Photographs taken by Samantha Palmer

Evaluation of the Colobus Conservation enrichment program for multiple species of pre-release non human primates, Kenya

Samantha Palmer
MSc Primate Conservation
Dissertation 2016

Colobus CONSERVATION

OXFORD BROOKES UNIVERSITY

Dissertation Course Name: Final Project	
Title: Evaluation of the Colobus Conservation enrichment program for multiple species of pre-release non human primates, Kenya	
Student Number: 15056602	Surname: Palmer
	Other Names: Samantha
Course for which Acceptable: MSc Primate Conservation	
Date of Submission: September 8th 2016	

This dissertation is submitted in part fulfilment of the regulations for an MSc degree.

Statement of originality

Except for those parts in which it is explicitly stated to the contrary, this project is my own work. It has not been submitted for any degree at this or any other academic or professional institution.

Signature....Samantha Palmer... Date ....September 7th 2016

Regulations Governing the Deposit and Use of Oxford Brookes University Projects/ Dissertations

1. The “top” copies of projects/dissertations submitted in fulfilment of programme requirements shall normally be kept by the School.

2. The author shall sign a declaration agreeing that the project/ dissertation be available for reading and photocopying at the discretion of the Dean of School in accordance with 3 and 4 below.

3. The Dean of School shall safeguard the interests of the author by requiring persons who **consult** the project/dissertation to sign a declaration acknowledging the author’s copyright.

4. Permission for any one other then the author to reproduce or photocopy any part of the dissertation must be obtained from the Head of School who will give his/her permission for such reproduction on to an extent which he/she considers to be fair and reasonable.

I agree that this dissertation may be available for reading and photocopying at the discretion of my Dean of School in accordance with regulations 3 and 4 above.*

Signature....Samantha Palmer... Date ....September 7th 2016

*The underlined words may be deleted by the author if he/she so wishes.

Evaluation of the Colobus Conservation enrichment program for multiple species of pre-release non human primates, Kenya

Samantha Palmer

Abstract

Animal welfare is a large area of science that is becoming increasingly more important to the scientific community. With the increase in importance the use of environmental enrichment for captive non human primates is becoming the norm solution to welfare problems. Evaluation of these enrichment programs is also now considered to be as important as the programs themselves. Using behavioural observations and enrichment evaluations this study assessed the enrichment program of three species of captive primates in the rehabilitation program at Colobus Conservation. The three species at Colobus Conservation are the black and white colobus (*Colobus angolensis palliatus*), the vervet monkey (*Cercopithecus aeithiops*) and the sykes monkey (*Cercopithecus mitis mitis*). I hypothesized that enrichment use would vary based on enrichment type, species, hierarchy, and age-sex class, and that the enrichment would affect stereotypic behaviours and aggression. The vervet and sykes monkeys used enrichments on the ground such as leaf litter the most while the colobus monkeys used enrichment hung on branches like hammocks and ice blocks most. This supports the idea that husbandry routines, especially those aspects involved in the psychological wellbeing of primates, should be species specific. As well, my results revealed that dominance hierarchy must be considered when enrichment programs are implemented. The age-sex class data from my study was very inconsistent much like the current literature on the subject. Lastly, both stereotypic behaviour and aggression were found to be in very low quantities in the primates at Colobus Conservation. Findings of this study are important because they add to the lacking literature for enrichment evaluations, and the research conducted in sanctuaries. In conclusion, I found the enrichment program, supported by other aspects of the husbandry routine at Colobus Conservation to be very affective in terms of deterring stereotypic behaviour and not promoting high levels of aggression.

Acknowledgements

Thank you to all the people and monkeys at Colobus Conservation, especially those who worked closely with me. Thank you to Alice for keeping me sane in the field. Thanks to my friends at Oxford Brookes; Nele, Liselot, Christian and Ben, for helping me through even when spread out over the globe. Thanks to my supervisor Kate for her excellent guidance, and last but not least, thank you so much to my family for always supporting me and allowing me to follow the path I have chosen.

Table of Contents **Page #**

List of Figures and Tables

1.Introduction

1.1 Animal Welfare and Enrichment

Animal welfare is a large area of science that is becoming increasingly more important to the scientific community (Brent 2007; Bennett et al. 2010). Due to much lobbying and consideration amendments were made to the animal welfare act changing standards for captive care of non human primates (Kulpa-Eddy et al. 2005). Since these 1985 amendments to the animal welfare act, special attention has been given to the captive non-human primates, and improving their psychological well-being (Kulpa-Eddy et al. 2005). Psychological well being is defined as the ability of a primate to adapt and change to its environment and situation (Husband et al. 2008) . Naturally, with an increase in attention towards welfare and improving psychological well being, scientific research has been directed towards different solutions to this issue. With this increase in attention and further research, like the animal care interviews done in 1997 there has been a large development in enrichment programs and the use of these programs in the lives of most species of captive animals (Nelson & Mandrell 2005). Enrichment is defined as a dynamic process in which changes to a structure and husbandry practice are made (Kulpa-Eddy et al. 2005; Nelson & Mandrell 2005). This change in animal husbandry is done with goals of increasing behavioural choices available to animals, and increasing species' appropriate behaviours and abilities, therefore enhancing animal welfare (Kulpa-Eddy et al. 2005; Nelson & Mandrell 2005). Enrichment has also been used to decrease aggression in captive environments with some success (Honess & Marin 2006).

1.1.1 Enrichment Types

There are many different types of enrichment including Social, Occupational, Physical, Sensory, and Nutritional (Baker 2007; Honess & Marin 2006). Social enrichment is either contact or non contact, and can include interaction with conspecifics, other species, or staff (Husband et al. 2008).

Physical enrichment is anything to do with a change in the physical shape of the enclosure and its accessories, temperature, humidity illumination, and sound exposure (Husband et al. 2008). Sensory enrichment includes visual, auditory, and other stimuli (Husband et al. 2008). Lastly nutritional enrichment is divided into both delivery method and type, for example presenting food in a novel manner, or providing treats not usually incorporated into the diet (Husband et al. 2008). All of these different types of enrichment work to achieve the same improvement of animal welfare. The following paper focuses on enrichment for non-human captive primates but there are also enrichment programs created with successful outcomes for other species of animals such as large cats, dolphins, small mammals, pandas, and avian species (Ruskell et al. 2015; Miller & Mench 2005; Lin et al. 2011; Swaisgood et al. 2001).

1.1.2 Where do you find enrichment programs?

Enrichment programs can be implemented in a variety of captive environments. They have been implemented to improve the lives of research animals in a laboratory setting (Young 2003). This was done because improving the lives of the captive test subjects would improve the validity and accuracy of any results received from a study (Young 2003). Zoos are also a common place one may find enrichment programs (Young 2003). Originally zoos used metal cages with a very artificial appearance and feel, with little concern for the well being of the animal being displayed (Young 2003). Modern zoos, however, are moving towards more natural and enriched environments for their captive animals, including non human primates (Young 2003; Brent & Belik 1997). Part of this change comes from public demand and part comes from our increased knowledge and regulations for animal welfare (Young 2003). In the United States a law was passed in 1991 requiring zoos to develop enrichment programs with special specifications made for non human primates (Husband et al. 2008). The public's opinion and monetary support play a large role

in changes seen and studies, conducted in the past decade, on the zoo visiting public show that visitors now expect to see enrichment and proper welfare procedures during their visits (Young 2003).

1.1.3 Evidence of enrichment benefit

Evidence from research conducted over the years shows enrichment can change behaviour for the better in captive primates (Honess & Marin 2006; Husband et al. 2008). Reductions in abnormal and stereotypic behaviour have been observed as well as increased expressions of desirable species specific behaviour and reduced aggression (Young 2003; Husband et al. 2008). Research in the veterinary field also supports enrichment programs showing that when implemented properly they can also improve physical health and reduce common health problems (Young 2003). Enrichment programs can also cause an increase in reproduction and longevity (Husband et al. 2008). Nutritionists employed at zoos also implement enrichment in their routines (Mowry & Campbell 2001). They do this in the form of foraging enrichment and other feeding enrichments such as browse that are very common in husbandry practices developed in the 21st century (Mowry & Campbell 2001).

