) educated visitors were able to identify Tiger correctly, and 87.5% (n

= 112) identified Himalayan Black Bear and 96.88% (n = 124) identified Greater One-horned Rhino before zoo visit. However, after visiting zoo, 100% (n = 128) of the educated respondents identified the Rhesus Monkey, 95.65% (n = 22) identified Tiger, 100% (n = 23) identified Himalayan Black Bear and 95.65% (n = 22) identified Greater One-horned Rhino.

Only 8.69% (n = 2) uneducated respondents were able to identify the IUCN status of Elephant before zoo visit. However, 4.34 % (n = 1) uneducated visitors were able to identify the IUCN status of Rhesus Monkey and 13.04% (n = 3) identified that of Tiger before zoo visit. IUCN status of Himalayan Black Bear and Greater One-Horned Rhino were recognized by none of the uneducated visitors before and after zoo visit. However, after visiting zoo, 21.74% (n = 5) uneducated respondents identified the IUCN status of Rhesus Monkey and 21.73% (n = 5) identified that of Tiger. Only 14.84% (n = 54) of the educated visitors were able to identify the IUCN status of Asian Elephant correctly before zoo visit, 30.47% (n = 39) identified IUCN status of Rhesus Monkey, 35.94% (n = 46) identified that of Tiger, 17.97% (n = 23) identified that of Himalayan Black Bear and 0.78% (n = 2) identified that of Greater One-horned Rhino before zoo visit. However, after visiting zoo, 71.09% (n = 91) of the educated respondents identified the IUCN status of Asian Elephant, 64.84% (n = 83) identified the IUCN status of Rhesus Monkey, 67.97% (n = 87) identified that of Tiger, 30.46% (n = 39) identified that of Himalayan Black Bear and 1.56% (n = 2) identified of Greater One-horned Rhino.

About 21.73% (n = 5) of the uneducated visitors were also able to identify the national protection status of Elephant correctly before zoo visit, 8.69% (n = 2) identified of Rhesus Monkey and 30.43% (n = 7) uneducated visitors were able to identify the national protection status of Tiger correctly, 17.39% (n = 4) identified of Himalayan Black Bear and 26.09% (n = 6) identified of Greater One-horned Rhino before zoo visit. However, after visiting zoo, 56.52% (n = 13) of the uneducated respondents identified the national protection status of Asian Elephant, 30.43% (n = 7) identified the national protection status of Rhesus Monkey, 60.87% (n = 14) identified of Tiger 100% (n = 23) identified of Himalayan Black Bear and 56.52% (n = 13) identified of Greater One-horned Rhino. About 42.19% (n = 54) of the educated visitors were able to identify the national protection status of Elephant correctly before zoo visit, Rhesus monkey by 13.28% (n = 17) and 53.13% (n = 68) educated visitors were able to identify the national protection

status of Tiger correctly, and 31.25% (n = 40) identified of Himalayan Black Bear and 53.91% (n = 69) identified of Greater One-horned Rhino before zoo visit. However, after visiting zoo, 71.09% (n = 91) of the educated respondents identified the national protection status of Asian Elephant, 33.59% (n = 43) identified the national protection status of Rhesus Monkey, 73.44% (n = 94) identified of Tiger, 61.72% (n = 79) identified of Himalayan Black Bear and 74.22% (n = 95) identified of Greater One-horned Rhino by 74.22% (n = 95).

Among the total surveyed respondents, 68.21 % (n = 103) were male and 48% (n = 48%) were female (Figure 9). All respondents identified the Asian Elephant correctly before and after visiting zoo.

