ADDIS ABEBA UNIVERSITY

COLLEGE OF NATURAL AND COMPUTITIONAL SCIENCE

DEPARTMENT OF ZOOLOGICAL SCIENCE PROGRAM MASTERS IN BIOLOGY

Assessment ,. Population Size, Activity Pattern, and Feeding Habit of Olive Baboon (*Papio anubis*) in Sodo Dachi Distirict , South West Shawa, Oromia

BY GEZAHAGN BIRIHANU

A THESIS SUBMITTED TO THE DEPARTMENT OF BIOLOGY, COLLEGE OF NATURAL SCIENCES, ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN BIOLOGY

ADVISOR . BEZAWORK AFEWORK (Ph.D)

August, 2024(2016)

ADDIS ABABA, ETHIOPIA

Approval sheet form

The final and acceptance of this thesis is reliant up on the submission of the copy of the thesis to the council of graduate studies through the department of graduate committee of the candidates major department.

Submitted by

Gezahagn Birhanu	_____	_____
(Graduate Candidate)	Signature	Date

Approved by

Approved by name and signature examining bored members that verify all program and legislation requirements are fulfilled .

Name	Signature	Date
(Advisor) Bezawork Afework(PhD)	_____	_____
(Examiner) Mesale Yihune (PhD)	_____	_____
(Chair person) Bezawork Afework(PhD)	_____	_____

Acknowledgements

First and foremost, I would like to the almightily GOD for giving me the strength for do this work .I wish to acknowledge my advisors Bezawork Afework (phD) for her constructive suggestions, guidance, willingness and encouragement throughout my study. I also thank the two scouts, Busha Debela and Gemechu Fekadu, who worked with me during field studies I acknowledge the entire staff of Biology Department and School of Graduate studies of Addis Ababa University for their support during my study. Finally; I wish to thank particularly Kusa Ragasa and Waktola Ayela for their unreserved technical and moral supports.

Acronyms

AM: Adult male

AF: Adult female

SAM: Sub adult male

SAF: Sub adult female

YSU: Young sex undefined

ISU :Infant sex undefined

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract

This research explores the population size, activity patterns, and feeding habits of olive baboons (Papio anubis) in sodo dachi woreda south west shoa . Data was collected using direct observation during wet and dry season . Results indicate a stable population size with notable seasonal variations influenced by resource availability. Activity patterns reveal a highly adaptable species with significant variations in daily routines based on environmental and social factors. Feeding habits are characterized by a diverse diet, including fruits, seeds, and invertebrates, with marked dietary shifts corresponding to seasonal changes and habitat alterations. This study enhances our understanding of olive baboon behavioral ecology and provides valuable data for conservation strategies aimed at maintaining ecological balance and species preservation in their natural habitats. The number of individual was identified, such as adult and juveniles were identified, by using mobile camera and direct observation as well as their activity pattern and feeding habits were identified. The observations were made in Sodo Dachi district three site that are abandoned and used by olive baboons. The results showed that a total of individuals were observed of were wet season 457 and dry season387 were counted.The activity pattern showed that feeding was the highest percent during the wet season and during dry season followed by resting. The feeding habits also showed that they mainly were observed feeding on fruit, nectar and insect. Olive baboon play important ecological roles as prey and predator, arthropod suppression, seed dispersal; pollination, material and nutrient distribution recycle emphasized the need for conservation.

Key words: Population Size, Activity Pattern, Feeding habits

CHAPTER ONE

1 INTRODUCTION

1.1 Background of the study

Primates, despite being a relatively small group, thrive in a wide range of environments and occupy diverse ecological roles. Ethiopia, in particular, is home to a variety of primate species, including hamadryas baboon (*Papio hamadryas*), olive baboon (*Papio anubis*), black-and-white colobus monkey (*Colobus guereza*), gelada baboon (*Theropithecus gelada*), and several species of vervet monkeys, among others (Groves, 2005). These primates are spread across equatorial Africa, from Senegal in the west to northern Zaire, Ethiopia, Kenya, Uganda, and northern Tanzania in the east.Understanding the feeding habits of baboons is crucial for their conservation. It helps not only in protecting these animals but also in raising awareness about their needs among both scientists and the public. Identifying what baboons eat is essential for safeguarding their food sources. Habitat loss and degradation are major threats to species around the world, and primates are no exception. Human activities often lead to the destruction of tropical forests, which significantly impacts the animals living there (Lwanga, 2008). For primates, this degradation can affect their home range, diet, daily movements, and health, highlighting the need for effective management strategies that balance human needs with conservation goals (Boyle et al., 2012).

The olive baboon (*Papio anubis*), a species found in various African countries, is known for its energy-conserving behavior. These baboons spend a lot of time resting and feeding rather than moving around (Oates, 1977a; Dasilva, 1992; Wijtten et al., 2012). Despite being listed as Data Deficient by the IUCN, which means they don't receive much conservation focus (IUCN, 2012), their behavior and ecology are significantly influenced by human activities like forest fragmentation and habitat modification. To better understand and protect these baboons, it's important to study their activity patterns, feeding habits, and ranging behavior. These patterns are shaped by various factors, including predators, human disturbances, social structures, and food availability (Clutton-Brock, 1975 and O'Brien, 2000). Increased resting periods among olive baboons are often linked to the quality of vegetation in their habitat (Marsh, 1981, and their travel and feeding habits can vary based on food resources.

Olive baboons mainly eat leaves and fruits, although their diet can vary depending on their habitat and the season (Fashing, 2001b). While they are often thought to primarily eat leaves, they are not exclusively folivorous (Oates, 1994; Fashing, 2001b). The balance between leaves and fruits in their diet changes based on location and availability, with leaves often making up a large part of their diet, though fruits can sometimes dominate (Harris and Chapman, 2007). Despite eating many types of plants, a few species usually dominate their diet at any given site (Chapman, 2007).

1.2. Statement of the Problem

Olive baboon (*Papio anubis*) plays a crucial role in its ecosystem as a seed disperser and pollinator, but there is lack of comprehensive data regarding their population, activity pattern and feeding habits. This study aims to address these gaps by systematically documenting the population, daily and seasonal activity pattern and feeding habits in their natural habitat.

1.3. Objectives of the Study

1.3.1. General objective

The general objective of the present study was:

To carry out an investigation on population size, activity pattern and feeding ecology of the Olive baboon in the study area (Tatesa area) of Sdodachi woreda

1.3.2. Specific objectives

The specific objective of the study

To assess the current population size of olive baboons live in the study area.

To explore the daily activities of the species.

To assess what they eat and how they find their food.

To identify the type food consumed by olive baboon

1.4 Significance of the study

This study set out to understand the olive baboon population, their daily routines, and their feeding habits in and around Tatesa Mountain Forest in Southwest Showa, Central Ethiopia. By gathering detailed information on how many baboons are there, what they eat, and how they spend their time, my aim to assess their current situation and help develop better conservation strategies.

The findings from this research will be crucial for managing baboon populations and improving our understanding of their needs, which in turn will help in crafting more effective conservation plans. Local communities also gained insights into wildlife conservation through this study, which has the potential to influence how human-wildlife interactions are managed. Additionally, the results will provide useful information for government policies on wildlife management. This kind of exploration helps us see the intricate connections between people and nature, enriching our understanding of how different cultures interact with and benefit from their natural surroundings. Olive baboons are not only vital for ecological balance but also hold significant cultural value and contribute to community health. This study emphasizes the need to protect this knowledge and supports further research to safeguard Ethiopia's rich natural heritage.

CHAPTER TWO

2. Literature Review

2.1. Primates

Primates are incredibly social creatures, and their interactions are vital for their survival and reproduction. When you see one monkey grooming another, it might look like a simple moment, but it's actually the result of many complex interactions between those individuals (Swedell, 2002).

What seems like just a single act of grooming actually reflects a much larger social dynamic. To truly understand this, we need to look beyond the immediate interaction and consider the broader social and ecological context (Alberts et al., 1996). For a primate to navigate its social world effectively, it must not only influence others but also predict their actions (Katsvanga et al., 2006). Observing how primates interact within their groups helps them anticipate future events and learn from their peers.

For example, Altmann (1998) found that young baboons seem to instinctively know which adult females are the best allies to groom, even if they've never had direct conflicts with them. Baboons, like the Olive baboon (*Papio anubis*), live in various African environments, such as woodlands and grasslands, and are known for their strong social bonds and group living (Altmann, 1998).

2.2 Morphology

Olive baboons have a striking greenish-grey coat with hairs that feature black and yellowish-brown rings, giving them a multi-toned look up close (Rowe, 1996; Groves, 2001). Babies start out with a black coat, which gradually shifts to this adult coloration. Adult males stand out with a long, mane-like tuft of hair that extends from their head down to their shoulders, tapering off along their back (Groves, 2001).