1.1.4 Gaps in Enrichment Research

One problem with enrichment programs is that there is a large amount of application and very little evaluation of the enrichment (Young 2003). Although research has shown that enrichment can improve animal welfare it is possible that some forms of enrichment are better suited than others, and that specific species differ in their reaction to particular enrichments (Young 2003). It is even possible and has been shown in case studies that enrichment can cause harm to the primates using it (Nelson & Mandrell 2005). Previous research on captive primates has shown that some enrichment can even have no effect on behaviour, which then becomes an improper

use of time and money and sometimes can be harmful to the animals (Schapiro et al. 1997). Assuming that because enrichment has good intentions and has proved beneficial before, that it will always result in positive improvement is not necessarily important because it is possible that some have detrimental effects and decrease welfare (Young 2003). As a scientific community we must rely on empirical evidence that comes only through evaluating these enrichment programs (Young 2003). Without the evidence animal care takers also risk cluttering the environment with objects that are of little interest to the monkeys (Bryant et al 1988). Increasingly, authors argue that evaluation and documentation of the enrichment is as important, if not more important, than the enrichment itself (Quirke & O'Riordan 2013). More research, especially research being done in zoos, is investigating ways of evaluating enrichment programs so the information gathered can be shared amongst those who hold captive primates ensuring that maximum improvement of enrichment programs can be achieved (Quirke & O'Riordan 2013). Common reasons for enrichment programs not being implemented are because of cost, staff shortage, time, and space (Baker 2007). Therefore, it is important that the most effective and beneficial enrichment programs are used so as to not waste time, money and other resources (Baker 2007). Some research in this area has even shown that by spending more money on enrichment we are not necessarily bettering the welfare compared to a less expensive and better executed program (Schapiro et al. 1997). By increasing evaluation and communication in the field these enrichment programs can be constantly improved upon and standards can be created (Baker 2007). One area where this is specifically important is in rehabilitation and sanctuaries that hold captive primates.

Studies on the primates in sanctuaries has been almost nonexistent in the past years (Brent 2007). There are many reasons for this such as financial concerns or lack of trained staff (Brent 2007). Additionally, rehabilitation and sanctuaries were not always accepted as a method of conservation but research has shown that over the last decade, especially in African countries, sanctuaries have become more numerous and opinions towards them as a tool for conservation are changing (Schoene & Brend 2002). Sanctuaries aiming for rehabilitation and release of their primates aim to supply the primates with resources and skills they need to survive in the wild, and sanctuaries have the ability to conserve wild habitat, affect law enforcement, promote education, and reintroduce primates back into the wild. In Africa this need to evaluate and communicate has become so important that the Pan African Sanctuaries Alliance (PASA) was created to increase the communication between sanctuaries, so when research is completed what is learnt can be shared with a larger audience and the knowledge can be used to improve many conservation initiatives across the globe (Schoene & Brend 2002). PASA was also created with the aim of improving the management and increasing professionalism in the industry (Schoene & Brend 2002). Studying primate welfare and enrichment in sanctuary and rehabilitation environments is less common so far but is especially important due to the proven up and coming importance of rehabilitation in the area of conservation (Brent 2007). Sanctuaries also provide an excellent environment for enrichment evaluation. With their interesting behaviour cases, animal histories, and great variety of enclosures and programs they allow for a great chance to compare and evaluate (Brent 2007).

1.2 Evaluating Enrichment Programs

Enrichment programs can be evaluated through analyzing different types of data including behavioural, physiological, and neurological (Young 2003). For the purpose of this paper we

will focus on the effect the enrichment program has on behaviour of the primates coming in contact with it. Above it is mentioned that enrichment programs aim to improve behavioural diversity, increase species normal behaviours, and decrease stereotypic behaviours (Nelson & Mandrell 2005). Therefore, if behaviour of a species is observed and these behaviours are recorded they can be compared and analyzed for differences or change. One common way these behaviours are analyzed are through the creation and comparison of activity budgets or time budgets (Fashing et al. 2007). An activity budget or a time budget is a recording of the amount of time an animal spends on each activity during the span of its day (Fashing et al. 2007). Activity budgets have been used for many studies in the field of primate conservation and are commonly created to analyze activity patterns, for example when Fashing and his team analyzed the activity patterns of the Angolan colobus (*angolensis ruwenzorii)* in Rwanda (2007). These activity patterns can be incredibly useful for conservation because researchers learn about behaviour, feeding, and social interactions and can apply this knowledge to their management plans (Fashing et al. 2007). Enrichment programs have also been known to be used to create behaviours similar to that of a wild conspecific's activity budget in certain species of animals (Young 2003).

1.3 Location and Study Species

The purpose of this study is to assess the current enrichment program for four different species of primates residing at the Colobus Conservation in Diani, Kenya. Colobus Conservation has been conserving and providing rehabilitation for primates with a specific focus on the black and white colobus (*Colobus angolensis palliatus*) since its establishment in 1997 (Colobus Conservation 2012)**.** The primates of Colobus Conservation have a variety of histories prior to being part of the rehabilitation program. Some of the primates were ex-pets before being

rescued, some were found abandoned or injured and some were brought in as orphans receiving differing intensities of human contact specific to each case. There are three species of primate in the care of Colobus Conservation; the black and white colobus (*Colobus angolensis palliatus*), the vervets (*Cercopithecus aeithiops*) and the sykes (*Cercopithecus mitis mitis)*.

1.3.1 *Colobus angolensis palliatus*

The black and white colobus or the angolan colobus (*Colobus angolensis palliatus*) is a member of the cercopithecidae family and is in the Least Concern section of the IUCN Red List, and is on Appendix 2 of CITES (Butynski et al. 2013). The black and white colobus is the primary concern of Colobus Conservation because it is a national species that has a high death rate caused by human interaction in the highly visited tourist areas of Diani Beach (Colobus Conservation 2012). The black and white colobus is an arboreal species that is black and white in colour (Butynski et al. 2013). They can be recognized by their distinctive white cheek hairs, white shoulder patches, with a black crown and neck area (Butynski et al. 2013). They have black faces around the orbital and nose regions with a white brow line above the eyes and a black tail that finishes with a section of white (Butynski et al. 2013). The females of this species are smaller and weigh around 80% of the male adult weight but both sexes are similar in colour and pattern (Butynski et al. 2013). Infants of this species can be recognized by pink faces and white fur that turns black as they mature, developing similar patterns to the adults around 3.5 -4 months of age (Butynski et al. 2013). As well as rehabilitating the black and white colobus, Colobus Conservation also takes in vervet monkeys (*Cercopithecus aeithiops*), sykes monkeys (*Cercopithecus mitis albogularis*), and galago (Galago spp.). The galago is the most different from the group of species as it is a nocturnal arboreal primate that is solitary and will likely have very different activities and reactions to the enrichment program (Butynski et al. 2013). As well,

there will be no captive galagos when I am doing my research. For these two reasons, I will not be including the galagos in my behavioural enrichment study.

1.3.2 *Cercopithecus aeithiops*

The vervet monkey is also a member of the cercopithecinidae family, but is part of the cercopithecinae sub family while the black and white colobus fell under the colobinae sub family (Hoelzer et al. 2004)**.** The main distinguishing feature that split the Cerpoithecinae from the colobinae is the presence of cheek pouches in the Cercopithecinae and the forgut fermentation in the colobinae (Young 1998). The vervet monkey is of Least Concern according to the IUCN Red List, and is on Appendix 2 of CITES (Butynski et al. 2013). The vervet monkey is viewed as a major pest in most of its home range and is one of the primates that is found in increadiby large numbers in rehabilitation programs across Africa (Guy & Curnoe 2013; Guy et al. 2012). The vervet monkey is semi terrestrial unlike the colobus and has a light brown, greyish, olive-brown back and sides (Butynski et al. 2013). The ventral surface of the vervet is white along with the whisker area around the black face (Butynski et al. 2013). The adult female weighs up to 70% of the adult male and has similar coloration except for the ano-genital area, adult males have a blue scrotum while females do not (Butynski et al. 2013). The infant vervet can be recognized by their pink face and black or brownish fur, and by 6 months they have acquired adult coloration (Butynski et al. 2013).

1.3.3 *Cercopithecus mitis mitis*

The sykes monkey is also from the Cercopithecidae family and is of Least Concern on the IUCN Red List and in Appendix 2 of CITES (Butynski et al. 2013). The sykes monkey is semi terrestrial like the vervet and can be recognized by its dark face, oval shaped cheeks, black forelimbs, hands, feet, and distal half of tail, and its white throat. The shoulders and back area

are usually orange or yellow (Butynski et al. 2013). The females and males show similar coloration but the female is smaller weighing 60% of the adult male (Butynski et al. 2013). Infant sykes monkeys are black and brown sometimes showing a faint crown (Butynski et al. 2013). The group structure of a sykes monkey is dominated by matrilineal female groups, usually with one resident male (Fairgrieve & Muhumuza 2003; Klass & Cords 2015). Number of females in a group is usually determined by environmental factors such as space and resource availability (Fairgrieve & Muhumuza 2003). Within the dominance hierarchy of sykes monkeys there is a clear inheritance of dominance through the mothers line (Klass & Cords 2015).