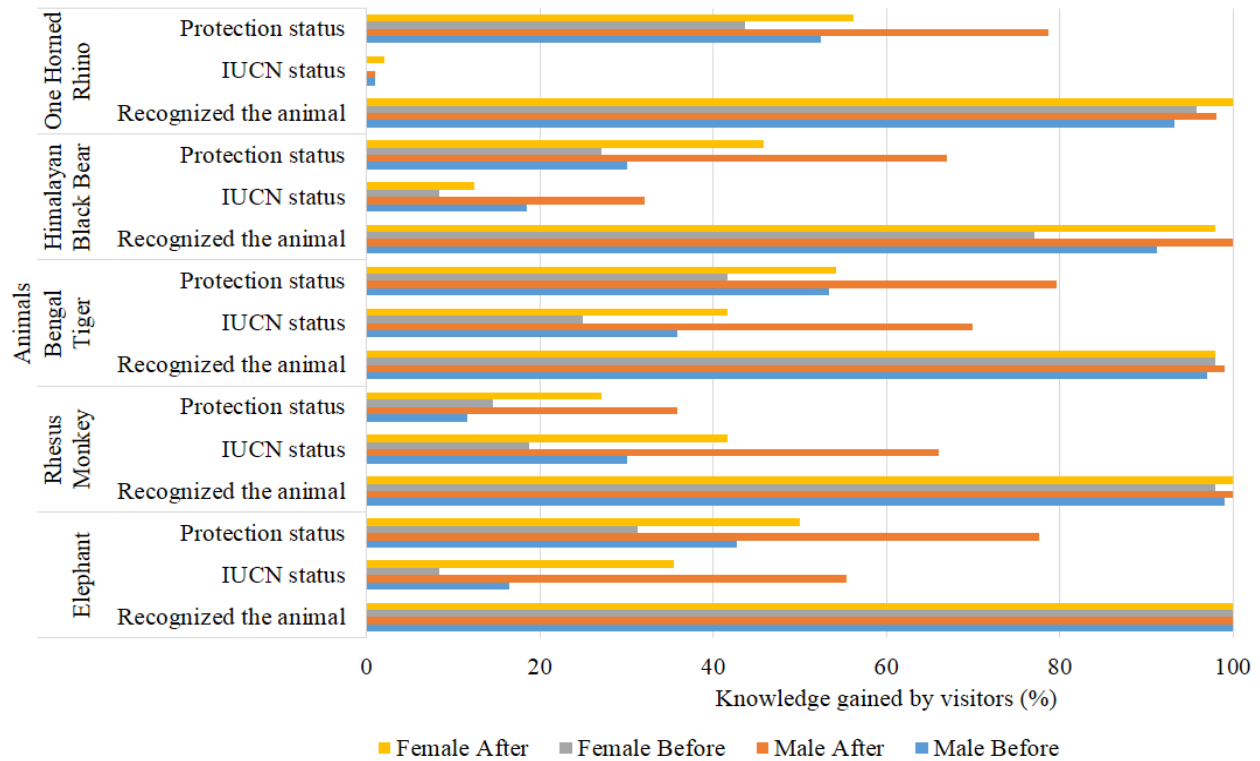


Figure 9: Knowledge gained by male and female visitors before and after zoo visit from December 2021 to April 2022

Before zoo visit, 99.03% (n = 102) male visitors were able to identify Rhesus Monkey, 97.09% (n = 100) identified Tiger, 91.26% (n = 94) identified Himalayan Black Bear and 93.20% (n = 96) identified Greater One-horned Rhino. However, after visiting zoo, 100% (n = 103) male respondents identified the Rhesus Monkey, 99.03 (n = 10) identified Tiger, 100% (n = 103) identified Himalayan Black Bear and Greater One-horned Rhino by 98.06% (n = 101). Before zoo visit, 97.92 (n = 47) of the female visitors were able to identify Rhesus Monkey before zoo visit, 97.92% (n = 47) identified Tiger, 77.085% (n = 37) identified Himalayan Black Bear and 95.83% (n = 46) identified Greater One-horned Rhino. However, after visiting zoo, all female

respondents were able to identify the Rhesus Monkey and Greater One-horned Rhino, whereas 97.92% (n = 47) identified Tiger and Himalayan Black Bear each.

Only 16.50% (n = 17) of the male respondents were able to identify the IUCN status of Asian Elephant before zoo visit. However, 30.0% (n = 31) male visitors were able to identify the IUCN status of Rhesus Monkey correctly, 35.92% (n = 37) identified of Tiger and 18.45% (n = 19) identified of Himalayan Black Bear and 0.97% (n = 1) identified of Greater One-Horned Rhino before zoo visit. However, after visiting zoo, 55.34% (n = 57) of the male respondents identified the IUCN status of Asian Elephant, 66.02% (n = 68) identified of Rhesus Monkey, 69.90% (n = 72) identified of Tiger, 32.04% (n = 33) identified of Himalayan Black Bear and 0.97% (n = 1) identified of Greater One-horned Rhino. Only 8.33% (n = 4) female visitors were able to identify the IUCN status of Asian Elephant correctly before zoo visit, 18.75% (n = 9) identified of Rhesus Monkey and 25% (n = 12) female visitors were able to identify the IUCN status of Tiger correctly, 8.33% (n = 4) identified of Himalayan Black Bear and none of the female visitors identified the IUCN status of Greater One-horned Rhino before zoo visit. However, after visiting zoo, 35.42% (n = 17) of the female respondents identified the IUCN status of Asian Elephant, 41.67% (n = 20) identified the IUCN status of Rhesus Monkey, 41.67% (n = 20) identified of Tiger, 12.5% (n = 6) identified of Himalayan Black Bear and 2.08% (n = 1) identified of Greater One-horned Rhino.