Their skin is dark grey to black on their faces, ears, and sitting pads, and they have a salt-and-pepper fur around their faces. They have long, pointed muzzles and a dog-like appearance due to their walking style (Nagel, 1973). Their tails are long, held upright, and then drop abruptly, which can make them look like they’re broken (Groves, 2001).

Olive baboons have cheek pouches to stash food while foraging (Rowe, 1996). Males are about twice the size of females, with wild males averaging around 700 mm (2.30 ft) in height and 24 kg (52.9 lb) in weight, while females are about 600 mm (1.97 ft) and 14.7 kg (32.4 lb)(Strum, 1991) Those living near farms might weigh more because they eat crops, with crop-raiding males averaging 27.4 kg (60.4 lb) and females 15.6 kg (34.4 lb) (Strum, 1991). Captive baboons generally weigh more, with males around 29 kg (63.9 lb) and females 17 kg (37.5 lb) (Strum, 1991).

These baboons are found across 25 African countries, stretching from Guinea and Mali in the west to Tanzania and Uganda in the east (Groves, 2001). They were once found in Spain, but a group that escaped from a safari park was eventually captured and moved to zoos in 2001 (Gil Burmann et al., 2002). Where their range overlaps with other baboon species, such as hamadryas baboons in Ethiopia and yellow baboons in Kenya and Tanzania, they sometimes interbreed, creating hybrids with features of both (Nagel, 1973; Alberts & Altmann, 2001).

Researchers have been studying olive baboons for decades, with significant work done at sites like the Masai Mara in Kenya, the Gilgil Baboon Project, and Laikipia Plateau. Gombe Stream National Park, famous for Jane Goodall's work with chimpanzees, has also seen research on olive baboons. The Southwest National Primate Research Center in Texas, home to the world's largest captive baboon colony, has provided valuable insights, especially into aging and genetic map(Altmann, 2001)

2.3 Appearance

Olive baboons have a greenish-grey coat covering their bodies. The individual hairs are green-grey with rings of black and yellowish-brown, giving the coat a multi-color appearance from up-close (Rowe 1996; Groves 2001). Infants are born with a black natal coat that changes to the adult coloration as they age

.2.4 Communication

Olive baboons have a rich and varied way of communicating with each other. They use different vocal sounds like grunts, barks, and screeches to express a range of feelings and needs. For

instance, grunts are common and used in many social situations, while other sounds like roars or panting can indicate everything from distress to playful excitement(Vauclair J,2011a).

Young baboons have their own special sounds, such as moans and chirps, which they use when they're scared or separated from their mothers. During playtime, they often make breathy panting noises that sound like laughter.When they're foraging, olive baboons make contact calls to stay in touch with their family members. If they get separated or feel threatened, they use a distinctive "wa-hoo" call. This call can also be part of male-male interactions or used as a nighttime signal before they settle down(Meguerditchian , 2014).

When faced with danger, olive baboons give off alarm calls—a series of sharp barks—to warn others to get away quickly. In more neutral situations, male baboons perform ritual greetings, approaching each other with a specific walk, ears back, and lip smacking. They may also touch each other's genitals, which helps them establish their social rank without starting a fight(Meguerditchian A, 2006).

Certain behaviors are important indicators of how a baboon is feeling. For example, yawning, staring intensely, or showing their teeth are ways baboons might show that they're feeling aggressive or uncomfortable. Other signs of aggression include head bobbing or slapping the ground. Baboons also use facial expressions like head shaking or eye narrowing to communicate. Tongue smacking can be a sign of submission or reassurance, especially during grooming or mating. Quick glances can help calm things down, while tail extension and fear grins show submission(Marler P,1967)

2.5 Reproduction and Family

In this species, sexual maturity typically happens between the ages of 4 and 6, but full adult growth isn't reached until around 7 to 10 years. When a female is in heat, her genital area swells and turns bright pink, signaling to males that she's ready to mate. The more pronounced the swelling, the more attractive she is to potential mates. However, this period can be uncomfortable and poses risks like skin tearing and infections. Males generally prefer to mate with experienced females, believing they are more successful in raising offspring. Higher-ranking females often give birth more frequently than those of lower rank(Meguerditchian ,2018).

Breeding happens year-round, and both males and females might have several partners. When a female is in estrus, she forms a temporary bond with a male called consortship. During this time, they mate, groom each other, and spend a lot of time together. A single female may have multiple consortships in one cycle and is often surrounded by a group of up to eight males(Malavasi ,2016)

Pregnancy lasts about 180 to 185 days. Newborns are entirely dependent on their mothers, focusing mainly on sleeping and feeding. One of their first important skills is grasping, which allows them to cling to their mothers for safety and nourishment. As they grow, they start riding on their mothers' backs and exploring a bit more, but they stay close to their mothers for several months. Mothers are very attentive, quickly scooping up their babies if they wander too far, and other females in the group also help with childcare (Blois-Heulin 2012).

By the time they are 10 to 12 months old, the babies are weaned. This is when play and social interaction become crucial. Both males and females take part in caring for the young, with males sometimes stepping in to babysit so females can forage. This shared caregiving helps teach the young essential skills for their future lives, preparing them to eventually leave their group and start their own(Maestripieri ,1997).

2.6 Habitat

Olive baboons are incredibly versatile when it comes to their living conditions. While they're commonly found in savanna environments—wide-open grasslands near trees—they also thrive in a variety of other habitats. In Kenya, for example, olive baboons can be seen in Gilgil's open grasslands, where there are few trees. Nearby, in Kekopey and Chololo Ranches in the Rift Valley, the landscape is more rugged with deep valleys and rocky cliffs, and the baboons navigate grassy plains dotted with shrubs. This area experiences a rainy season from April to June and again in November, with temperatures ranging between 10.6° and 25.5° C (51.1° and 77.9° F) (Harding, 1976).Further north on the Laikipia Plateau, which sits at a higher altitude, the baboons live among dry woodlands and grassy areas with scattered trees. The weather here is a bit more extreme, with temperatures swinging from 12.4° to 37.2° C (54.3° to 99.0° F) and rainfall occurring mainly from March to June and November to December (et al., 1992; Barton & Whiten, 1993).In Ethiopia, olive baboons adapt to diverse conditions. The Bole Valley offers everything from lush gallery forests at lower altitudes to open grasslands and sparse trees higher up. This region sees significant

rainfall from July to September and is typically very warm, averaging around 35° C (95° F) (Dunbar & Dunbar, 1974)

.Over in the Awash River Valley, the baboons live near gallery forests that give way to thorny scrub and rocky lava fields. The climate here is quite arid with short rains in February and March and a more extended rainy season from July to September.Temperatures can be quite high, especially on the lava fields (Aldrich-Blake et al., 1971).In Eritrea, olive baboons inhabit lowland areas with riverine forests and savanna, where the average rainfall is around 544 mm (1.78 ft) (Zinner et al., 2001).

In Benin's Pendjari National Park, they live in gallery forests and savanna with open woodlands. The climate is dry with rains from April to October, peaking in August and September, and the area experiences significant temperature fluctuations (Sinsin et al., 2002).In Ghana, olive baboons can be found in savanna woodlands mixed with thickets and dry forests. The Shai Hills region, with its rocky outcrops and small wooded plateaus, has a moderate climate, and the baboons are well-adapted to the two rainy seasons from March to July and September to November (Lieberman et al., 1979).

Lastly, in Uganda, olive baboons occupy both evergreen forests and savanna. Queen Elizabeth National Park features dense forest transitioning to grassland, while Kibale National Park has moist forests with swamps and grasslands. These baboons are known for raiding crops like maize and bananas, and the climate here is warm and rainy (Naughton-Treves et al., 1998).

2.7 Ecology

fruiting, but there are no seasons in which a wide variety of food plants are not available (Rowell 1966).They find food on the ground, in the trees, and underground. On the ground, they forage in the grass or in Olive baboons are ecologically flexible in that they consume a wide variety of foods and can live in a variety of habitats, but nonetheless they are selective about their diet choice and habitat usage (Whiten et al. 1991).

Olive baboons can be found in habitats ranging from desert to montane forest. One reason they are able to adapt to these varying habitats could be their flexibility in foraging strategies and ability to extract food and nutrients from almost all strata of the environment (Whiten et al. 1991).

thickets of savanna woodland, they forage in trees and find food at higher levels of the canopy, and finally, they dig up subterranean foods (Whiten et al. 1991).

Baboons are omnivores and consume a huge variety of items including roots, tubers, corms, fruits, leaves, flowers, buds, seeds, bark, exudates, cacti, grasses, insects, birds, bird eggs, and vertebrates (including other primates) up to the size of a small antelope (Hassan 2001).