1.4 Aims and Hypotheses

Due to the lack of financial resources at a sanctuary, enrichment programs should be inexpensive, easy to obtain, create or purchase, and most importantly effective (Dickie 1998). The overall aim of this study is to determine if the enrichment provided at Colobus Conservation falls into the above statement. I have multiple smaller aims to achieve for this study, the first of which is to determine the extent, and type of enrichment use by the three species of primates at the Colobus Conservation. My second aim is to develop accurate methods for making and implementing enrichment activities suitable for pre-release monkeys, ensuring they are made to a consistent high standard, taking particular care in reducing hazards and ensuring their usefulness. Thirdly I aim to determine whether the current enrichment schedule in place at Colobus Conservation is sufficient to encourage and teach natural behaviours to pre-release monkeys, while discouraging stereotypic behaviours. The first hypothesis for this study is that the current enrichments in the program at Colobus Conservation are used differently by each of the three species in this study as well as between different age sex classes within each species. The second hypothesis is that the hierarchy will affect the use of enrichment. The third

hypothesis is that the enrichments in the program do affect the activity budget data for these three species and thirdly that the enrichment program does discourage the presence of aggression and stereotypical behaviour.

My first objective is to conduct scan samples of all enclosures making note of behaviours following an ethogram provided by Colobus Conservation paying specific attention to use of enrichment by each species. My second objective is to compile behavioural data into activity budgets for comparison of behaviours between enrichment types, species, sex, age and hierarchy. My third objective is to collect materials and supplies and construct all enrichments from the Colobus Conservation manual, making notes on safety, cost, effort, and scoring the individual enrichments using a uniform scoring method across the enrichments. My fourth and last objective is to compile both behavioural and physical data to be able to make suggestions to Colobus Conservation on which enrichments are being used the most, which enrichments are the most effective in promoting species specific behaviours and which are the most cost and time effective for their program.

1.5 Importance of Study

Although all the primates involved in this research are listed as Least Concern in the IUCN Red List this study is still important to conservation and welfare of primates (Butynski et al. 2013). The results from this research will fill in a gap that is present in our knowledge due to the low amount of research conducted in rehabilitation programs and in sanctuaries. This is important because these programs are becoming increasingly recognized as having an important role in conservation throughout Africa (Guy & Curnoe 2013). By filling in this gap in knowledge we are creating more successful rehabilitation and sanctuary programs that will continue to benefit conservation through

reintroductions, education, and habitat protection (Guy & Curnoe 2013). This research is also highly important because of our need to properly evaluate enrichment programs (Young 2003). Preserving genes through our captive primate populations will not be enough for long-term survival of a species if enrichment programs are ineffective and natural behaviours are lost causing reintroductions to be impossible (Dickie 1998). Evidence for the effectiveness of enrichment clearly suggest a role for enrichment programs in maintaining endangered species in captivity which benefits conservation initiatives (Swaisgood et al. 2001). By evaluating this enrichment program, I can identify areas that work well, and areas that are lacking and need improvement to increase animal welfare for captive primates. I will also be able to identify if the current program is suitable for all the species of primates present in the enclosures since each species will have species specific preferences and requirements. The results of this study can then be shared amongst any location be it a sanctuary, zoo, or laboratory that care for captive primates so that they too can learn and improve their welfare standards. By doing this study and sharing the results and gained knowledge we are improving animal welfare not only at Colobus Conservation but across Africa and many other places in the world.

2. Materials and Methods

2.1 Study Subjects

I collected data on three species of primates: the black and white Angolan colobus (*Colobus angolensis palliatus*) (n=5), the vervet monkey (*Cercopithecus aethiops*) (n=16), and the sykes monkey (*Cercopithecus mitis albogularis*) (n=8). To see a complete list of primates included in this study see Appendix 1.

2.2 Housing and Enrichment

On the Colobus Conservation land there are a total of 5 enclosures that house the colobus troop, sykes troop, vervet troop and the two nursery troops. The enclosures vary in size with the two nursery enclosures being the smallest and the vervet and sykes enclosures the largest. They are made of metal sidings with either a metal mesh floor or a cement floor. All enclosures provide protection from the elements through either metal roofing, boxes, or an indoor portion of the enclosure. The monkeys are fed in the morning at approximately 8:30 am and then again at approximately 4. Seeds are also given at 2pm and are either given as part of the enrichment or separately.

The enrichment program at Colobus Conservation follows a repeating 11-day rotation; enrichment is provided on 10 days with one day remaining enrichment-free. Each of the 5 enclosures receives the same enrichment at the same time with a few differences in types of food with relation to feeding enrichments. The enrichment can be split into that which is permanent in the enclosures and that which is temporary. Permanent enrichments are swings, rotten logs, beams, and hanging branches. All of the enrichment in this program falls into either feeding/ foraging, or manipulative toys (physical). For a list of novel enrichments added each day see Table 1.

The enrichment at Colobus Conservation takes on a more naturalistic appearance as they are encouraging the primates in their care to not interact with man-made objects, and trash. This is so that when rehabilitated and released they can adapt to their tourist populated habitat and not be tempted to interact with people and their belongings (Personal Communication, Kelly

Martin). This means some of the more common enrichments seen in zoos and in sanctuaries where release is not a concern are not an option at Colobus Conservation putting a strain on the amount of options available for the program.

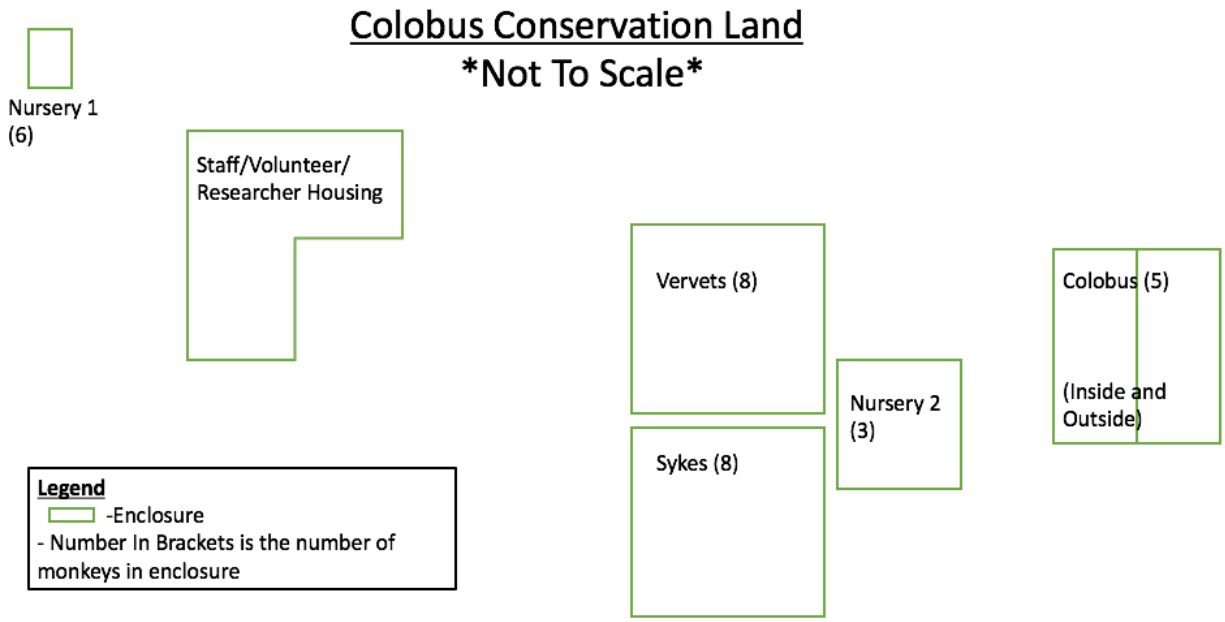


Figure 1. Schematic of Colobus Conservation Land and location of enclosures on the Land. Not to scale.

Table 1. List of enrichments used at Colobus Conservation for all three species of prerelease primates.