About 42.72% (n = 44) of the male visitors were also able to identify the national protection status of Elephant correctly before zoo visit, 11.65% (n = 12) identified of Rhesus monkey, 53.40% (n = 55) identified of Tiger, 30.10% (n = 31) identified of Himalayan Black Bear and 52.43% (n = 54) identified of Greater One-horned Rhino before zoo visit. However, after visiting zoo, 77.68% (n = 80) of the male respondents identified the national protection status of Asian Elephant, 35.92% (n = 37) identified the national protection status of Rhesus Monkey, 79.61% (n = 82) identified of Tiger, 66.99% (n = 69) identified of Himalayan Black Bear and 78.64% (n = 81) identified of Greater One-horned Rhino. About 31.25% (n = 15) of the female visitors were also able to identify the national protection status of Elephant correctly before zoo visit, 14.58% (n = 7) identified of Rhesus Monkey, 41.67% (n = 20) identified of Tiger, 27.08% (n = 13) identified of Himalayan Black Bear and 43.75% (n = 21) identified of Greater One-horned

Rhino. However, after visiting zoo, 50% (n = 24) of the female respondents identified the national protection status of Asian Elephant, 27.08% (n = 13) identified the national protection status of Rhesus Monkey, 4.17% (n = 26) identified of Tiger, 45.83% (n = 22) identified of Himalayan Black Bear and 56.25% (n = 27) identified of Greater One-horned Rhino.

5 DISCUSSION

5.1 Behavioral study

This study assessed the behavioral effects of visitors on captive primates. This study examined how primates behaved both with and without visitors in order to assess the effects of visitors. Variation on the behavioral activities of captive primates at the Central zoo suggests that Rhesus Monkey and Mona were stressed by the presence of visitors. In the presence of visitors, primates appeared to rest less and become more active. This may be the result of the visitors' disruption because majority of visitors cheers and try to chasing them. This outcome is consistent with the research on gorillas by Wells (2005), which discovered that the primates rested less in presence of higher number of visitors. Not only in these primates, visitor presence also affects the behavioral activities of Ostrich (Sharma et al. 2020).

Vervet, Siamang, Common Langur and Mona all reacted differently to the presence of the visitors. The Common Langur seemed to spend more time grooming and feeding. When there were guests around, Vervet monkeys would frequently make their way to the terrace of the building where their cage was housed and rest there—possibly in an effort to avoid visitors. Siamang was seen to be more animated and lively while visitors were around, maybe as a result of all the attention they were getting. When guests were present, Patas monkeys were observed to fight and scratch more frequently. It might be to reduce stress. It has been acknowledged that the presence of visitors in zoo enclosures contributes to higher levels of stress in wild animals kept in captivity (Chamove et al. 1988, Mitchell et al. 1991, Venugopal and Sha 1993, Anderson et al. 2002, Birke 2002, Mallapur and Chellam 2002, Mallapur et al. 2005). However, it was found that the presence of visitor did not affect these primates in captivity though moving, playing, feeding, scratching, grooming, auto-grooming, teasing, etc. appeared to change when visitors were present. However, there was no discernible difference between those activities in the presence and absence of visitors. It's possible that this predicament was brought on by imprisoned primates becoming accustomed to the zoo's surroundings and visitors. Similar findings were made in a research by Choo et al. (2011) which indicated that habituation to people caused a small visitor effect in captive-bred primates.

Although it was not reported in Vervet and Patas, which also had females in their group, reproductive behavior, or mating, was also observed in Rhesus monkey and Common Langur in addition to general behaviors. The lack of reproductive behavior in Vervet and Patas was attributed to the breeding season not occurring from December to April, which was the study period. Mating season of Vervet falls between April and June and Patas falls between June through September. Contrary to the findings of (Mallapur et al. 2005) on captive lion-tailed macaques (*Macaca silenus*), where it was discovered that visitors influenced mating behaviors, the presence of visitors in Central Zoo did not appear to effect the mating behavior of Rhesus monkey and Common Langur.