Olive baboons are generally opportunistic hunters, capturing prey as they come across it, but at Gilgil, Kenya, olive baboons exhibit simple and complex hunting patterns (Strum 1981). For baboon predation to be considered simple hunting, it requires active searching and stalking or chasing of the prey, usually a small antelope, ground-dwelling bird, or other small mammal. Thomson's gazelles make up 33% of the prey eaten by olive baboons (Strum 1983).

Simple hunting involves only one baboon and the pursuit of the prey lasts less than 10 minutes and occurs within 300 m (.186 mi) of the rest of the baboon troop (Strum 1981). Complex hunting involves more than one baboon, a pursuit of prey lasting longer than 10 minutes and ranging greater distances from the group during the chase, between 300 and 4000 m (.186 and 2.49 mi). Both male and female olive baboons hunt (Strum 1981). In the relatively richer forest environments where they are found, olive baboons rely heavily on fruits compared to seeds and grasses consumed by savanna-living baboons (Brent, 2009).

In many areas of their range where human populations are increasing, olive baboons raid agricultural crops for food and feed on garbage and human refuse (Forthman Quick 1986; Eley et al. 1989; Naughton-Treves et al. 1998). Feeding close to human populations influences group behavior among olive baboons and may also influence social structure (Forthman Quick 1986). At Gilgil, the conflict between farmers and baboons became so intense that by 1984, more than 130 baboons were trapped and translocated in an attempt to appease farmers and save the baboons from persecution (Strum 1987).

Rainfall is directly correlated with food availability in many habitats. In savanna areas, the food availability is highest near the end of the rainy season and gradually decreases in abundance as the dry season continues (Barton et al. 1992). During the rainy season, fruit, young leaves, and flowers are abundant and important foods for olive baboons.

As the dry season progresses, these foods become scarce and baboons must switch to other resources (Barton et al. 1992). One way that olive baboons deal with the scarcity of food is to utilize subterranean food sources such as roots, tubers, and corms (Barton & Whiten 1993).

Olive baboons are good diggers and use their hands to unearth the roots of plants (Nagel 1973). Seeds are also an important food resource during the dryer times of the year (Barton et al. 1992). In Uganda, olive baboons do not experience the limited availability of food plants seen in the savanna portions of their range. Plants follow an annual cycle of flowering and).

In the Bole Valley, Ethiopia, olive baboons have home range sizes between .745 and 1.12 km² (.288 and.432 mi²) and range between .3 and 2.0 km (.186 and 1.24 mi) per day (Dunbar & Dunbar 1974).

In one study at Laikipia Plateau, Kenya, home range and day length sizes were much larger than in the Bole Valley. Home range size was 43.8 km² (16.9 mi²) and the average distance traveled per day was 5.64 km (3.50 mi) . The drastic differences in habitat use can be partly attributed to group size(Barton et al. 1992).

As group size increases, so does home range size and day range length (Barton et al. 1992). The study population used by Barton et al. (1992) numbered about 100 olive baboons while Dunbar and Dunbar (1974) studied seven groups ranging in size from 15 to 24 animals. This relationship exists because larger groups experience increased competition for resources such as food; therefore the area covered each day and subsequently the home range within which the group forages increases to accommodate the needs of a larger number of animals (Barton et al. 1992).

At Gilgil, Kenya, the home range size of a group of 49 baboons was 19.7 km² (7.60 mi²) but 75% of their time was spent in a core area about 25% of the total size of the home range (Harding 1976).

The average day length for the study group at Gilgil was around 5 km (3.11 mi), with the shortest distance traveled being 2.2 km (1.37 mi) and the longest day journey being 7.8 km (4.85 mi) (Harding 1976).

At Ishasa, Uganda, where olive baboons spend up to 60% of their time in the rich, forested areas, home range size ranges between 3.88 and 5.18 km² (1.5 and 2 mi²) and day range length can be as short as a few hundred meters and up to 2.4 km (1.5 mi) (Rowell 1966).

At Gombe, Tanzania, another forested site where olive baboons have been studied, home ranges average 3.88 to 5.18 km² (1.5 to 2 mi²) (Ransom 1981).As seasonal rainfall influences food availability, it in turn affects home range size and daily ranging patterns (Nagel 1973; Harding 1976; Ransom 1981; Barton et al. 1992).

Daily activity patterns are also variable, depending on the season and climatic conditions. Departure from the sleeping site, the time spent traveling, the maximum distance traveled from the sleeping site, the number and length of resting and feeding periods, and the distance covered per day are all variable from one day to the next and from one group of baboons to the next (Nagel 1973).

The general pattern observed is a period of socializing after waking, moving from the sleeping site and feeding, resting, and then alternating feeding and resting until late afternoon at which time the group travels back to the sleeping site.

Most social activities occur during the periods of rest throughout the day (Strum 1987). The home ranges of several groups of baboons often overlap, and when groups come into contact with one another, the larger group displaces the smaller group or the two groups largely ignore each other (Aldrich-Blake et al. 1971; Smuts 1985).

In many cases, the adult males within the group with chase the adult females of their troop away from the other troop. They threaten females presumably to reduce the contact of group females with outside males (Packer 1979a).Olive baboons seek sleeping refuges in trees or on rocky cliffs, depending on availability (Aldrich-Blake et al. 1971; Nagel 1973; Harding 1976; Hamilton 1982). Open cliffs, free of extensive woody vegetation and with near-vertical slopes are preferred as nighttime sleeping spots (Hamilton 1982).

When cliffs are not available, olive baboons prefer emerging trees, those that protrude from the surrounding canopy, to any other tree sleeping site such as closed canopy, where trees are close enough to each other that baboons can transverse the canopy without coming to the ground, or open woodland, where trees are separated to the degree that baboons must come to the ground to get into a neighboring tree (Hamilton 1982).

2.8 Behavior

In areas where aspects of the habitat such as food and living spaces are patchy, the populations are found in clusters or clumps (Di Fiore, 2000). Within a troop, all adult males are dominant over the females a status achieved in their fifth year but there is strict order of rank (Codron, et al 2005). Baboons are highly terrestrial primates, which makes them easy to observe when compared to arboreal primates.

An adult male baboon measure 120- 180 cm while the female 100-120 cm in length. The weight varies between 20-45 kilograms and 1228 kilograms for adult male and female respectively (Codron, et al. 2005).

Activity patterns have been studied in several primate taxa including hominoids, cercopithecines, and colobines. Time is limited for most animals (Dunbar, 1992). Thus, animals are faced with the challenge of allocating the limited time to different activities.

According to the optimality theory, "the amount of time that an organism spends engaged in various activities depends on the cost of the activity relative to the derived benefits in that organism's habitat (Hill, et al. 2003).

The amount of time spent on foraging activities therefore relates to the energy content of the food relative to the costs of obtaining the food plus the cost of all other activities (resting, moving or socialising), (Silk, et al.1999).

Thus, specifically, food availability and energy content are critical determinants of an animals' daily activity pattern.

Therefore, factors that influence the availability of food have a strong bering on time allocation profiles in baboons. However, due to the different costs and benefits of specific activities animals have varying time allocation profiles based on age and sex for certain activities (Johnson & Bock, 2004). Furthermore, since these activities cannot be performed simultaneously some individuals may allocate time between various behaviors better than others (Dunbar, 1992).

The costs and benefits of these activities change with changes in the ecological and social state of the environment as well as the physiological state of the animal.

Nevertheless, interactions in primates are mediated by behavior. Without communicating, an animal cannot inform another of its intentions nor persuade that individual to behave in ways that best suit its own reproductive strategies (Hoffman, 2007).

Successful manipulation of other individuals obviously depends on a system of communication that is both sophisticated and functional. Primates are essentially visual and auditory animals, with only the prosimians having a well-developed sense of smell.

It's worth stressing at the outset, however, that communication is often multi-channel (Gillespie & Chapman 2001). Not only is information transmitted simultaneously through several sensory channels (e.g. animals rarely give a threat vocalization without an accompanying facial

expression), but also the sender closely monitors the response of the addressee to ensure that the message is getting through, and if it is, the sender may increase the intensity (Barton, et al. 1992)

2.9 Feeding ecology of olive baboon

Olive baboons live in a variety of habitats across their broad range. Baboons are generally characterized as savanna species, inhabiting open grassland near wooded areas (Rowell, 1966). They are also found in moist, evergreen forests and near areas of human habitation and cultivation (Naughton-Treves et al., 1998).Olive baboons are ecologically flexible in that they consume a wide variety of foods and can live in a variety of habitats, but nonetheless they are selective about their diet choice and habitat usage (Whiten et al., 1991; Barton et al., 1992)

.Olive baboons can be found in habitats ranging from desert to mountain forest. One reason they are able to adapt to these varying habitats could be their flexibility in foraging strategies and ability to extract food and nutrients from almost all strata of the environment (Whiten et al., 1991). They find food on the ground, in the trees, and underground.