Enrichment	**Type**
Leaf Litter	Feeding/ Foraging
Hammocks	Manipulative
Foliage Balls	Feeding/ Foraging
Rock Piles	Feeding/ Foraging
Coconuts	Feeding/ Foraging
Elevated Forage	Feeding/ Foraging
Branched Floors	Feeding/ Foraging
Sand Piles	Feeding/ Foraging
Ice Blocks	Feeding/ Foraging
Feathers	Manipulative

2.3 Data Collection

I collected data at the Colobus Conservation for a period of approximately three months from May 6th to July 26th 2016. During this three-month period there were two main parts to my research.

2.3.1 Behavioural Data Collection

The first part of my research was to collect behavioural data on each enclosure to create activity budgets for each individual monkey, and for each overall species (Gilby et al. 2011). Each monkey in an enclosure had a specific ID which I became familiar with prior to observations. Behavioural observations were collected from 2-6pm Monday through Friday. There was approximately 176 hours of behavioural data collection. Some of the enrichments used at Colobus Conservation are left in for multiple days but not exceeding a 3 day period. For the purpose of my study only the novel enrichments added on the day of observation were considered so that independent analysis of each enrichment could occur.

Instantaneous scan sampling was used to observe behaviour. Instantaneous scan sampling began at 2pm and occurred again at 15 after, 30 after and 45 after the hour (Altman 1974; Martin & Bateson 2007). This was repeated every hour until 6pm. After scanning the behaviours of every individual in the first enclosure I walked to the next enclosure. I continued this process till I had completed all 5 enclosures. The order of enclosures for data collection was on a rotating schedule to avoid any bias in the time of data collection for each enclosure. During the scan sampling I noted behaviour states of every primate in the enclosure making reference to an ethogram provided by Colobus Conservation and altered for my study (See Appendix 2, Ethogram). The most important aspects of the ethogram are the uses of the enrichment by the primates and the presence of aggression and affiliative behaviours between animals.

2.3.2 Hierarchy

As well as collecting behavioural data with the ethogram, informal observations were also made on the observed hierarchy of the primates within each enclosure. This will later be referred to as observed rank. Hierarchy or observed rank, was not analyzed for the nursery enclosures. Each enclosure was split into three categories of hierarchy, Highest, Middle, and Low. The variables used to determine the hierarchy amongst the group were the displacements and threats between individuals. After observations the results were confirmed with the veterinarian on staff. It is important to assess the hierarchy of the primates in each enclosure because it is well known that resources (in this case enrichment) are acquired differently and in differing amounts by primates of different hierarchal level in a group.

2.3.3 Assessment of Enrichment

The second part of my research was to complete a full assessment of each type of enrichment object by helping the animal care team create the enrichments while taking notes and pictures. This occurred on a non uniform schedule, over a period of approximately 50 hours. I made notes containing details on the safety of the object for humans and monkeys, the cost, and the reusability. Then using a uniform scoring system for all the enrichments I ranked each in a list from best to worst based on all the above features (See Appendix 3, Enrichment Evaluations). This was combined and compared with the behavioral data to create improvements and suggestions for Colobus Conservation's enrichment program.

2.4 Analysis

To create activity budgets certain behaviors were combined to create 7 categories; aggression feeding, resting, social/ affiliative, moving, enrichment use, and other (Table 2). Activity

budgets were then compared using a one-way ANOVA for each category followed by a LSD post hoc test.

Table 2. Enrichment categories for analysis and their make up using the ethogram behaviours.

Category	Ethogram Components
Aggression	Severe Aggression Moderate Aggression Mild Aggression
Feeding	Feeding Foraging
Resting	Resting Alone Resting Socially
Social	Play Grooming Being Groomed
Moving	Locomotion
Enrichment Use	Using Enrichment Sharing Enrichment
Other	Auto-grooming Vigilance (of group, outside animals, people) Drinking

Analysis was conducted for the overall group, including all 30 primates, as well as separately for each enclosure. For this analysis certain days of behavioural data collection were excluded for two reasons. One reason data was excluded was that two of the sykes monkeys were released during my study (Sang and Pett). Reason two for excluding data was that enrichment was not given to an enclosure during a specific day of my study. A Klomogorov-Smirnov test was first used to test for normality among the data to make sure the statistical tests chosen were appropriate for the data. A repeated measures ANOVA was used to analyze both the whole group data and the data once separated by enclosure. Enclosures were separated using the split file function on SPSS. For the remainder of this paper enclosures will be referred to by the following numbers; enclosure 1 is the colobus enclosure, enclosure 2 is the vervet enclosure, enclosure 3 is the sykes enclosure, enclosure 4 is the 1st nursery enclosure, and enclosure 5 is the 2nd nursery enclosure. Analyses were

conducted to determine if the type of enrichment each day had an effect on the behaviour of the primates. Did different enrichments cause different levels of aggression? Did the different enrichments promote different levels of affiliative behaviour? Did different enrichments cause higher levels of certain behaviours? Did different enrichments cause overall different levels of enrichment use? Lastly, did the rank or age-sex class affect the use of enrichment? Certain confounding variables that could have affected the results of this study where the presence of baboons and the occurrence of the feeding period during my observation. The presence and effect of baboons were not statistically analyzed because it was determined that they were only around for an inconsequential amount of days during which I did my study, and because the effect of their presence was not long lasting enough to affect my results. Feeding time and its effects were not statistically analyzed due to the fact that it was a factor that always occurred and affected every enclosure causing it to balance out and not overly affect my results. The feather enrichment was not analyzed due to the fact that there were never enough feathers collected to put in the enclosures.

3. Results

3.1 Activity Budgets

Activity budgets were created for each of the three species observed at Colobus Conservation. As well activity budgets were created for each individual. For the purpose of this study it is impossible to discuss and compare every single individual but their activity budgets can be found in appendix 2.

3.1.1 Colobus Monkeys

The average activity budget for the colobus monkeys observed is 0.04% aggression, 29.8% feeding, 23.3% resting, 6.8% social, 4% moving, 9.4% using enrichment, and 26.6% on other. A one-way

ANOVA showed that time spent resting was not significantly different between enrichment types (df: 9, F: 1.145, Sig: 0.355). Although the one-way ANOVA was not significant, when taking a closer look using a LSD post hoc test it revealed that time spent resting did differ between the leaf litter and the coconuts enrichment. For the social category of the activity budget, the one-way ANOVA revealed there was no significant difference in time spent on social behaviours between enrichment types (df: 9, F: 1.507, Sig: 0.179). Again, taking a closer look the post hoc test revealed that there were significant differences between some of the enrichment types and the amount of time engaged in social behaviours which can be seen in Table 3 below. In the movement category the one-way ANOVA revealed that there was a significant difference in the amount of time spent moving between enrichment types (df: 0, F: 2.212, Sig: 0.042). The post hoc test revealed that there were significant differences between many of the enrichment types which have been demonstrated in Table 4 below. In the enrichment use category, the one-way ANOVA revealed that there was a significant difference in the amount of time animals engaged with the different enrichment types (df: 9, F: 4.892, Sig: 0.000). The post hoc test revealed that there were significant differences between many of the enrichment types which can again be seen below in Table 5. For the colobus monkeys observed aggression was not statistically analyzed as it was only observed once during the study when elevated forage was the enrichment.

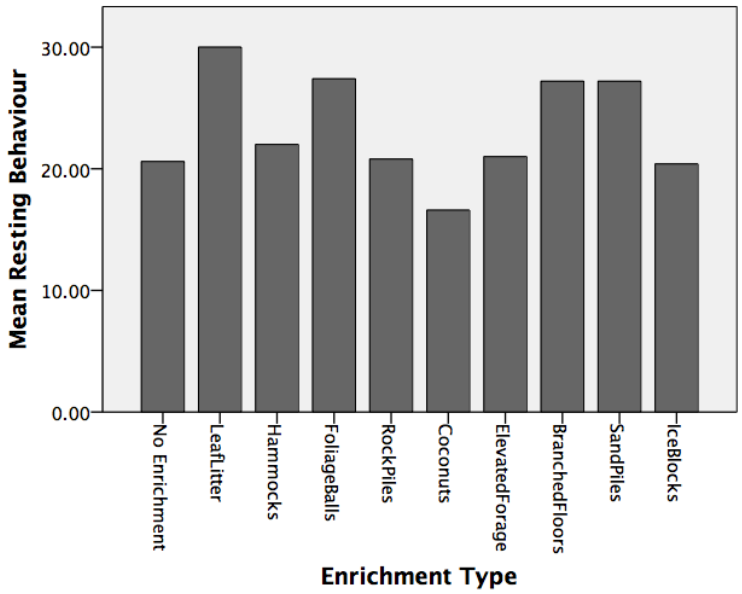


Figure 2. The mean amount of activity budgets spent on resting for the colobus monkeys. Significance between the leaf litter and coconut enrichment.