Stereotyped or abnormal behaviors, such as self-biting, masturbating, and banging on the cage wall were recorded in Rhesus Monkeys, Common Langurs, and Patas whereas it was not recorded in Vervet, Siamang, or Mona. Banging on the cage wall by the Rhesus Monkey varied dramatically depending on whether visitors were present or not, indicating that their presence may have an effect on the Rhesus Monkey's behavior. This conclusion is supported by the findings of the Mallapur et al. (2005) study, which found that captive Lion-tailed macaques (*Macaca silenus*) displayed more abnormal behavior while visitors were present than when they were not. Other than that, it was discovered that the presence of visitors had no effect on any other stereotyped behaviors. In the presence of visitors, all primates exhibited one other abnormal behavior: begging. Although it was completely against the zoo's laws to feed the animals, visitors persisted to do so. According to Goldstone et al. (2016) research, there was no discernable correlation between the chance of requesting and the availability of a food item, showing that people were not more likely to beg for a limited supply. Therefore, beggar events cannot entirely be explained for as a way to obtain food.

For this study, visitor behaviors—which might have been one of the influencing variables of the behavioral changes in confined primates—were not observed. Active viewers have a greater influence on monkeys' behavior than are passive viewers (Chamove et al. 1988). Therefore, in order to obtain reliable results, a thorough investigation on a variety of elements, including visitor behavior, crowd size, enclosure design, and environmental parameters, is required.

5.2 Role of zoo in conservation awareness

This study was conducted to determine whether the zoo's goal of educating visitors about conservation was being attained or not. According to a questionnaire survey of first-time zoo visitors, the Central Zoo has done a good job of educating visitors about conservation. The majority of the interviewees were men. This occurred because more women were reluctant to participate in interviews. They may have been hesitant because they had kids with them, which could be one of the causes. Most of the interviewees had some kind of education. Students made up the majority of the interviewees since they were friendlier and more willing to participate in the inquiry.

From the analysis of this study, it was found that visitors do not have any problems to identify large bodied animals like Asian Elephant and Greater One-horned Rhino. These type of animals have major attraction for the visitors. There was significant variation in the knowledge of national protection status and IUCN status in the visitors. After visiting the zoo, knowledge about the state of national protection enhanced. Their curiosity and the presence of informational displays about the animals may have contributed to their increased knowledge.

Though, Tiger is one of the main attraction of the zoo, visitors seemed to confuse it with Leopard before zoo visit. Before zoo visit, similar confusion were seen in Himalayan Black Bear where it was confused with Chimpanzee and Panda whereas recognizing Rhesus Monkey was not hard for most of the visitors as it is a very common animal. There was significant variation on the IUCN status, national protection status and habitat status of these animals as the knowledge of visitors about these status seemed to enhance after zoo visit. Observing the animals in captivity, reading the signboard and talking to the zoo personnel about these animals could have been the reason for this. Many for the visitors were surprised to see Himalayan Black Bear begging for peanut as the visitors were quite confident about it being Carnivore before visiting zoo. They seemed to be more surprised when they found out Rhesus Monkeys are Omnivore from the signboard. Curiosities and observations like these could be the reason in variation found in feeding status of Himalayan Black Bear and Rhesus monkeys, in which there was found increment of knowledge after zoo visit.

Visitors who were educated were found to have gained more information than those who were not. The inability of the uneducated tourists to understand the signboards and depend on someone else to give them the information they required may be one of the reasons. The knowledge they acquired after their visit appeared to have come from their observations of the animals and the informed family and friends they went to the zoo with. Additionally, the zoo staff members who could have given them information about the animals weren't always on duty.

After the study's analysis, it was shown that men's conservation knowledge appeared to have grown more than women's. This could be because women typically brought children and had to spend more time parenting than watching the animals. Another explanation could be that more of the female interviewees visited for recreation than education purpose.

Even though there were many people visiting the zoo for the first time, many of the interviews could not be finished since it was difficult to interview the same person again after their visit because of entrance and exit gates being different. With additional personnel working on this study, more data could have been collected, allowing for a deeper comprehension of the topic.

6 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Given some restrictions, our study's findings on the behavioral changes in captive primates at the Central Zoo show that visitors' presence significantly affected the Rhesus Monkey and Mona, but no significant changes were seen in the behaviors of the other captive primates, including the Common Langur, Vervet, Siamang, and Patas. Locomotion appeared to differ between Rhesus Monkeys in both the presence and absence of visitors. This can be related to the stress that visitors cause, and in Mona, increase in visitors appeared to have caused restlessness, which could also be related to stress and anxiety. Additionally, it was discovered that the zoo's efforts to teach visitors about conservation, which is one of its key goals, are successful. Visits to zoos do inform tourists about conservation-related issues.