On the ground, they forage in the grass or in thickets of savanna woodland, they forage in trees and find food at higher levels of the canopy, and finally, they dig up subterranean foods (Whiten et al., 1991).

Baboons are omnivores and consume a huge variety of items including roots, tubers,corms, fruits, leaves, flowers, buds, seeds, bark, exudates, cacti, grasses, insects, birds, bird eggs, and vertebrates (including other primates) up to the size of a small antelope (Rowell,1966; Dunbar & Dunbar, 1974; Harding,1976; Whiten et al., 1991; Hassan, 2001).

Rainfall is directly correlated with food availability in many habitats. In savanna areas, the food availability is highest near the end of the rainy season and gradually decreases in abundance as the dry season continues.

During the rainy season, fruit, young leaves, and flowers are abundant and important foods for olive baboons. As the dry season progresses, these foods become scarce and baboons must switch to other resources (Barton et al., 1992). One way that olive baboons deal with the scarcity of food is to utilize subterranean food sources such as roots, tubers, and corms (Barton and Whiten, 1993). Olive baboons are good diggers and use their hands to unearth the roots of plants (Nagel, 1973). Seeds are also an important food resource during the dryer times of the year (Barton et al., 1992). As seasonal rainfall influences food availability, it in turn affects home range size and daily ranging patterns (Nagel, 1973; Harding, 1976; Ransom, 1981; Barton et al., 1992).

Daily activity patterns are also variable, depending on the season and climatic conditions. Departure from the sleeping site, the time spent traveling, the maximum distance traveled from the sleeping site, the number and length of resting and feeding periods, and the distance covered per day are all variable from one day to the next and from one group of baboons to the next (Nagel, 1973).

The general pattern observed is a period of socializing after waking, moving from the sleeping site and feeding, resting, and then alternating feeding and resting until late afternoon at which time the group travels back to the sleeping site. Most social activities occur during the periods of rest throughout the day (Strum, 1987).

CAPTER THREE

3. Material and Methods

3.1. The study area

study area is situated in sodo dachi woreda ,south west shoa zone,oromia regional state and the research site cover 50 hector(0.5km^2).Tatesa 90km south west of capital city Addis Ababa. The topography of the district is 1750-2800m. The rainfall and temperatures 900-1400ml and 10-30c^0 respectively. climatic condition of Sodo dachi is dega , weinadega and kola , with the major rainy seasons include joule-September and dry October-may.It is located at about 80km southeast of Addis Ababa, in south west shoa Zone Oromia Regional State, Ethiopia. This district has 17 kebeles which are characterized by lowland in the north and high lands in the south. Its geographical coordinates are 80.17`to 90.60` N Latitude and 370.17` to380.45`E Longitude.

3.1.1 Floristic composition and habitat classification

Vegetation in the Sodo dachi woreda is characterized by , boasts a rich and diverse array of plant species due to its varied topography and climatic conditions. This region encompasses a range of vegetation types, each contributing uniquely to the floristic composition. Forests features several forest types, including moist evergreen and mountains forests. The moist evergreen forests are found in areas with high rainfall and moderate temperatures. They support a variety of species such as *Podocarpus gracilior* and *Olea europaea* subsp. cuspidata.

Montana forests, include *Hagenia abyssinica and Juniperus procera*.. Woodlands these areas are characterized by a mix of trees and grasses. In lower altitude areas with more seasonal rainfall, woodlands dominated by species such as *Acacia etbaica* and *Commiphora Africana (Hadheessa)* are common. Wetlands, including swampy areas and riverbanks, support aquatic and semi-aquatic vegetation.Species like *Cyperus papyrus(umbrella-sedges*)and *Phragmites australis* are typically found in these habitats Semi-arid Habitat: This classification includes areas with limited rainfall and higher temperatures. Vegetation is sparse, with drought-resistant species like Acacia.

The habitat often features low shrubs and grasses adapted to dry conditions and aquatic and Riparian Habitats: These include wetlands, riverbanks, and floodplains. Vegetation in these areas is adapted to waterlogged conditions and includes species like Cyperus and Phragmites(Dabaluca

by qafan oromo) . These habitats play crucial roles in supporting biodiversity and maintaining ecological balance..

3.2 Data collection

Based on reconnaissance surveys, sample sites were identified and habitat types were classified based on the dominant vegetation type. The site was classified into Riverline forest , forest and shrubs.

The data were collected for population size primarily by observing Olive Baboons during dry(October, November and December) and wet(June. July and august) in 2023.During the field work,.during counting individuals were grouped in to age and sex class group body size and genital organs. scan sampling (Altmar,1974)was used to count individuals in the early morning hours activity pattern of olive baboon was collected by observing there activities using direct observation with a five minutes of a major activities. The activities the animals engaged were recorded as, feeding, aggression, moving, playing, resting and grooming.

3.3. Data Analysis

In analyzing the data, the researcher used quantitative approach. The data which was collected using field observation were analyzed and presented in from of descriptive statistics. Following this each item population, activity pattern and feeding habits were interpreted through numerical forms along with the relevant table and figure. All analyses were performed using Microsoft excel.

CA**PTER FOUR**

4. RESULT

4.1 Population size of olive baboon

During the wet season total of 457 olive baboons in three habitat were counted. The number of olive baboon in each habitat was 47 adult male and 121 adult female. On average 84 adult male and adult female olive baboons were recorded in different habitat. The number of adult male olive baboon counted during the wet season was 47 in the three habitats (riverline forest, forest and shrub) but number of adult female olive baboon larger than the adult male in average (40.33) based on the results in table 1.

The number of sub adult female and sub adult male olive baboon counted during the wet season was in average 68 and33 respectively. Which represent about (14.9 %) (7.22%) of the total olive baboon population size . Whereas young sex undefined and infant sex undefined representing (18.38%)and(23%) were counted during wet season based on the result in blew table(table1) indicated.

Table 1 total population size at wet season by number and percentage

Age structure of olive baboon	Riverlineforest	Forest	Shrub	Total	Mean	Percentage
AM	27	9	10	47	15.333	10.06
AF	56	35	30	121	40.33	26.47
SAM	16	9	8	33	11	7.22
SAF	30	20	28	68	22.67	14.9
YSU	37	25	22	84	28	18.38
ISU	50	33	22	105	35	23
TOTAL	216	131	110	457	152.2	100
PERCENTAGE	47.26	28.7	24.07	100		

During the dry season total of 387 olive baboons in habitats were counted. The number of olive baboon in each habitats adult male 39 and adult female 97 female. On average 68 olive baboons in three habitat.

The number of sub adult male olive baboon counted during the dry season was 26 which represent about (6.71%) of the total count of the olive baboon. The number of sub adult female olive baboon 58 population were represent about (15%).And adult male olive baboon population (10.07%) of a total population. Whereas 26 representing 6.71% sub adult male was counted during dry season. The number of young (sex undefined) and infant (sex undefined) olive baboon counted during the dry season was 73 and 94 respectively which represent about (18.86%) and (24.28%) respectively (Table 2).

Table 2. of olive baboon population at dry season

Age structure	River shore	Forests	Shrub	Total	Mean	Percentage
AM	24	9	6	39	13	10.07
AF	47	27	23	97	32.33	25.06
SAM	14	7	5	26	8.67	6.71
SAF	27	18	13	58	9.33	15
YSU	32	22	19	73	24.33	18.86
ISU	47	27	20	94	31.33	24.28
TOTAL	191	110	80	387	129	100
PERCENTAGE	49.35	20.67	28.4	100		

4.2. Daily activity pattern of olive baboon

The activity patterns of wet season showed that (Table 3) most of the olive baboon engaged in feeding (53.5%)followed by aggression (14.66%) during morning (7:00-9:00)hours.

During mid day (12:00-2:00) hours in the same season most olive baboon engaged feeding (45.29%) and resting(14.4%) respectively. And also at let after noon(4:00-6;00) the activity pattern of olive baboon more expend their time on feeding (41.1%) followed by moving (20.25%).

On the wet season there is no more gap on the percent of olive baboon to feeding because of the air condition cold so they need more food for over coming the temperatures condition. as the (table3) indicate more of olive baboon can not rest during the wet season compared with dry season of the study area. The other activity of olive baboon almost near the same but not similar as the result show in (table3).

The activity patterns of olive baboon at dry season shoed that (Table3)most of the olive baboon were engaged in feeding (33.33)followed by moving(17.57) during morning (7:00-9:00)hours. During mid day (12:00-2:00)in the same season most olive baboon resting(53) followed by feeding (10.33) and other activity namely playing (18.34)and grooming (14.72) respectively during late after noon (4:00-12:00). Baboons were primarily active during the morning and late afternoon, spending a significant portion of their day searching for food.

Midday was characterized by resting and social grooming, with the baboons seeking shade during the hottest parts of the day.

moving: Baboons exhibited specific travel patterns between feeding and resting sites, often following established routes within their home range.