Table 3. Demonstration of the relationships between the enrichment types for social category of colobus monkeys observed. Where there is an X there is a significant difference between the two enrichments.

	NoEnrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
NoEnrichment										
Leaf Litter										
Hammocks				X	X					
Foliage Balls			X				X			X
Rock Piles			X							
Coconuts										
Elevated				X						
Branched										
Sand piles										
Ice Blocks				X						

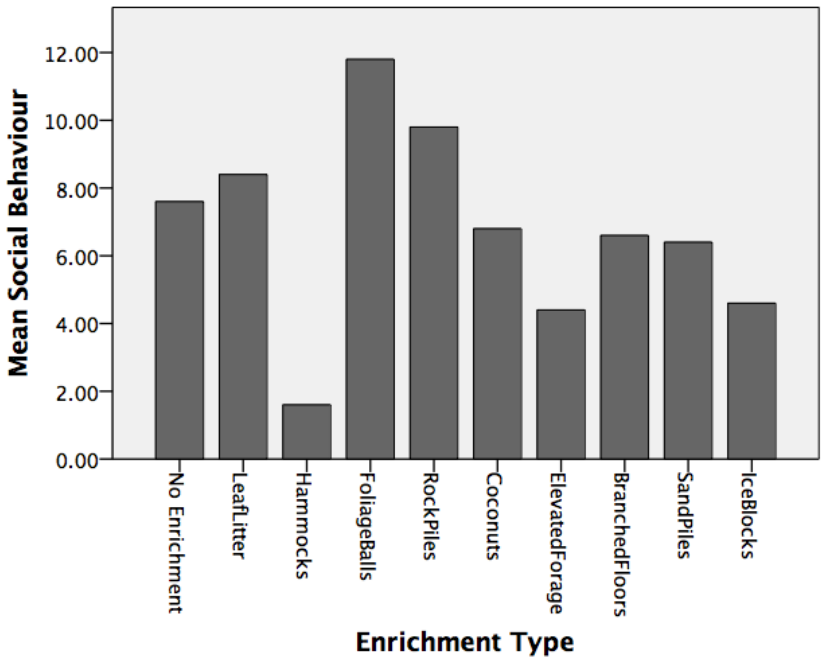


Figure 3. The mean amount of activity budget spent on social behaviour for the colobus monkeys. Significant differences shown above in Table 3.

Table 4. Demonstration of the relationships between the enrichment types for movement category of colobus monkeys observed. Where there is an X there is a significant difference between the two enrichments.

	NoEnrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
NoEnrichment			X				X			X
Leaf Litter										
Hammocks	X			X		X		X		
Foliage Balls			X							
Rock Piles										
Coconuts			X				X			X
Elevated	X					X				
Branched			X							
Sand piles										
Ice Blocks	X					X				

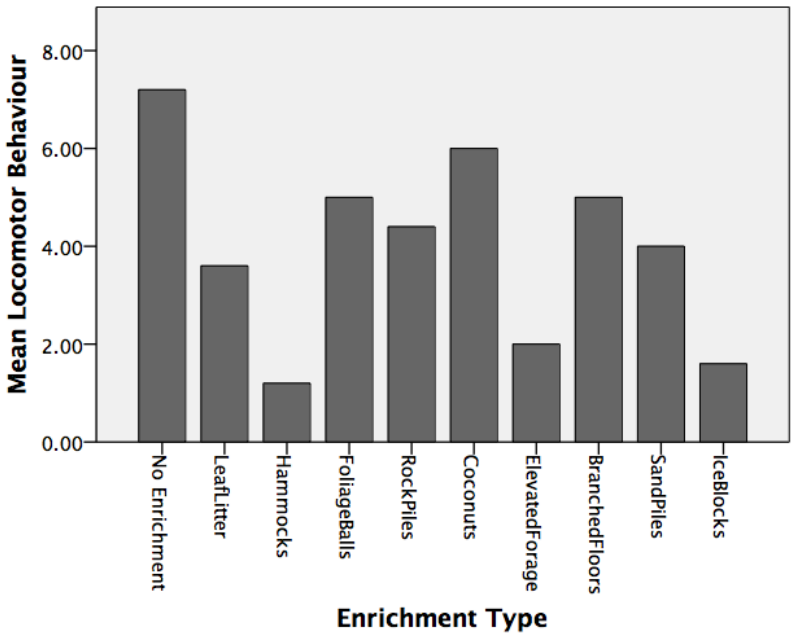


Figure 4. The mean amount of activity budgets spent on locomotor behaviour for the colobus monkeys. Significant differences shown above in Table 4.

Table 5. Demonstration of the relationships between the enrichment types for the enrichment use category of colobus monkeys observed. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment		X		X	X	X		X		
Leaf Litter	X		X	X	X	X	X	X	X	X
Hammocks		X				X				
Foliage Balls	X	X								
Rock Piles	X	X								
Coconuts	X	X	X							X
Elevated Forage		X								
Branched Floor	X	X								
Sand Piles		X								
Ice Blocks		X				X				

3.1.2 Vervet Monkeys

The activity budget for the vervet monkeys was 0.19% aggression, 41.23% feeding, 15.2% resting, 7.73% social, 8.33% moving, 13.55% using enrichment, and 12.86% on other. One-way ANOVAs in the categories of resting, social behaviour and enrichment use showed a significant difference between enrichment types while aggressive behavior, and moving did not differ significantly. Time spent moving only differed significantly between elevated forage and no enrichment. For the aggression, resting, social behaviour and enrichment use; the post hoc test revealed many significant differences that are summarized in Tables 6, 7, 8 and 9.

Table 6. Demonstration of the relationships between the enrichment types for the aggression category of the vervet monkeys observed. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment							X			
Leaf Litter							X			
Hammocks							X			
Foliage Balls										
Rock Piles										
Coconuts										
Elevated forage	X	X	X			X		X		X
Branched floor							X			
Sand piles										
Ice Blocks							X			

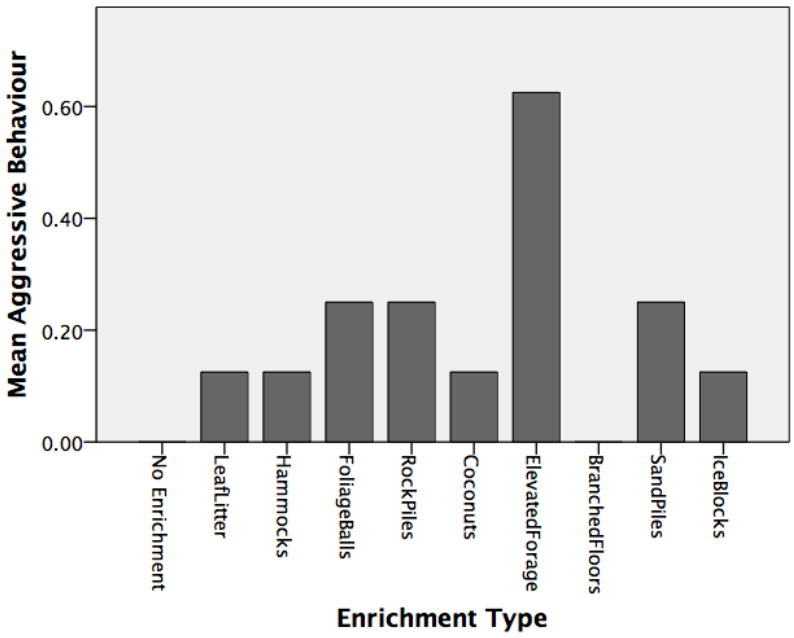


Figure 5. The mean amount of activity budgets spent on aggressive behaviour for the vervet monkeys. Significant differences shown above in Table 6.