Putting up signboards with information on the animals on show has really proven to be successful because people learn a lot about the creatures from them. However, it seemed to help only the knowledgeable visitors. Staff personnel or knowledgeable volunteers should be placed in strategic locations close to the most popular displays, offering guest information about the resident animals and emphasizing the need for them to keep quiet and refrain from feeding, disturbing, or teasing them.

Recommendation

The study's findings support the following recommendations for reducing the little impact of visitors on primates and educating visitors about conservation.

Effects of visitors on primate

- To lessen the impact of visitors on the primates, it would be preferable if the Central Zoo installed one-way glass.
- Additionally, stray monkeys were discovered on the grounds of the zoo, which could frighten the animals in captivity and be dangerous for both the tourists and the primates in captivity because they could carry diseases like rabies and attack visitors. Therefore, they must be taken out of the zoo.

- There must be strict regulations in place to prevent visitors from feeding the captive primates. Teasing the animals by throwing water at them, poking them with sticks, and other visitor behavior that negatively impacts the confined primates should result in severe consequences.

Role of zoo

- As uneducated visitors could not understand signboards, zoo personnel for each animal department should be more proactive in providing information about those creatures.
- Visitors were unaware of the Wildlife Display Center, and even though they were aware of it, they chose not to visit because they thought it would cost them money. Therefore, accurate information about the Center must be given to the visitors.

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APPENDICES

Appendix 1: Description of studied Captive Primates from December 2021 to April 2022

S.N.	Species	Scientific name	Total no. of species	Sex	Rearing history	Cage size
1.	Vervet Monkey	<i>Chlorocebus aethiops</i>	3	Male=2 Female=1	31/06/2074 B.S.	724 sq. ft.
2.	Siamang	<i>Symphalangus syndactylus</i>	2	Male=2	30/05/2057 B.S. 27/09/2077 B.S	720 sq. ft.
3.	Patas Monkey	<i>Erythrocebus patas</i>	3	Male=2 Female=1	31/06/2074 B.S.	780 sq. ft.
4.	Mona Monkey	<i>Ceropithecus mona</i>	1	Male=1	31/06/2074 B.S.	780 sq. ft.
5.	Rhesus Monkey	<i>Macaca mulatta</i>	8	Male=2 Female=6	24/08/2068 B.S. (Two females) After 2072 B.S.(rest of the individuals)	2600 sq. ft.
6.	Common Langur	<i>Semnopithecus schistaceus</i>	6	Male=2 Female=4	07/12/2072 B.S. (Sita) 29/02/2072	2600 sq. ft.

					B.S.(Maruti) 10/12/2063 B.S. (Ram Sewak) 18/01/2075 B.S. 19/12/2076 B.S. 13/05/2078 B.S.	
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Appendix 2: Comparison of behaviors of Captive Primates in absence and presence of visitors before and after zoo visit from December 2021 to April 2022

Primates	Behaviors	In absence of visitors (%)	In presence of visitors (%)	Test
Rhesus Monkey	Moving	17.64	12.23	$\chi^2 = 22.106, df = 1, P < 0.005$
	Playing	12.65	12.84	$\chi^2 = 1.840, df = 1, P = 0.1749$
	Resting	37.28	29.71	$\chi^2 = 0.66256, df = 1, P = 0.4157$
	Feeding	5.16	23.72	$\chi^2 = 0.3841, df = 1, P = 0.4157$
	Scratching	3.29	2.66	$\chi^2 = 0.0268, df = 1, P = 0.8698$
	Auto-grooming	5.68	3.44	$\chi^2 = 0.15715, df = 1, P = 0.6918$
	Grooming	8.55	4.98	$\chi^2 = 2.5092, df = 1, P = 0.1132$
	Lactating	5.64	1.52	$\chi^2 = 0.5501, df = 1, P = 0.4583$
	Foraging	3.14	1.71	$\chi^2 = 0.65896, df = 1, P = 0.7974$