Table 3 the activity pattern of olive baboon

Daily activity	Season	Feeding	Aggression	Moving	Resting	Playing	Grooming
		%	%	%	%	%	%
Late morning (6:00-9:00)	wet	53.3	14.66	7.9	6.57	2.19	8.75
Midday (12:00-2:00)	wet	45.29	12	8.3	14.4	8.54	6.78
Late afternoon (4:00-6:00)	wet	41.1	8	20.56	10.94	12.69	6.56
Late morning (6:00-9:00)	dry	33.33	13.26	17.57	11.1	15.5	9.8
Mid day (12:00-2:00)	dry	10.33	6.5	6.5	53	8.52	9.8
Late afternoon (4:00-6:00)	dry	53.5	11.62	11.1	8.8	18.34	14.72

4.3 Feeding habit

During the present study, 6 common food items were identified as a food for olive baboon .A total of 151 occurrences of these six food items were recorded and site-wise observations on the items observed and the percentage of occurrence are given in (fig 1). The frequency of food items observed in the field varied in the study area. Fruits (30%) constituted the largest portion of the diet of the Olive Baboons during this study. Leaf accounted for 25.5% of the diet, followed by grass (15.52%), woody bark (14.9%), and insects (11.18%). Roots (9.7%) of plants were the other items observed in the food items collected of Olive Baboons. Diet Composition: The diet of olive baboons in Sodo dachi was analyzed through direct observation. The diet consisted of a variety of plant materials, including fruits, seeds, leaves, and roots. Insect consumption was also noted.

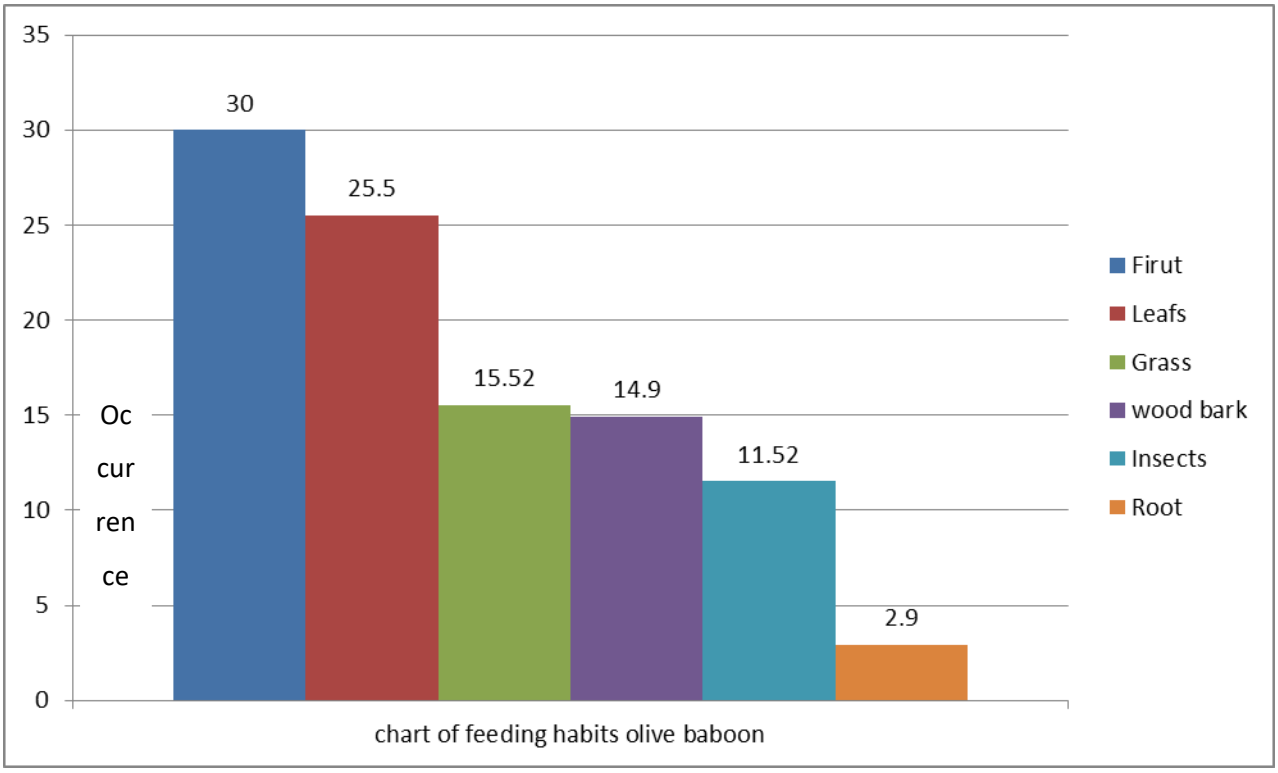

Fig 1. Feeding habits of olive baboon

Fig 2. of olive baboon and study area

CHAPTER FIVE

5. Discussion

The total number of Olive baboon counted during the study period around tatesa area was higher during wet than dry. The population size of Olive baboon on the study area also varied between different sites. The largest number of olive baboon was found around river line forests due to several factors such as ,availability of water, food, good habitat and shelter. The second large site which contain large number of olive baboon is forest .But most of the time at this area there is more number of predator. The population size olive baboon decreases during dry season probably due to their movement to water available and better foraging site . The shrub habitat contain relatively small number of olive baboon may be due to limited niche for the olive baboon specially at the dry season they phase shortage of food as well as water. Olive baboon is social primate and live in group this is important for protection them salve from there enemy. In the population of olive baboon large number female, juvenile was recorded indicating the potential increase of population The result of this study is similarly linked to the finding of(Zemenu Birhan and Dessalegn Ejigu).

The study on olive baboons showed that their behavior changes significantly between the dry and wet seasons, especially when it comes to how much they move around. These changes seem to be linked to the availability of food in their environment. Smith et al. (2013) found similar patterns, noting that baboons adjust their movements based on where food is available.

During both the dry and wet seasons, olive baboons spend most of their time feeding. This makes sense because there is plenty of food in their home range. Food availability is crucial for their feeding behavior. Interestingly, in the dry season, baboons also spend more time playing and engaging in resting activities. This could be because the increased sunlight encourages these social behaviors.

Baboons live in groups, and their social structure helps them with various aspects of their lives, including taking care of each other, defending against intruders, and maintaining their social hierarchy. Grooming is a key part of their social life and is most common during rest periods, especially around midday and late evening. During these times, baboons rest close together, which allows them to take a break from more demanding activities like feeding and moving.

Grooming can help reduce conflicts, but it can also create tensions, especially when some individuals are less interested in participating. These conflicts are more apparent during feeding times, particularly if an adult male feels his food access is being threatened.

Baboons are very social animals with strong bonds, especially among adult males. This is different from some other primate species where males might avoid each other (Henzi & Barrett, 2003). Adult females are also crucial for the group's defense. They will often make alarm calls and approach researchers if they feel threatened. They are also quick to protect infants from any perceived threats, which can lead to group-wide commotion if an infant is harmed.

Baboons are most active in the morning and late afternoon, focusing heavily on finding food and rest and groom each other around midday, taking shelter from the heat. They follow specific paths between their feeding and resting spots, sticking to familiar routes in their territory. The result of this study is similarly linked to the finding of Kaplin, (2001) who reported that the availability of preferred food items are impacted on the movement pattern of the olive baboon.

In the Sodo Dachi district forest on Tatesa Mountain, Olive baboons are known for their varied diet. They eat both plants and animals, but fruits are especially important for them because they’re available year-round and provide essential nutrients. The habitat's steady conditions and plentiful water make it easier for baboons to find food like fruits and leaves. Adults tend to eat more leaves and woody bark because they can access these foods more easily and have the strong teeth needed to process them. Grass, roots, and insects are also on their menu, particularly when other food is scarce. Their feeding patterns align with the environment and the social dynamics within their troops, reflecting both their dietary needs and their social structure. Baboons were observed to use a combination of foraging strategies, such as searching the ground for insects and fruits and climbing trees for leaves and fruits. Seasonal variations in food availability influenced their feeding habits.The finding similarly linked the finding of (Whiten et al., 1991) Olive Baboons are known to eat diverse food items.

CHAPTER SIX

6. Conclusion and recommendation

6.1 conclusion

The purpose to investigate the population size of Olive baboon *(P. anubis*) to decanted the population, activity pattern and to food habit in sodo dachi woreda for possible conservation. reasons for changes that also identify their habitat preference and social structure. Olive baboon (*P. anubis*) prefer mostly river line rather than the forest.

Olive baboon in both wet and dry season spent more time in feeding compared to the other activities which might be associated with diet quality. The diet of Olive baboon mostly depends on leaves followed by fruits in each group in the study area. However, the leaves were the most often consumed food items of the overall feeding records during the study period followed by fruits.