Table 7. Demonstration of the relationships between the enrichment types for the resting category of the vervet monkeys observed. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment		X								
Leaf Litter	X		X	X	X		X	X	X	
Hammocks		X				X				
Foliage Balls		X								
Rock Piles		X								
Coconuts			X							
Elevated forage		X								
Branched floor		X								
Sand piles		X								
Ice Blocks										

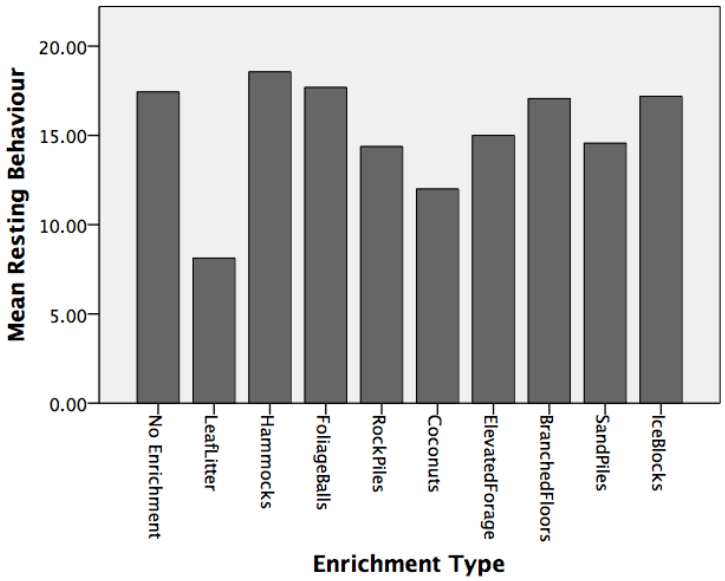


Figure 6. The mean amount of activity budgets spent on resting for the vervet monkeys. Significant differences shown above in Table 7.

Table 8. Demonstration of the relationships between the enrichment types for the social category of the vervet monkeys observed. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment								X	X	
Leaf Litter				X						
Hammocks										
Foliage Balls		X				X	X	X	X	
Rock Piles								X	X	
Coconuts				X						
Elevated forage				X						
Branched floor	X			X	X					X
Sand piles	X			X	X					X
Ice Blocks								X	X	

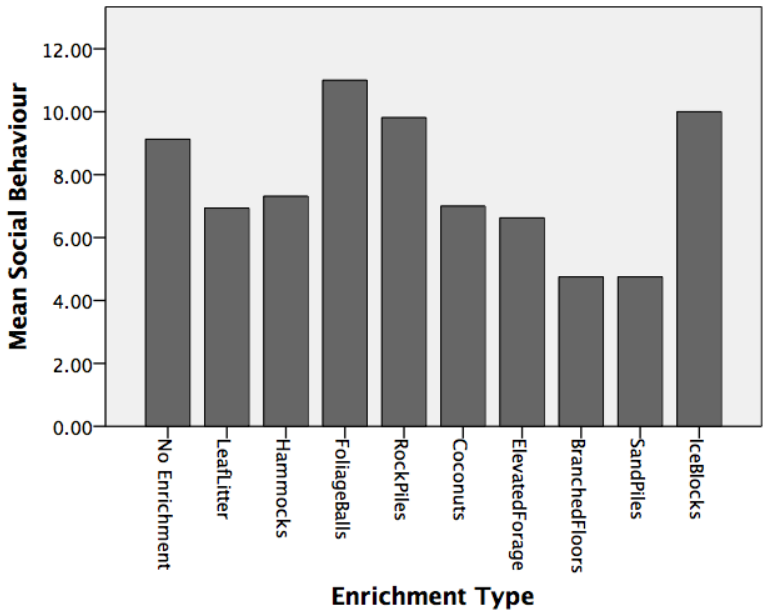


Figure 7. The mean amount of activity budgets spent on social behaviour for the vervet monkeys. Significant differences shown above in Table 8.

Table 9. Demonstration of the relationships between the enrichment types for the enrichment use category of the vervet monkeys. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment		X	X	X	X	X	X	X	X	X
Leaf Litter	X		X	X	X	X	X			X
Hammocks	X	X			X		X	X	X	
Foliage Balls	X	X			X		X	X	X	
Rock Piles	X	X	X	X		X		X		
Coconuts	X	X			X		X	X	X	
Elevated forage	X	X	X	X		X		X	X	X
Branched floor	X		X	X	X	X	X			X
Sand piles	X		X	X		X	X			X
Ice Blocks	X	X					X	X	X	

3.1.3 Sykes Monkeys

The average activity budget for the sykes monkeys was 0.37% aggression, 41.48% feeding, 20.16% resting, 3.75% social, 11.36% moving, 9.53% using enrichment, and 13.78% on other. The one-way ANOVA tests for the sykes monkeys revealed that there was a significant difference in the enrichment use between different enrichment types (df: 9, F: 8.213, Sig:0.000). There was no significance found for aggression, resting, social behaviour, or moving. Looking closer, the post hoc test for social behaviour and enrichment use both revealed many significant differences among the enrichment types which can be seen below in Tables 10 and 11.

Table 10. Demonstration of the relationships between the enrichment types for the social category of the sykes monkeys observed. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment										
Leaf Litter				X						
Hammocks				X						X
Foliage Balls		X	X		X	X	X	X	X	
Rock Piles				X						
Coconuts				X						
Elevated forage				X						
Branched floor				X						
Sand piles				X						
Ice Blocks			X							

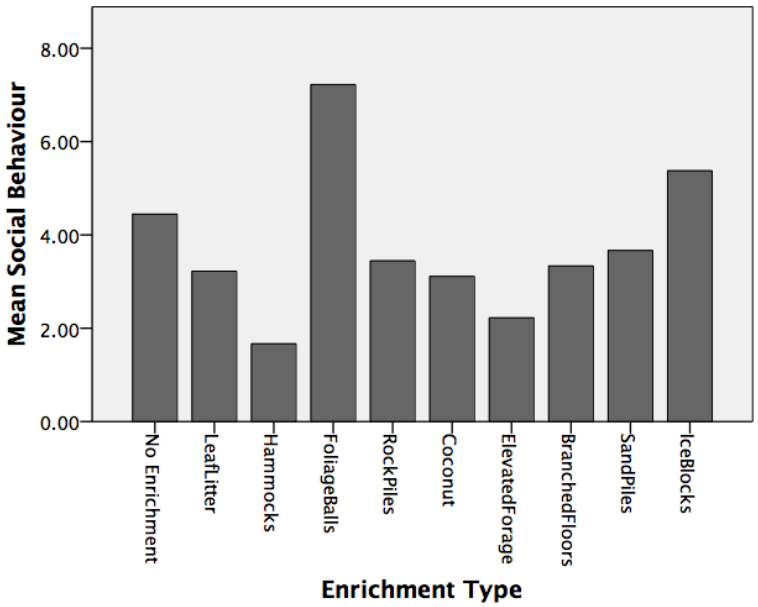


Figure 8. The mean amount of activity budgets spent on social behaviour for the sykes monkeys. Significant differences shown above in Table 10.

Table 11. Demonstration of the relationships between the enrichment types for the enrichment use category of the sykes monkeys. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment		X		X	X		X	X	X	
Leaf Litter	X		X	X	X	X	X			X
Hammocks		X					X	X	X	
Foliage Balls	X	X						X	X	
Rock Piles	X	X						X	X	
Coconuts		X					X	X	X	
Elevated forage	X	X	X			X				X
Branched floor	X		X		X	X			X	X
Sand piles	X		X		X	X		X		X
Ice Blocks		X					X	X	X	

3.2 Whole Group: Enrichment Use

When considering the entire group of primates at Colobus Conservation within subject contrast test of a general linear model showed that enrichment type does significantly affect the amount of time

in which an enrichment is used (df: 1, F: 11.681, Sig: 0.003). The LSD post hoc test revealed a significant difference between many of the enrichment types which can be seen below in Table 12. Between subject analysis shows that age-sex class does not significantly change the use of enrichment across the whole group. A one-way ANOVA done across all 30 primates showed that there is a significant difference in the amount of total enrichment use between species (df: 2, F: 19.885, Sig: 0.000). The LSD post hoc test revealed significant differences between all three categories of species. Analysis of resting for the whole group was not found to be affected significantly by the enrichment type, species, age, or sex.