Common Langur	Playing	9.33	9.63	$\chi^2 = 0.019$, df = 1, P = 0.8893
	Feeding	5.68	24.48	$\chi^2 = 1.3917$, df = 1, P = 0.2381
	Scratching	4.03	3.09	$\chi^2 = 0.262$, df=1, P = 0.6088
	Auto-grooming	2.16	2.01	$\chi^2 = 0.017$, df=1, P = 0.8959
	Grooming	2.28	4.55	$\chi^2 = 1.311$, df=1, P = 0.2523
	Lactating	4.20	1.82	$\chi^2 = 0.593$, df=1, P = 0.441
	Foraging	2.09	1.72	$\chi^2 = 0.000$, df=1, P = 0.9903
Vervet	Moving	23.11	17.24	$\chi^2 = 1.508$, df=1, P = 0.2194
	Playing	2.19	0.84	
	Resting	50.47	39.68	$\chi^2 = 1.285$, df=1, P = 0.2568
	Feeding	10.69	28.88	$\chi^2 = 0.026$, df=1, P = 0.8721
	Scratching	2.97	2.87	$\chi^2 < 0.005$, df=1, P = 1
	Auto-grooming	2.77	2.19	$\chi^2 = 0.309$, df=1, P = 0.5777
	Grooming	2.49	4.66	$\chi^2 = 0.409$, df=1, P = 0.5221
	Foraging	4.89	3.17	$\chi^2 = 0.000$, df=1, P = 0.9903
Siamang	Moving	13.21	15.49	$\chi^2 < 0.005$, df=1, P = 1
	Resting	63.16	46.26	$\chi^2 = 0.505$, df=1, P = 0.4773
	Feeding	1.42	18.72	$\chi^2 = 2.516$, df=1, P = 0.1127
	Scratching	3.85	5.06	$\chi^2 = 1.116$, df=1, P = 0.2907

Patas	Moving	13.06	15.89	$\chi^2 = 1.090$, df=1, P = 0.2964
	Resting	67.51	45.64	$\chi^2 = 1.054$, df=1, P = 0.3046
	Feeding	6.88	25.78	$\chi^2 = 2.6187$, df=1, P = 0.1056
	Scratching	2.80	4.08	$\chi^2 = 0.709$, df=1, P = 0.3998
	Auto-grooming	3.07	3.00	$\chi^2 = 1.2662$, df=1, P = 0.2605
Mona	Moving	13.36	13.87	$\chi^2 = 0.238$, df=1, P = 0.6255
	Resting	35.02	20.75	$\chi^2 = 4.778$, df=1, P = 0.02882
	Feeding	5.16	16.39	$\chi^2 = 0.003$, df=1, P = 0.9574
	Auto-grooming	23.17	25.51	$\chi^2 = 0.775$, df=1, P = 0.3785
	Grooming	14.17	8.50	$\chi^2 = 2.261$, df=1, P = 0.1327

Appendix 3: Increase in Knowledge of interviewee before and after zoo visit

S.N	Animals	Topic	Before visit (%)	After visit (%)
1	Asian Elephant	Common name	100	100
		Protection status	39.07	68.87
		IUCN status	13.91	49.01
		Habitat status	13.91	49.01
		Feeding status	95.36	98.01
2	Rhesus Monkey	Common name	98.67	100
		Protection status	12.58	33.11
		IUCN status	26.49	58.28
		Habitat status	26.49	58.28
		Feeding status	18.54	17.88
3	Tiger	Common name	97.35	98.67
		Protection status	49.67	71.52
		IUCN status	32.45	60.93
		Habitat status	32.45	60.93
		Feeding status	97.35	99.34
4	Himalayan Black Bear	Common name	86.75	99.34
		Protection status	29.14	60.26
		IUCN status	15.23	25.83
		Habitat status	15.23	25.83

		Feeding status	25.166	30.46
5	Greater One horned Rhino	Common name	94.04	98.68
		Protection status	49.67	71.52
		IUCN status	0.66	1.32
		Habitat status	0.66	1.32
		Feeding status	85.43	94.04

Appendix 4: Ethogram for the captive primates behaviors at Central Zoo

S.N	Behavior	Description
1	Resting	Sleeping, sitting idle or not doing anything
2	Moving	Walking, running, jumping or climbing
3	Playing	participating in a fun activity like playing with an object or non-aggressive fighting
4	Feeding	Consuming food
5	Fighting	Showing aggression with another individual, hitting, pulling tails, biting, scratching etc.
6	Scratching	Rubbing lightly, scraping or digging with nails and claws
7	Grooming	Cleaning other members of the cage
8	Auto-grooming	Cleaning oneself
9	Teasing	Mocking each other or visitors
10	Foraging	Searching for food
11	Defecating	Excreting scat and urine
12	Mating	Reproductive activity; sexual intercourse between male and female
13	Lactating	Female feeding their babies milk from their mammary glands
14	Self-biting	Biting own tail and limbs
15	Banging on the cage wall	Striking, pulling, hitting the enclosure walls