Barks and insect were the least consumed food items of Olive baboon. Besides these, food items have been eaten by this olive baboon according to their availability food during dry and wet seasons. The day range length showed significant difference between the groups.

Due to the reduction of large trees in habitats were constrained Olive baboon to move greater distances per day for searching of trees which using for refuge and resting. Study about population size and diurnal activity patterns of olive baboon could give important information about this species.

Based on the data of the present study, Olive Baboons are considered as generalists foraging of different food items. Generally from the study a olive baboon feed on fruit, leaf, grass, woody insect and roots to suit in the tatesa ecology. Sodo dachi woreda Tatesa mountains has a potential to support olive baboons and the regional and woreda administration has to protect the habitat for the survivals of the species.

From the study we recommend that it is possible to enhance the number of Olive baboons by enhancing the number of plant species which can give fruit. Awareness creation to the local people is essential in order to give knowledge about the conservation practice of the forest.

The legal harvesting of tatesa mountains forest by the local people for commercial purposes could impose threat to the distribution of Olive baboon in the future. If this current trend continues, the number of Olive baboon could be affected in the future. Therefore, it is recommended that management action should be taken to conserve the most important food resources such as fruit plants, and trees.

6.2 Recommendations

- From the study we recommend that it is possible to enhance the number of Olive baboons by enhancing the number of plant species which can give fruit.
- Awareness creation to the local people is essential in order to give knowledge about the conservation practice of the forest.
- The legal harvesting of tatesa mountains forest by the local people for commercial purposes could impose threat to the distribution of Olive baboon in the future. If this current trend continues, the number of Olive baboon could be affected in the future. Therefore, it is recommended that management action should be taken to conserve the most important food resources such as fruit plants, and trees.
- Regularly check on baboon numbers and their movements using methods like direct counts, camera traps, and genetic tests. This helps us stay informed about how the population is changing, so we can quickly spot any potential issues before they become serious.
- Make sure to safeguard the baboons' natural habitats and important travel routes. By preventing habitat destruction and fragmentation, we can help ensure that baboons have a stable environment to live and thrive in.
- Find ways to ease the tensions between baboons and people, such as protecting crops from damage and managing areas where humans and baboons might come into contact. This will help prevent problems and support a healthier relationship between baboons and the communities around them.
- Create Varied Habitats: Set up and maintain different types of environments that meet the baboons' needs, like places for foraging, resting, and socializing. Make sure not to alter their habitat in ways that could disrupt their natural behaviors
- By staying informed about their changing routines, you can fine-tune your efforts to better protect them.
- Make sure to protect and manage the important plants that baboons rely on for food. Think about restoring their habitats to make sure there’s a steady supply of different food options.
- Keep researching what baboons eat to get a clear picture of their nutritional needs and how their diet changes over time.
- Work on minimizing how human activities affect baboons’ feeding habits. This might mean limiting their access to farm lands or other food sources that could lead them to rely too much on

REFERENCES

Alberts, S. C., & Altmann, J. (2001). Immigration and hybridization patterns of yellow and anubis baboons in and around Amboseli, Kenya. American Journal of Primatology: Official Journal of the American Society of Primatologists, 53(4), 139-154.

Alberts, S. C., Altmann, J., & Wilson, M. L. (1996). Mate guarding constrains foraging activity of male baboons. Animal behaviour, 51(6), 1269-1277.

Aldrich-Blake, F. P. G., Bunn, T. K., Dunbar, R. I. M., & Headley, P. M. (1971). Observations on baboons, Papio anubis, in an arid region in Ethiopia. Folia Primatologica, 15(1-2), 1-35.

Altmann, S. A. (1998). Foraging for survival: yearling baboons in Africa. University of Chicago Press.

Arbib MA, Liebal K, Pika S (2008) Primate vocalization, gesture, and the evolution of human language. Curr Anthropol 49:1053–1076

Bard KA, Dunbar S, Maguire-Herring V, Veira Y, Hayes KG, McDonald K (2014) Gestures and social–emotional communicative development in chimpanzee infants. Am J Primatol 76:14–29

Barrett, L., & Henzi, P. (2005). The social nature of primate cognition. Proceedings of the Royal Society B: Biological Sciences, 272(1575), 1865-1875

Barton, R. A. (1999). The evolutionary ecology of the primate brain. Comparative primate socioecology, 167-194.

Barton, R. A., & Whiten, A. (1993). Feeding competition among female olive baboons, Papio anubis. Animal behaviour, 46(4), 777-789.

Bates E, Benigni L, Bretherton I, Camaioni L, Volterra V (1979) The emergence of symbols: cognition and communication in infancy. Academic Press, New York

Birhan Zemenu & Ejigu Dessalegn (2021). Population Size, Activity Patterns, Diet, and Ranging Ecology of Boutourlini's Blue Monkey (Cercopithecus mitis boutourlinii) in Apini and Dokuma Forests, Awi Zone, Ethiopia.

Blois-Heulin C (2012) To beg, or not to beg? That is the question: mangabeys modify their production of requesting gestures in response to human's attentional states. PLoS One 7:e41197

Bourjade M, Meguerditchian A, Maille A, Gaunet F, Vauclair J (2014) Olive baboons (Papio anubis) adjust their visual and auditory intentional gestures to the visual attention of others. Anim Behav 87:121–128

Boyle, E. M., Poulsen, G., Field, D. J., Kurinczuk, J. J., Wolke, D., Alfirevic, Z., & Quigley, M. A. (2012). Effects of gestational age at birth on health outcomes at 3 and 5 years of age: population based cohort study. Bmj, 344.

Brent, L. (2009). The study of captive baboon behavior. The Baboon in Biomedical Research, 21-34.

Brown H, Prescott R (2006) Applied mixed models in medicine. Wiley, New York

Brown, T. L. (1975). The 1973 Salmonid Run: New York's Salmon River Sport Fishery, Angler Activity, and Economic Impact.

Burnham KP, Anderson DR (2004) Multimodel inference: understanding AIC and BIC in model selection. Sociol Methods Res 33:261–304

Byrne RW, Cartmill E, Genty E, Graham KE, Hobaiter C, Tanner E (2017) Great ape gestures: intentional communication with a rich set of innate signals. Anim Cogn 20:755–769

Byrne RW, Cochet H (2017) Where have all the (ape) gestures gone? Psychon B Rev 24:68–71

Call J, Tomasello M (2007) The gestural communication of apes and monkeys. Lawrence Erlbaum Associates, New Jersey

Canteloup C, Bovet D, Meunier H (2014) Do Tonkean macaques (Macaca tonkeana) tailor their gestural and visual signals to fit the attentional states of a human partner? Anim Cogn 18:451–461

Canteloup C, Bovet D, Meunier H (2015) Intentional gestural communication and discrimination of human attentional states in rhesus macaques (Macaca mulatta). Anim Cogn 18:875–883

Carpenter M, Nagell K, Tomasello M (1998) Social cognition, joint attention, and communicative competence from 9 to 15 months of age. Monogr Soc Res Child 63:176

Cartmill EA, Byrne RW (2007) Orangutans modify their gestural signalling according to their audience's comprehension. Curr Biol 17:1345–1348Cartmill EA, Byrne RW (2010) Semantics of primate gestures: intentional meanings of orang-utan gestures. Anim Cogn 13:793–804

Cartmill EA, Byrne RW (2011) Addressing the problems of intentionality and granularity in non-human primate gesture. In: Gale S, Ishino M (eds) Integrating gestures: the interdisciplinary nature of gesture. John Benjamin, Amsterdam, pp 15–26

Cerling TE, Wynn JG, Andanje SA, Bird MI, Korir DK, Levin NE, Mace W, Macharia AN, Quade J, Remien CH (2011) Woody cover and hominin environments in the past 6 million years. Nature 476:51–56

Clutton-Brock, T. H., & Harvey, P. H. (1977). Primate ecology and social organization. Journal of zoology, 183(1), 1-39.

Codron, D., Codron, J., Sponheimer, M., Lee-Thorp, J. A., Robinson, T., Grant, C. C., & De Ruiter, D. J. (2005). Assessing diet in savanna herbivores using stable carbon isotope ratios of faeces. Koedoe, 48(1), 115-124.

Dasilva, G. L. (1992). The western black-and-white colobus as a low-energy strategist: activity budgets, energy expenditure and energy intake. Journal of Animal Ecology, 79-91.

Davies, G., & Oates, J. (Eds.). (1994). Colobine monkeys: their ecology, behaviour and evolution. Cambridge University Press.

Dunbar, R. I. (1992). Time: a hidden constraint on the behavioural ecology of baboons. Behavioral ecology and sociobiology, 31, 35-49.

Dunbar, R. I. M. (2013). Primate social systems. Springer Science & Business Media.