Table 12. Demonstration of the relationships between the enrichment types for the enrichment use of the whole group data. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment		X	X	X	X	X	X	X	X	X
Leaf Litter	X		X	X	X	X	X			X
Hammocks	X	X			X		X	X	X	
Foliage Balls	X	X					X	X	X	
Rock Piles	X	X	X			X		X	X	
Coconuts	X	X			X		X	X	X	
Elevated forage	X	X	X	X		X		X	X	X
Branched floor	X		X	X	X	X	X			X
Sand piles	X		X	X	X	X	X			X
Ice Blocks	X	X					X	X	X	

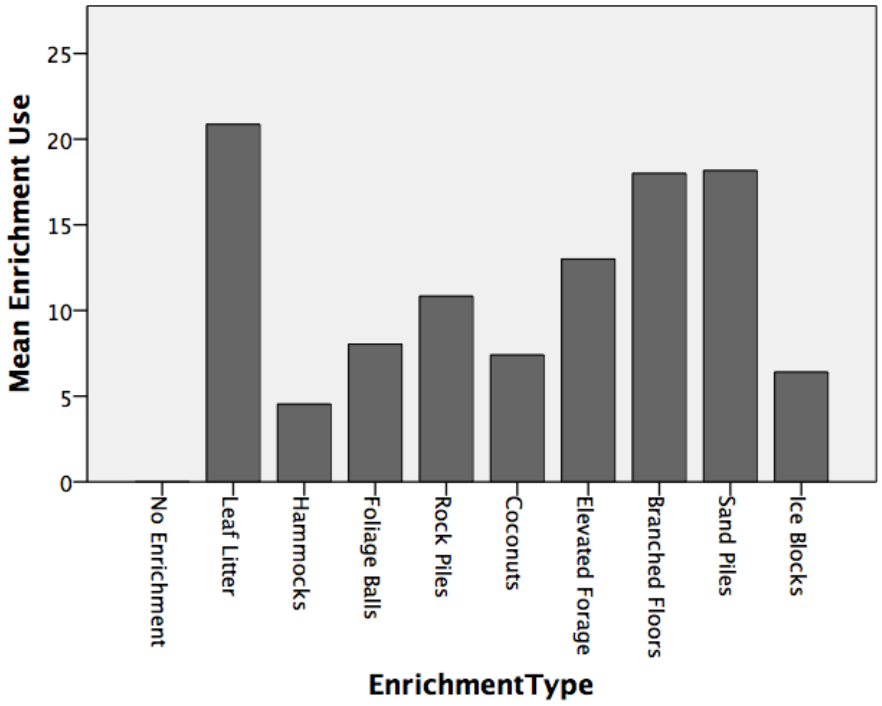


Figure 9. Mean enrichment use of the whole group data dependent on the type of enrichment. Significant differences are noted above in Table 12.

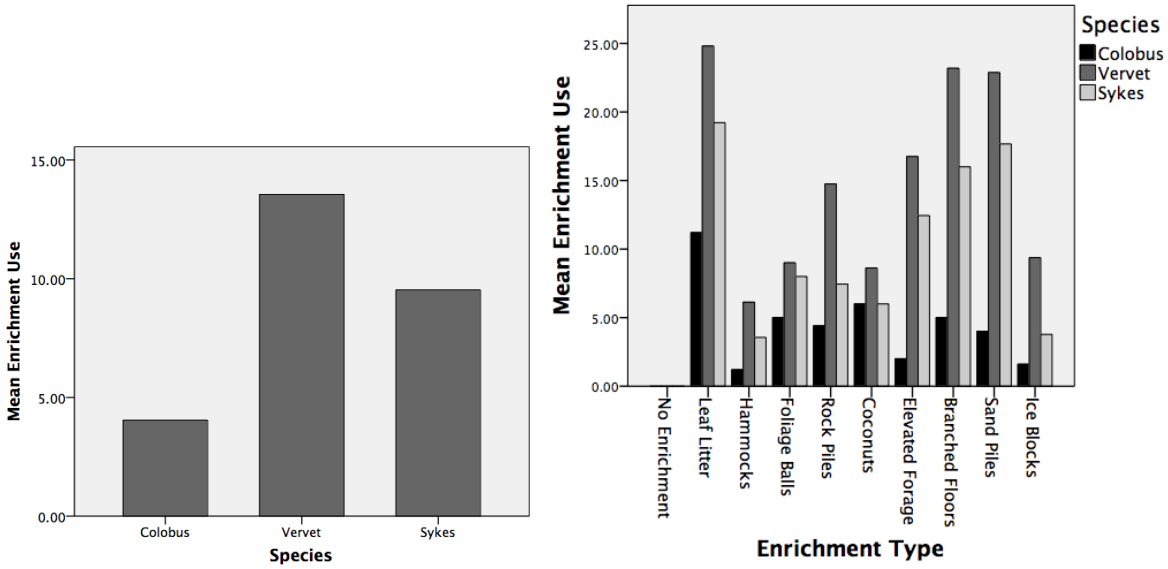


Figure 10. The above figures are from the whole group data. A) Left: The mean percentage of enrichment use from the activity budget. B) The mean enrichment use for the species, compared between types of enrichment.

3.3 Separated by Enclosures: Enrichment Use

3.3.1 Colobus Enclosure: Enclosure 1

Enrichment type does significantly affect the amount of time spent using an enrichment (df: 1, F: 43.323, Sig: 0.022). Analysis for observed rank, and age-sex class were unable to be completed due to the low sample size of enclosure 1. In the ethogram, enrichment use was observed as two types. Enrichment use was considered when the individual was alone using enrichment and sharing enrichment was considered to be when an individual was using an enrichment at the same time as another individual. Therefore, a one-way ANOVA was also done to determine if different enrichment types promoted different levels of sharing enrichment. For enclosure 1 the one-way ANOVA showed there was a significant difference in sharing of enrichment between enrichment types (df: 9, F: 3.024, Sig: 0.008). Results of the LSD post hoc test can be seen in Table 13. When resting was observed for enclosure 1 there was no significance found in the amount of time resting between enrichment types.

Table 13. Demonstration of the relationships between the enrichment types in the sharing enrichment category in Enclosure 1. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment			X	X	X		X	X		X
Leaf Litter			X							X
Hammocks	X	X				X			X	
Foliage Balls	X									
Rock Piles	X									
Coconuts			X							X
Elevated forage	X									
Branched floor	X									
Sand piles			X							
Ice Blocks	X	X				X				

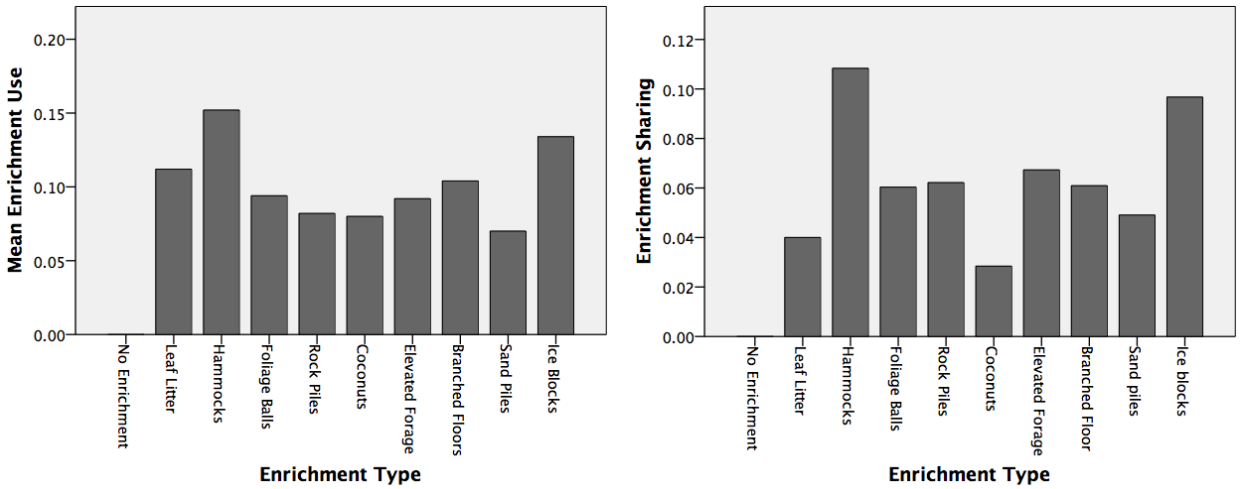


Figure 11. The above figures are for enclosure 1. A) Top Left: Mean use of enrichment between the enrichment types. B) Top Right: Mean amount of time spent sharing each enrichment type. Significant differences are noted above in Table 13.