16	Masturbating	Stimulating the genitals with one hands for sexual pleasure
17	Calling	Making loud sounds
18	Begging	Soliciting food from visitors

Appendix 5: Questionnaire for visitors



A



B



C



D



E

vii. Extinct in the wild

viii. Extinct

5. Where is the habitat of the given animal?

- i. Tropical forest ii. Temperate forest iii. Tundra iv. Desert v. grassland

6. What is the feeding status of the animal?

- i. Carnivores ii. Herbivores iii. Omnivores

7. Can you describe any behavior of the animal?

After visit:

Animal: _____

1. Do you recognize the given animal in the picture?

- i. Yes ii. No

2. What is the common name of the animal?

3. What is the National protection status of the animal?

- i. They are protected by various conservation organizations and laws.
ii. They are not being conserved.
iii. No idea

4. What is the IUCN status of the given animal is?

- i. Don't know
ii. Least concerned
iii. Near threatened
iv. Vulnerable
v. Endangered

vi. Critically endangered

vii. Extinct in the wild

viii. Extinct

5. Where is the habitat of the given animal?

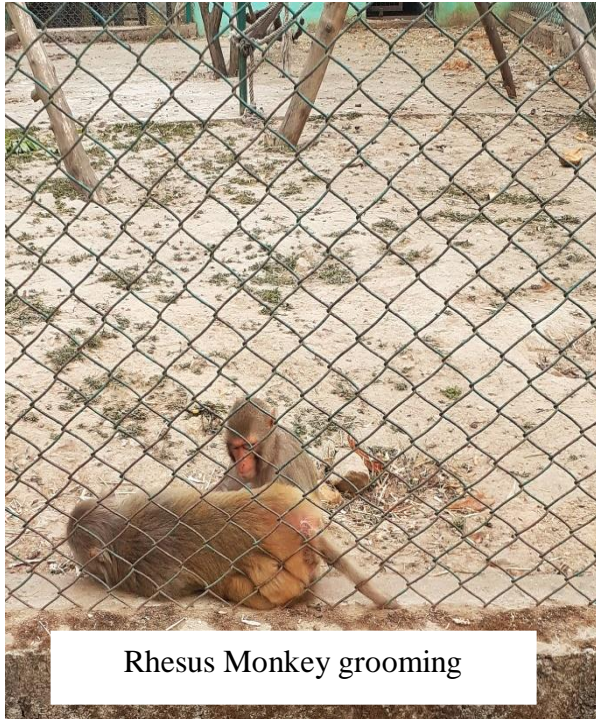
i. Tropical forest ii. Temperate forest iii. Tundra iv. Desert v. grassland