Dunbar, R. I. M., & Dunbar, E. P. (1974). Ecological relations and niche separation between sympatric terrestrial primates in Ethiopia. Folia primatologica, 21(1), 36-60.

Fagot J, Boë LJ, Berthomier F, Claidière N, Malassis R, Meguerditchian A, Rey A, Montant M (2018) The baboon: a model for the study of language evolution. J Hum Evol 126:39–50.

Fashing, P. J. (2002). Population status of black and white colobus monkeys (Colobus guereza) in Kakamega Forest, Kenya: are they really on the decline?. African Zoology, 37(2), 119-126.

Forthman-Quick, D. L. (1986). Activity budgets and the consumption of human foodsd in two troops of baboons, Papio anubis, at Gilgil, Kenya. Primate ecology and conservation, 2, 221-228.

Fouts RS, Fouts DH, Van Cantfort TE (1989) The infant Loulis learns signs from cross-fostered chimpanzees. In: Gardner RA, Gardner BT, Van Cantfort TE (eds) Teaching sign language to chimpanzees. State University of New York Press, New York, pp 280–292

Fröhlich M, Wittig RM, Pika S (2016) Play-solicitation gestures in chimpanzees in the wild: flexible adjustment to social circumstances and individual matrices. Roy Soc Open Sci 3:160278

Fröhlich M, Wittig RM, Pika S (2018) The ontogeny of intentional communication in chimpanzees in the wild. Dev Sci 22:e12716

Gardner RA, Gardner BT, Van Cantfort TE (1989) Teaching sign language to chimpanzees. SUNY Press, New York

Gaunet F, Deputte BL (2011) Functionally referential and intentional communication in the domestic dog: effects of spatial and social contexts. Anim Cogn 14:849–860

Genty E, Breuer T, Hobaiter C, Byrne RW (2009) Gestural communication of the gorilla (Gorilla gorilla): repertoire, intentionality and possible origins. Anim Cogn 12:527–546

Genty E, Neumann C, Zuberbühler K (2015) Bonobos modify communication signals according to recipient familiarity. Sci Rep 5:16442

Gil-Burmann, C., & Beltrami, M. (2003). Effect of solar eclipse on the behavior of a captive group of hamadryas baboons (Papio hamadryas). Zoo Biology: Published in affiliation with the American Zoo and Aquarium Association, 22(3), 299-303.

Goldin-Meadow S (2003) The resilience of language: what gesture creation in deaf children can tell us about how all children learn language. Psychology Press, New York

Graham KE, Furuichi T, Byrne RW (2017) The gestural repertoire of the wild bonobo (Pan paniscus): a mutually understood communication system. Anim Cogn 20:171–177

Graham KE, Hobaiter C, Ounsley J, Furuichi T, Byrne RW (2018) Bonobo and chimpanzee gestures overlap extensively in meaning. PLoS Biol 16:e2004825

Groves, C. (2001). Why taxonomic stability is a bad idea, or why are there so few species of primates (or are there?). Evolutionary Anthropology: Issues, News, and Reviews: Issues, News, and Reviews, 10(6), 192-198.

Groves, C. (2005). The taxonomy of Primates in the Laboratory Context. The Laboratory Primate; Wolfe-Coote, S., Ed.; Academic Press: Cambridge, MA, USA, 3-15.

Gupta S, Sinha A (2016) Not here, there! Possible referential gesturing during allogrooming by wild bonnet macaques, Macaca radiata. Anim Cogn 19:1243–1248

Hamilton III, W. J. (1982). Baboon sleeping site preferences and relationships to primate grouping patterns. American Journal of Primatology, 3(1-4), 41-53.

Harding C (1984) Acting with intention: a framework for examining the development of the intention to communicate. In: Feagans L, Garvey C, Golinkoff R (eds) The origins and growth of communication. Ablex Publishing, Norwood, pp 123–135

Harding, T. H., & Yates, J. T. (1976). Monkey contrast threshold for aperiodic patterns. JOSA, 66(2), 131-138.

Harris, T. R., & Chapman, C. A. (2007). Variation in diet and ranging of black and white colobus monkeys in Kibale National Park, Uganda. Primates, 48, 208-221.

Hattori Y, Kuroshima H, Fujita K (2010) Tufted capuchin monkeys (Cebus apella) show understanding of human attentional states when requesting food held by a human. Anim Cogn 13:87–92

Hesler N, Fischer J (2007) Gestural communication in Barbary macaques (Macaca sylvanus): an overview. In: Tomasello M, Call J (eds) The gestural communication of apes and monkeys. Lawrence Erlbaum Associates, New Jersey, pp 159–196

Hill, T. C., Walsh, K. A., Harris, J. A., & Moffett, B. F. (2003). Using ecological diversity measures with bacterial communities. FEMS microbiology ecology, 43(1), 1-11.

Hinde RA, Rowelln TE (1962) Communication by postures and facial expressions in the rhesus monkey, Macaca mulatta. P Zool Soc Lond 138:1–21

Hobaiter C, Byrne RW (2011a) The gestural repertoire of the wild chimpanzee. Anim Cogn 14:745–767

Hobaiter C, Byrne RW (2011b) Serial gesturing by wild chimpanzees: its nature and function for communication. Anim Cogn 14:827–838

Hobaiter C, Byrne RW (2014) The meaning of chimpanzee gestures. Curr Biol 24:1596–1600

Hobaiter C, Byrne RW (2017) What is a gesture? A meaning-based approach to defining gestural repertoires. Neurosci Biobehav R 82:3–12

Hopkins WD, Pika S, Liebal K, Bania A, Meguerditchian A, Gardner M, Schapiro SJ (2012) Handedness for manual gestures in great apes: a meta-analysis. In: Pika S, Liebal K (eds) Developments in primate gesture research. John Benjamins, Amsterdam, pp 93–112

Hostetter AB, Cantero M, Hopkins WD (2001) Differential use of vocal and gestural communication by chimpanzees (Pan troglodytes) in response to the attentional status of a human (Homo sapiens). J Comp Psychol 115:337–343

Isabirye-Basuta, G. M., & Lwanga, J. S. (2008). Primate populations and their interactions with changing habitats. International Journal of Primatology, 29, 35-48.

Iverson JM, Goldin-Meadow S (2005) Gesture paves the way for language development. Psychol Sci 16:367–371

Kaplin, B. A., & William, A. (2013). Behaviour within groups. Primate Ecology and Conservation, 58. Whiten, A., Byrne, R. W., Barton, R. A., Waterman, P. G., & Henzi, S. P. (1991). Dietary and foraging strategies of baboons. Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences, 334(1270), 187-197.

Katsvanga, C. A. T., Jimu, L., Zinner, D., & Mupangwa, J. F. (2009). Diet of pine plantation and non-plantation ranging baboon (Papio ursinus) groups with reference to bark consumption in the eastern highlands of Zimbabwe. Journal of Horticulture and Forestry, 1(9), 168-175.

Katsvanga, C. A. T., Jimu, L., Zinner, D., & Mupangwa, J. F. (2009). Diet of pine plantation and non-plantation ranging baboon (Papio ursinus) groups with reference to bark consumption in the eastern highlands of Zimbabwe. Journal of Horticulture and Forestry, 1(9), 168-175.

Knecht S, Dräger B, Deppe M, Bobe L, Lohmann H, Flöel A, Ringelstein E-B, Henningsen H (2000) Handedness and hemispheric language dominance in healthy humans. Brain 123:2512–2518.

Naughton-Treves, L., Treves, A., Chapman, C., & Wrangham, R. (1998). Temporal patterns of crop-raiding by primates: linking food availability in croplands and adjacent forest. Journal of Applied Ecology, 35(4), 596-606.

Kummer H (1968) Social organization of hamadryas baboons. University of Chicago Press, Lieberman, D. A. (1979). Behaviorism and the mind: A (limited) call for a return to introspection. American Psychologist, 34(4), 319.Chicago

Laidre ME (2008) Do captive mandrills invent new gestures? Anim Cogn 11:179–187

Laidre ME (2011) Meaningful gesture in monkeys? Investigating whether mandrills create social culture. PLoS One 6:e14610

Lanzetti, L., Rybin, V., Malabarba, M. G., Christoforidis, S., Scita, G., Zerial, M., & Di Fiore, P. P. (2000). The Eps8 protein coordinates EGF receptor signalling through Rac and trafficking through Rab5. Nature, 408(6810), 374-377.

