

Primary article

Smith, L. W., Link, A., & Cords, M. (2008). Cheek pouch use, predation risk, and feeding competition in blue monkeys (*Cercopithecus mitis stuhlmanni*). *American Journal of Physical Anthropology*, 137(3), 334–341. <https://doi.org/10.1002/ajpa.20879>

Summary: Before the findings of this article, it was known that cheek pouch behaviour was a distinct trait for cercopithecine monkeys and were used to temporarily store food and begin the process of digesting the food. Smith et al. (2008) acknowledges that previously the adaptive function of cheek pouches remains largely unresolved. This article is investigating the role and functions of cheek pouch behaviour in blue monkey, *Cercopithecus mitis stuhlmanni*. Smith et al. (2008) explored two hypotheses for this behaviour-cheek pouch reduces predation vulnerability and cheek pouch reduces competition between species. This article will explore possible functions of cheek pouch. Methods used to determine which of the two hypotheses is more accurate include comparing the vulnerability to predators when filling and emptying cheek pouches by using samples of both occurring and getting an average of vulnerability scores and comparing it to the Wilcoxon Matched Pairs Signed Ranks test. The results supported the hypothesis that cheek pouches reduce predation by limiting exposure and found that cheek pouch use did not vary in use whether a diet of fruit or leaves thus had very little support for the second hypothesis of the competition reduction function of the cheek pouch. This article is significant because one of the functions of cheek pouch (which is to reduce exposure of the prey by predators while feeding on a food source, so the prey can go to an area with little to no exposure to finish feeding on the food source) is now known function of cheek pouch use. Further questions and studies are highlighted by the article as it stated the frequency of use of cheek pouch decreased with age thus exploring the reasons why this would occur.

Contribution: This article was chosen to be part of my literature review because it is one of the few recent articles that explores the topic of cheek pouch in depth. This article advanced my knowledge of this behaviour as it provided numerical evidence of the reasons and functions of the cheek pouch. The article did arise questions such as why cheek pouch behaviour decreases and the differences of the amount of usage between males and females. The article provided critical background information on blue monkey behaviours such as the tree locations as which is the safest with less exposure area.

Cords, M., & Chowdhury, S. (2010). Life history of *Cercopithecus mitis stuhlmanni* in the Kakamega forest, Kenya. *International Journal of Primatology*, 31(3), 433–455. <https://doi.org/10.1007/s10764-010-9405-7>

Summary:

Before the findings of this article, it was known that the size and composition of social groups are influenced by life history and demographic processes. Primates generally have slow life histories compared to other mammals. This is due to high energetic cost of having a large brain and having usually arboreal lifestyle (primates that live in more open habitats have faster life histories and primates who live in tropical rain forest have slower life histories). It is also previously known that the major selective pressures on life history evolution is environmental variability and ecologically determined variation in mortality. The objective of the article is to determine if there is an importance and correlation of mortality patterns in predicting fast versus slow life histories in primates. Methods used include monitoring a focal population and comparing to other population, also collecting data in the 29-year period of all birth, death, disappearances, and emigration of the population. Researchers calculated survival and fertility rates using an age-specific survivorship and fecundity rates. The results found that it was not possible to assess adult mortality to compare the life histories as the mortality data was not available but found that factors such as differential food availability, predation pressures and disease that does affect life history variables. With the data of the article, it was concluded in the article that blue monkeys do appear to have notable slow life history than other primates. This article is significant because through the comparison of several data, the article does confirm that blue monkey has a slow life history which is critical to furthermore investigate the behaviours of these species including the use of cheek pouch. Further studies can investigate better methods in examining adult mortality so it would be easier to collect these data information.

Contribution:

This article was chosen because it would give me appropriate level of background information that I would need to know on blue monkey that is related to the behaviour I am investigating (foraging/ cheek pouch). The article advances the knowledge to the field because it confirmed other studies and articles that blue monkey have slower life histories than other primates. This article does provide critical context and background information including age at first birth, infant survival, and longevity and provided a life table for female blue monkeys. Questions including finding a better method to track adult mortality in blue monkeys.