6. What is the feeding status of the animal?

i. Carnivores ii. Herbivores iii. Omnivores

7. Can you describe any behavior of the animal?

Appendix 6: Photo plates



Rhesus Monkey grooming



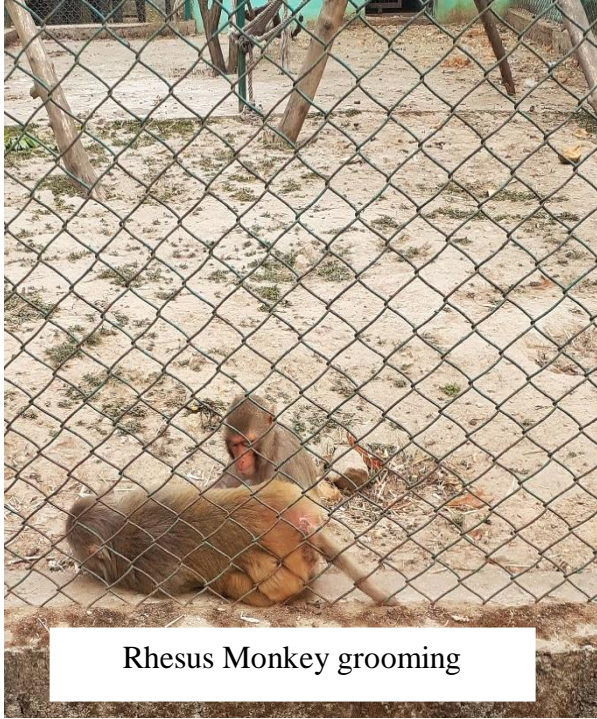
Vervet foraging



Siamang grooming



Vervet resting



Rhesus Monkey grooming



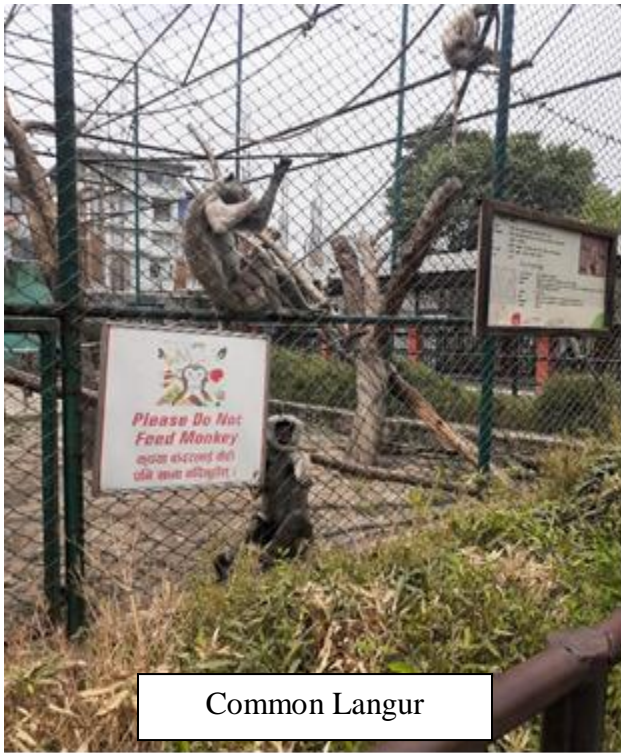
Vervet foraging



Siamang grooming



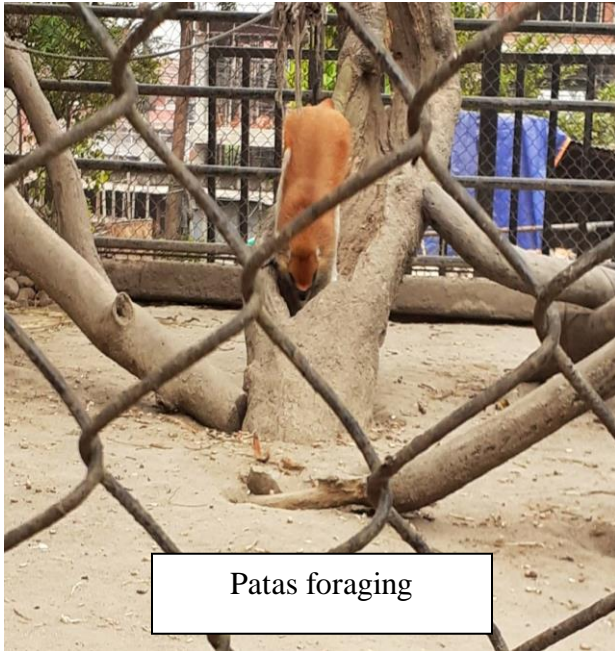
Vervet resting



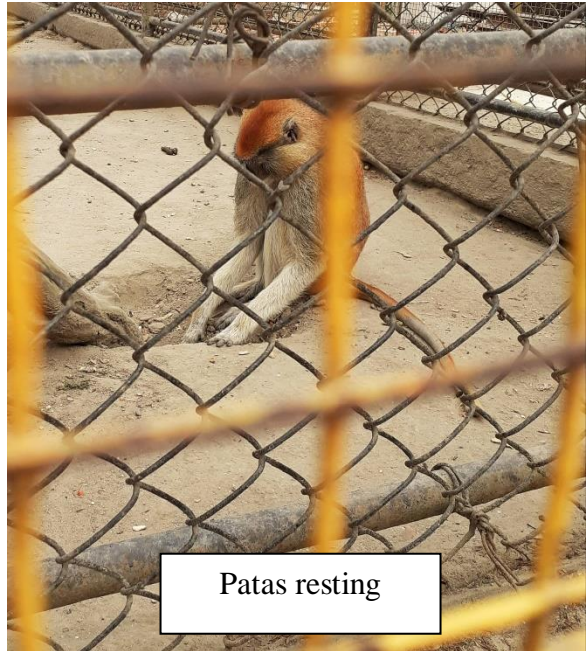
Common Langur



Common Langur grooming



Patas foraging



Patas resting



Photographs 2 : Questionnaire survey