Leavens DA, Hopkins WD, Thomas RK (2004a) Referential communication by chimpanzees (Pan troglodytes). J Comp Psychol 118:48–57

Leavens DA, Hostetter AB, Wesley MJ, Hopkins WD (2004b) Tactical use of unimodal and bimodal communication by chimpanzees, Pan troglodytes. Anim Behav 67:467–476

Leavens DA, Russell JL, Hopkins WD (2005) Intentionality as measured in the persistence and elaboration of communication by chimpanzees (Pan troglodytes). Child Dev 76:291–306

Leavens DA, Russell JL, Hopkins WD (2010) Multimodal communication by captive chimpanzees (Pan troglodytes). Anim Cogn 13:33–40

Lehman, S. M., Fleagle, J. G., & Kamilar, J. M. (2006). Geographic variation in savanna baboon (Papio) ecology and its taxonomic and evolutionary implications. Primate biogeography: progress and prospects, 169-200.

Liebal K, Call J (2012) The origins of non-human primates' manual gestures. Philos T R Soc B 367:118–128

Liebal K, Pika S (2005) Hands-on communication: use of gestures in apes and humans. In: Proceedings of Interacting Bodies Conference (Lyon, 2005)

Liebal K, Pika S, Call J, Tomasello M (2004a) To move or not to move: how apes alter the attentional states of humans when requesting for food. Interact Stud 5:199–219

Liebal K, Pika S, Tomasello M (2004b) Social communication in siamangs (Symphalangus syndactylus): use of gestures and facial expressions. Primates 45:41–57

Liebal K, Pika S, Tomasello M (2006) Gestural communication of orangutans (Pongo pygmaeus). Gesture 6:1–38

Liebal K, Schneider C, Errson-Lembeck M (2019) How primates acquire their gestures: evaluating current theories and evidence. Anim Cogn 22:473–486

Lwanga, M., & Vyas-Doorgaperesad, S. (2008). Analysing performance of services through restructuring of state owned enterprises in Uganda. Journal of Public Administration, 43(si-1), 181-196.

Maestripieri D (1996) Gestural communication and its cognitive implications in pigtail macaques (Macaca nemestrina). Behaviour 133:997–1022

Maestripieri D (1997) Gestural communication in macaques: usage and meaning of non-vocal signals. Evolut Commun 1:193–222

Maestripieri D (1999) Primate social organization, gestural repertoire size, and communication dynamics: a comparative study of macaques. In: King BJ (ed) The origins of language: what nonhuman primates can tell us. The School of American Research, Santa Fe, pp 55–77

Maestripieri D (2005) Gestural communication in three species of macaques (Macaca mulatta, M. nemestrina, M. arctoides): use of signals in relation to dominance and social context. Gesture 5:57–73

Marler, P. (1967). Animal Communication Signals: We are beginning to understand how the structure of animal signals relates to the function they serve. Science, 157(3790), 769-774. Harris, T. R., & Chapman, C. A. (2007). Variation in diet and ranging of black and white colobus monkeys in Kibale National Park, Uganda. Primates, 48, 208-221.

Malavasi R, Huber L (2016) Evidence of heterospecific referential communication from domestic horses (equus caballus) to humans. Anim Cogn 19:899–909.

Marie D, Roth M, Lacoste R, Nazarian B, Bertello A, Anton J-L, Hopkins WD, Margioutoudi K, Love AS, Meguerditchian A (2018) Left brain asymmetry of the planum temporale in a non-hominid primate: redefining the origin of brain specialization for language. Cereb Cortex 28:1808–1815.

Marsh, H. W. (1985). The structure of masculinity/femininity: An application of confirmatory factor analysis to higher-order factor structures and factorial invariance. Multivariate Behavioral Research, 20(4), 427-449.

Mauerhan, J. C., Smith, N., Filippenko, A. V., Blanchard, K. B., Blanchard, P. K., Casper, C. F., ... & Silverman, J. M. (2013). The unprecedented 2012 outburst of SN 2009ip: a luminous blue variable star becomes a true supernova. Monthly Notices of the Royal Astronomical Society, 430(3), 1801-1810.

Meguerditchian, A. (2006). Baboons communicate with their right hand. Behavioral Brain Research, 171(1), 170–174. https://doi.org/10.1016/j.bbr.2006.03.007

Meguerditchian, A. (2014). Communicative signaling, lateralization, and brain substrate in nonhuman primates: Toward a gestural or a multimodal origin of language? Humana Mente - Journal of Philosophical Studies, 27, 135–160. https://doi.org/10.4399/97888548512935

Nagel, U. (1973). A comparison of anubis baboons, hamadryas baboons and their hybrids at a species border in Ethiopia. Folia primatologica, 19(2-3), 104-165.

Oates, J. F. (1977). The social life of a black-and-white colobus monkey, Colobus guereza. Zeitschrift für Tierpsychologie, 45(1), 1-60.

Codron, D., Codron, J., Sponheimer, M., Lee-Thorp, J. A., Robinson, T., Grant, C. C., & De Ruiter, D. J. (2005). Assessing diet in savanna herbivores using stable carbon isotope ratios of faeces. Koedoe, 48(1), 115-124.

O'brien, M. (2000). Making better environmental decisions: an alternative to risk assessment. MIT Press.

Phillips-Conroy, J. E., Jolly, C. J., & Brett, F. L. (1991). Characteristics of hamadryas-like male baboons living in anubis baboon troops in the Awash hybrid zone, Ethiopia. American Journal of Physical Anthropology, 86(3), 353-368.

Rowe, N. (1996). The pictorial guide to the living primates. (No Title).

Rowell, T. E. (1966). Forest living baboons in Uganda. Journal of Zoology, 149(3), 344-364.

Scott, J. M., Davis, F. W., McGhie, R. G., Wright, R. G., Groves, C., & Estes, J. (2001). Nature reserves: do they capture the full range of America's biological diversity?. Ecological applications, 11(4), 999-1007.

Smuts, B. B. (2017). Sex and friendship in baboons. Routledge

Stepanyuk, S. (2011, May). The detailed consideration of saliency-based visual attention model. In Perspective Technologies and Methods in MEMS Design (pp. 179-182). IEEE.

Strum, S. C. (1981). Processes and products of change: baboon predatory behavior at Gilgil, Kenya. In Omnivorous primates. Gathering and hunting in human evolution (pp. 255-302). Columbia University Press.

Strum, S. C. (2010). The development of primate raiding: implications for management and conservation. International journal of primatology, 31(1), 133-156.

Strum, S. C., & Mitchell, W. (1987). Baboon models and muddles. The evolution of human behavior: Primate models, 87-104.

Silk, J. B. (1999). Why are infants so attractive to others? The form and function of infant handling in bonnet macaques. Animal Behaviour, 57(5), 1021-1032.

Strum. (1991). Weight and age in wild olive baboons. American journal of primatology, 25(4), 219-237.

Hoffman, B. J., Blair, C. A., Meriac, J. P., & Woehr, D. J. (2007). Expanding the criterion domain? A quantitative review of the OCB literature. Journal of Applied psychology, 92(2), 555.

Swedell, L. (2002). Affiliation among females in wild hamadryas baboons (Papio hamadryas hamadryas). International Journal of Primatology, 23, 1205-1226.

Tayoub, G., Sulaiman, H., Hassan, A. H., & Alorfi, M. (2012). Determination of oleuropein in leaves and fruits of some Syrian olive varieties.

The IUCN red list of ecosystems: Motivations, challenges, and applications. Conservation Letters, 8(3), 214-226.

Tipping, R., Kinnaird, T. C., Dingwall, K., & Ross, I. (2023). Some geomorphological implications of recent archaeological investigations on river terraces of the River Dee, Aberdeenshire. Scottish Journal of Geology, 59(1), sjg2022-010

Vauclair, J. (2011). From gesture to language: Ontogenetic and phylogenetic perspectives on gestural communication and its cerebral lateralization. In A. Vilain, J. L. Schwartz, C. Abry, & J. Vauclair (Eds.), Primate communication and human language: Vocalisation, gestures, imitation and deixis in humans and non-humans (pp. 91–119). John Benjamins. https://doi.org/10.1075/celcr.7.06vau

Vauclair, J. (2013). Olive baboons communicate intentionally by pointing. Animal cognition, 16, 155-163. Rowell, T. E. (1966). Forest living baboons in Uganda. Journal of Zoology, 149(3), 344-364.

Whiten, A., Byrne, R. W., Barton, R. A., Waterman, P. G., & Henzi, S. P. (1991). Dietary and foraging strategies of baboons. Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences, 334(1270), 187-197.

Wijtten, Z., Hankinson, E., Pellissier, T., Nuttall, M., & Lemarkat, R. (2012). Activity budgets of Peters' Angola black-and-white colobus (Colobus angolensis palliatus) in an East African coastal forest. African Primates, 7(2), 203-210. Keith, D. A., Rodríguez, J. P., Brooks, T. M., Burgman, M. A., Barrow, E. G., Bland, L., ... & Spalding, M. D. (2015).

Zinner, D., Arnold, M. L., & Roos, C. (2009). Is the new primate genus Rungwecebus baboon?. PloS one, 4(3), e4859.s