Tweheyo, M., & Obua, J. (2001). Feeding habits of chimpanzees (*Pan troglodytes*), red-tail monkeys (*Cercopithecus ascanius schmidtii*) and blue monkeys (*Cercopithecus mitis stuhlmanii*) on figs in Budongo Forest Reserve, Uganda. *African Journal of Ecology*, 39(2), 133–139. <https://doi.org/10.1046/j.1365-2028.2001.00290.x>

Summary:

Before the findings of this article, it was known that during dry periods when food sources are the scarcest, chimpanzees, monkeys, and birds feed on figs as a major food source. The article will explore chimpanzees, red-tail and blue monkey's feeding habits on fig trees. Two hypothesis of the article that were tested was primate eat more fruit from figs than leaves from figs and the other hypothesis is that the availability of fig fruits and leaves does influences the feeding patterns of primates. Methods include selecting focal *Ficus* species and using past methods to assess the actives of the primates on the fig trees including primate group size and time duration. The article selected random species and recorded their various activities throughout the day such as feeding, socializing, or resting. The findings included that primate spent more time on fruits composition than leaves. This is evident by the data report that more than 80% of the feeding time was used to feed on fruits especially ripe ones. These results prove the first hypothesis of fig tree species were important to primates because of its fruit and not because of it's leaves. It was also found that fruit availability influenced group size and time of day primate's feed. This proves the second hypothesis to be true. These findings are significant because it emphasizes the importance to conserve of the fig species, the major food source for primates and to overall conserve tropical forest inhabited by primates. The article found no foraging actives for a specific fig species, but previous article found that primates do eat the fruit of that same specific fig specie therefore future research should investigate include why does these two contradicting findings exist?

Contribution:

This article was chosen because it thoroughly explains the feeding habitats of the blue monkey. The article explains how food source availability influences group size. The article provides key context and background information needed to understand to read future articles pertaining to this topic. The article further advances the knowledge of the field especially for conservation efforts for the fig species which conserves the primates that feed on the fig species as well.

Fairgrieve, C., & Muhumuza, G. (2003). Feeding ecology and dietary differences between blue monkey (*Cercopithecus mitis stuhlmanni* Matschie) groups in logged and unlogged forest, Budongo Forest Reserve, Uganda. *African Journal of Ecology*, 41(2), 141–149. <https://doi.org/10.1046/j.1365-2028.2003.00407.x>

Summary:

Previous studies have investigated the effects of logging and timber extraction have negatively affected the wildlife however other data have showed that logging at appropriate and controlled levels, may have conservation value. Many other previous studies have reported there have been lower primate densities in logged forest compared to unlogged forest but there also has been other studies that have reported the exact opposite. The study of this article is to test the hypothesis that there is difference in feeding ecology of *Cercopithecus mitis stuhlmanni* between logged and unlogged forest. Methods used include taking two groups of *C. mitis* were habituated and studied at a logged forest and unlogged forest sites where feeding scores, tree species, and food item code were recorded. These were compared between groups for the whole study period. The major findings were that there were no apparent differences in the total number of species/items that were fed on but when comparing the dietary composition that groups in the logged forest have a higher proportion of feeding scores with unripe fruit than unlogged forest. The group in logged forest consumed more bark than the other group. If any changes in forest composition thus food availability occurs for the top 20 food sources due to logging, it would result in significant effect on dietary quality. This article recognizes that further studies from other ecological specialists are needed to fully understand the effects of logging has on the primates.

Contribution:

This article was chosen because it furthermore enhances other articles I was reading as its key provided background information on how feeding of the blue monkey changes due to ecological factors such as logged or unlogged habitat. This article is significant in also how humans should critically examine how actions effect wildlife. This article does not contradict with other articles.

Lambert, J. E. (2005). Competition, predation, and the evolutionary significance of the cercopithecine cheek pouch: The case of *Cercopithecus* and *Lophocebus*. *American Journal of Physical Anthropology*, 126(2), 183–192. <https://doi.org/10.1002/ajpa.10440>

Summary: This article states that previous reports of the cheek pouch use and function was largely anecdotal and there was no investigations of its use. This article will explore two hypotheses for the selection of cheek pouch feature. The first hypothesis is that the cheek pouch reduces potential feeding competition as it allows the primate to retreat from another potential feeding competitor. Also hypothesized that cheek pouch is most used on contestable resources such as fruit. Another hypothesis states cheek pouch reduces the vulnerability to predation by allowing the primate to get their food and retreat to a safe, less exposed space to finish the food consumption. Methods used include observing focal animals as they were followed and all feeding events including food acquisition, processing, and ingestion were observed and recorded. Also the researchers recorded the number of items placed in the cheek pouch verse items that were immediately swallowed. To determine whether the cheek pouch is used to reduce potential vulnerability to predation is to record the position where the animal was present and had a scale of 1 (safest) to 16 (most exposed in which area 1 was understory tree with closed canopy and area 16 was when animal was on peripheral branch in an open canopy. Results were found that animals were significantly more likely to use their cheek pouch when with a greater number of conspecifics. Another finding was despite their age, sex or species, the animals moved to a safer position after filling their cheek pouch.

Contribution:

I choose this article because it provided very good information on the cheek pouch use and the reasons why blue monkey might use its cheek pouch. It was a clear article to obtain more knowledge and information about the uses of cheek pouch. It also provided areas in which the monkey was the least exposed and most safe and most exposed and least safe to predators. The findings of this article did not contradict other articles.

Tesfaye, D., Fashing, P. J., Bekele, A., Mekonnen, A., & Atickem, A. (2013). Ecological flexibility in Boutourlini's blue monkeys (*Cercopithecus mitis boutourlinii*) in Jibat forest, Ethiopia: A comparison of habitat use, ranging behavior, and diet in intact and fragmented forest. *International Journal of Primatology*, 34(3), 615–640. <https://doi.org/10.1007/s10764-013-9684-x>

Summary: Previous studies concluded what is critical to the survival of primates in fragments is the generally, their flexibility in dietary, ranging patterns, and the ability to use matrix environments. Evidence of previous studies found that fragmentation influence primates daily path lengths, home range sizes, dietary composition, physiological stress levels, etc. This article objective is to determine the extent the behaviour and ecology of the Boutourlini's blue monkey is influenced by fragmentation or other forms of human disturbance on their habitat. This article compares two focal groups, the Forest Group, and the Fragment Group. This article hypothesis that the blue monkeys in the two groups would differ greatly in patterns of habitat use, daily path length, home range size and dietary composition. Methods includes recording individuals in the groups that were feeding in the scan sample. This article categorized the feed items which include young leaves, mature leaves, flowers, fruits, seeds, etc. The article calculated the diet compositions for each group and to assess dietary diversity in the food sources, the article used Shannon-Wiener diversity index. The results after the 10-month study were that the ranging patterns (daily path length and home range size) were similar in both groups, but the diet was widely varied. The Forest Group was mostly frugivorous while the Fragment Group was folivores. These results are significant because the Boutourlini's blue monkeys' ability to withstand fragmentation and other disturbance determines the long-term conservation prospects for these primates.

Contribution:

I choose this article because it provided more key information regarding how blue monkeys have flexible diets that even if their habitat was forested or fragmented, they would still be able to survive. This is significant for conserve efforts because researchers now know that despite human disturbance, blue monkeys can survive in those habitats because of their wide range of food types.

Pazol, K., & Cords, M. (2005). Seasonal variation in feeding behavior, competition and female social relationships in a forest dwelling guenon, the blue monkey (*Cercopithecus mitis stuhlmanni*), in the Kakamega Forest, Kenya. *Behavioral Ecology and Sociobiology*, 58(6), 566–577.

<https://doi.org/10.1007/s00265-005-0953-3>

Summary:

Previous studies suggest the correlation between the differences in feeding strategies to the nature of female social relationships. Consuming large quantities of fruit are thought to promote competition but did not affect with relationships between the females. This article will examine whether female relations are more hierarchical under ecological conditions. This article will monitor adult females of two blue monkey groups to assess this investigation. The hypothesis investigated is that rank-based differences emerge during times of high competition or resource scarcity in which females have alternative feeding strategies. Methods used included keeping a continuous record of the focal samples to observe all grooming (affiliation) and interactions such as submitting, avoid, and inflicting aggression between the focal subject and others. Also noted what the subject was feeding in between the interactions. Results included that during the resource availability is low, low-ranking females increased time spent on feeding and females of all ranks increased consumption of levels. It is critical to note that at all times of the study, females spaced themselves apart while they were feeding. Dominance had a small effect on feeding behaviour-it was only when plant reproductive parts were scarce.

Contribution:

I choose this article to furthermore investigate that food availability/food scarcity has on social bonds and relationship of primates. This article explores this interesting topic. It contributes to other articles and does not contradict other articles. This article advances the knowledge in the field because it states that whether a female *C. mitis* consumes a high-quality food, it does not affect relationships therefore proves that feeding behaviours such as cheek pouches main function is not to decrease intraspecific competition.

Takahashi, M. Q., Rothman, J. M., Raubenheimer, D., & Cords, M. (2019). Dietary generalists and nutritional specialists: Feeding strategies of adult female blue monkeys (*Cercopithecus mitis*) in the Kakamega Forest, Kenya. *American Journal of Primatology*, 81(7), e23016.

<https://doi.org/10.1002/ajp.23016>

Summary: Previous studies of primate diets focused on food types such as leaves and fruits and identified the primate as frugivorous, folivores, generalist or specialist. The objective of the study is to evaluate the dietary choices and its effect on nutrient intake in *Cercopithecus mitis stuhlmanni* since it is known that blue monkey diet is variable in food types, there is little known about how this variability relates to nutrient intake. The methods used include recoding the duration of the animal feeding bouts and recording all focal animal does from the moment the food touches their mouth and observe how individuals processed food items. The results of the study were that while female blue monkeys appear to be diet generalists, they also select certain foods such as fruit to regulate and converge nutrient intakes. It can be concluded that blue monkey ability to feed flexibility but achieve a narrow nutrient intake. This finding is significant to this field because the findings of this article highlight that *C. Mitis* have a high survival rate and can survive in human-modified habitats.

Contribution:

I choose this article because it explores the dietary habits of the blue monkey. This article has minor contradiction to other articles I have read in the past as it suggests that blue monkey is not as of diet generalists as we made them out to be but rather blue monkeys are very particular in their nutrient intake from the food sources they are consuming. Other articles have stated that blue monkeys are diet generalists.

Secondary article

Coleman, B. T., & Hill, R. A. (2014). Biogeographic variation in the diet and behaviour of *Cercopithecus mitis*. *Folia Primatologica*, 85(5), 319–334. <https://doi.org/10.1159/000368895>

Summary: Before the findings of the article, it was known that climatic conditions have an important effects of food availability as climate drives species distribution over a continent as it impacts resource distribution. It is also known that primates with larger geographical distribution, have broader range of diets than primates with a small geographical distribution. This article explores the various dietary behaviours in widespread ecological conditions of arboreal guenon, *Cercopithecus mitis stuhlmanni*. This includes the ability to consume a diverse diet due to their geographic range. The article also investigates how the environmental factors in monkey diet and behaviour in wide and distributed populations as this is critical in understanding how species can behaviourally adapt to withstand various environment changes, conditions, and temperature. The article highlighted the observations of fecal analysis and stomach content analysis to separate the diet components into fruits, leaves, flowers, insects (animal matter), and fungi and unknown content. These were compared to the population of the different study sites including Kenya, Uganda, Ethiopia, etc. With more collection of data, the findings included the significant positive or negative relationships between diet components and other properties such as home ranges, temperature seasonality, day journey length and group size. This article is significant because it explores the different factors and the positive or negative relationship with diet. Further questions/studies one can ask and do is since guenons are both arboreal and diurnal, that specific foraging and dietary behaviours are due to inter/intra specific competition that exists when species that live in common area (trees) and are active during the same time (day time).

Contribution: This article was chosen to be apart of the literature review because it specifically determines the significant positive and negative relationships between diet components and properties. This advanced my knowledge of *C. mitis stuhlmanni* feeding behaviors and diets based on different properties such as mean annual temperature, temperature seasonality, rainfall, home range sizes, etc. It supports previous findings because it numerical explains the dynamics between the observational behaviours of the monkeys. A new set of questions arose as to what the significant relationship findings would be if there was a larger sample size.

Cords, M. (2012). The 30-year blues: What we know and don't know about life history, group size, and group fission of blue monkeys in the Kakamega forest, Kenya. In P. M. Kappeler & D. P. Watts (Eds.), *Long-Term Field Studies of Primates* (pp. 289–311). Springer. https://doi.org/10.1007/978-3-642-22514-7_13

Summary:

Before the findings of this book chapter, previous studies have concluded that blue monkeys have slow life histories due to low levels of mortality in their forest habitats. This book chapter examines everything known about the life history and to understand the basic life-history parameters for females and this book chapter also will address group fission (the changing of social group composition throughout time) and group size. This book chapter highlighted the data collection from late 1979 on the births, disappearances, death, immigration, and emigration of the individual animals. These data derived the variables of basic life history especially for females. This book chapter explores the rare event of group fission and stated that the common feature of all group fissions observed was a parent group split unequally. Since females stay in their natal group, it makes sense that females play the active role in deciding how original group divide and there is no observation of male behaviour to influence a group fission. This book chapter suggests that group fission is often an ecological necessary when the group is too large thus the competition for food is too high. After 30 years, there has only been five fission which is a very small sample making this a very complex event to investigate. Group fission raised future research inquires to have. This includes is competition for food the only reason why groups fission or other factors that suggest maybe less connected social networks between groups that cause fission.

Contribution:

I choose this book chapter because it furthermore enhances the key background information and context needed to understand to study the blue monkey feeding habits in depth. This article advances the knowledge of the field as it suggests that the reason why feeding strategies such as cheek pouches are not used mainly for intraspecific competition because the group size is not too big that competition for food sources need to occur.