3.3.2 Vervet Enclosure: Enclosure 2

In enclosure 2 enrichment type does not significantly affect the amount of time spent using an enrichment (df:1, F:4.319, Sig:0.173). The interaction between enrichment type and observed rank does significantly affect the amount of time spent using an enrichment (df:2, F:34.100, Sig:0.028). The interaction between enrichment type and age-sex class does not significantly affect the amount of time spent using enrichment. Observed rank and age sex class both significantly affect the amount of time spent using an enrichment (df:2, F:663.390, Sig: 0.002; df:3, F:179.279, Sig:0.006). Post hoc tests to determine the specific interactions for rank and age-sex were unable to be completed due to an insufficient amount of data in certain categories. Significance was found between enrichment types in the amount in which sharing enrichment occurred using a one-way ANOVA (df: 9, F: 8.464, Sig: 0.000). Results of the LSD post hoc test can be seen below in Table 14.

Table 14. Demonstration of the relationships between the enrichment types in the sharing enrichment category in enclosure 2. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment		X					X	X	X	
Leaf Litter	X		X	X	X	X				X
Hammocks		X					X	X	X	
Foliage Balls		X					X	X	X	
Rock Piles		X					X	X	X	
Coconuts		X					X	X	X	
Elevated forage	X		X	X	X	X				X
Branched floor	X		X	X	X	X				X
Sand piles	X		X	X	X	X				X
Ice Blocks		X					X	X	X	

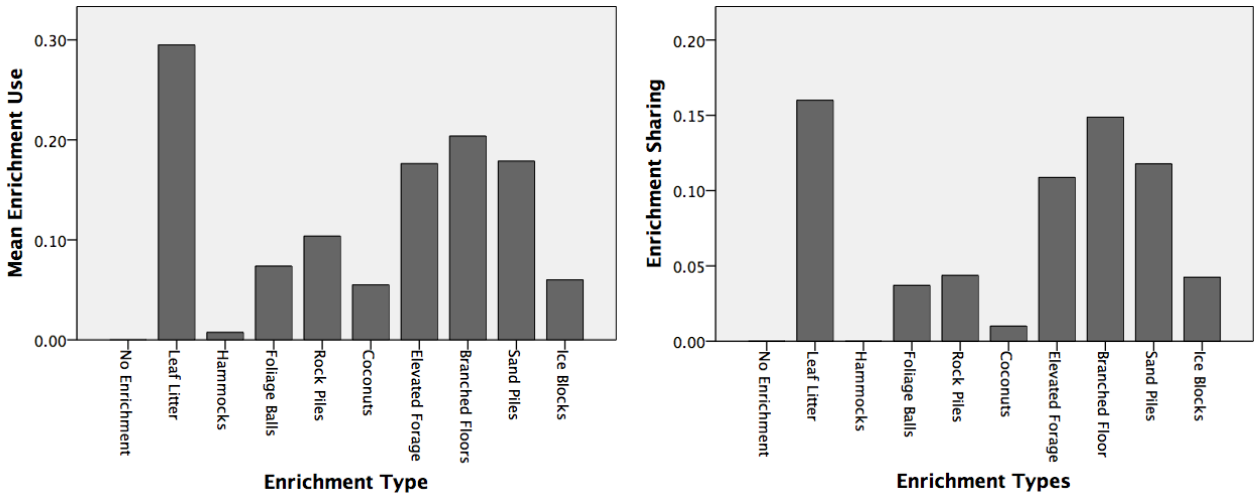


Figure 11. The above figures are for enclosure 2. A) Top left: Mean enrichment use between enrichment types. B) Top right: Mean amount of time spent sharing enrichment compared between enrichment types.

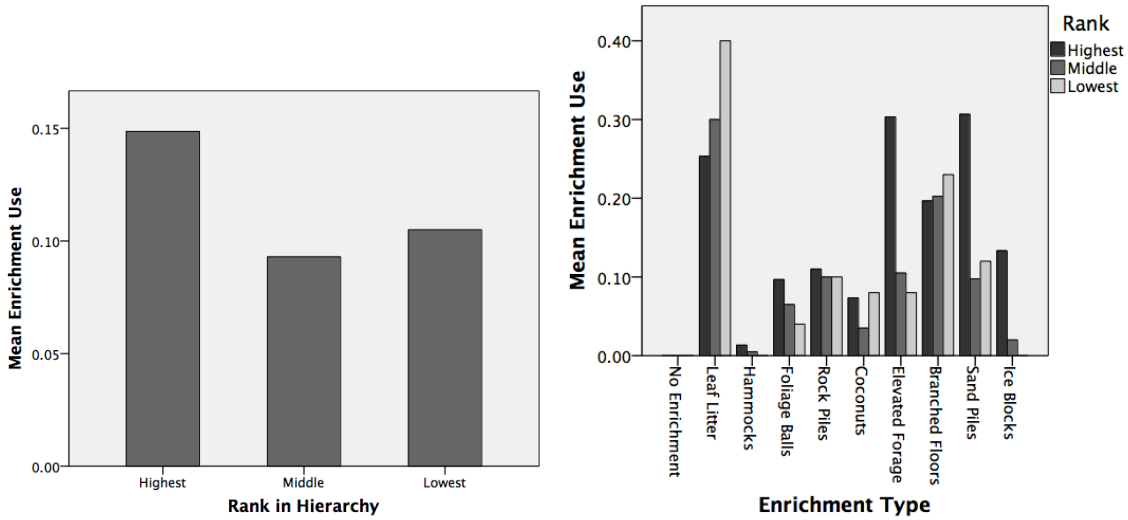


Figure 13. The above figures are for enclosure 2. A) Top left: Mean enrichment use for each rank. B) Top Right: Mean enrichment use for each enrichment type compared between rank categories.

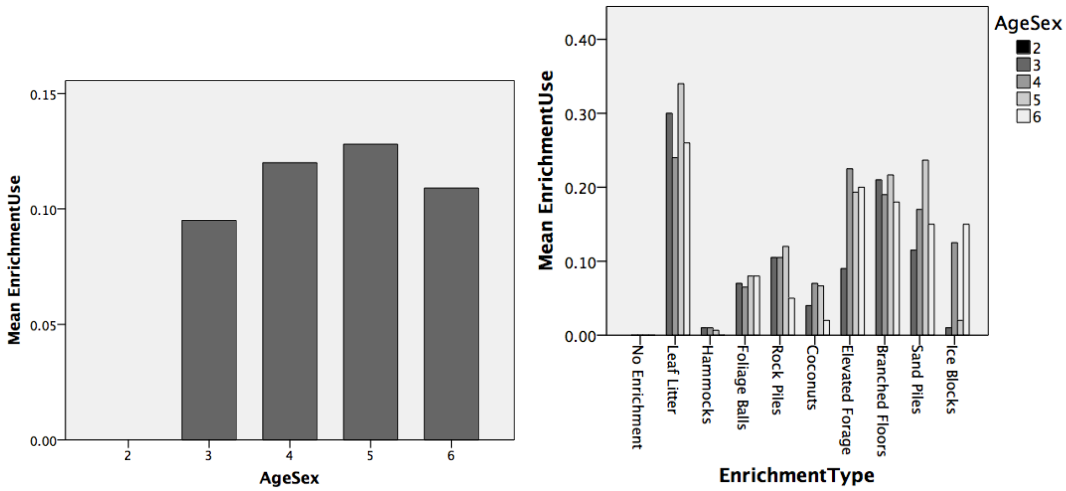


Figure 14. The above figures are for enclosure 2. A) Top left: Mean enrichment use for each age-sex category B) Top right: Mean enrichment use for each enrichment type compared between age-sex categories. Key: 2: Infant Male, 3: Juvenile Male, Infant Female, 4: Sub-Adult Male, Juvenile Female, 5: Adult Male, Sub-Adult Female, 6: Adult Female.

3.3.3 Sykes Enclosure: Enclosure 3

In enclosure 3 enrichment type does significantly affect the amount of time spent using an enrichment (df:1, F:161.052, Sig:0.006). The interaction between enrichment type and observed rank, and the interaction between enrichment type and age-sex class both do not significantly affect

the use of enrichment. Observed rank and age-sex class when considered alone, both significantly affect the amount of time spent using an enrichment (df:3, F:51.595, Sig: 0.019; df:3, F:47.621, Sig:0.021). The LSD post hoc test showed significance between all categories of rank but was unable to be completed for age-sex because of an insufficient amount of data in certain categories. Significance was found between enrichment types in the amount in which enrichment was shared using a one-way ANOVA (df: 9, F: 11.556, Sig: 0.000). Results of the LSD post hoc test can be seen below in Table 15. For the resting analysis, the time spent resting in enclosure 3 did differ significantly between enrichment types (df: 1, F: 26.581, Sig: 0.036).

Table 15. Demonstration of the relationships between the enrichment types in the sharing enrichment category in enclosure 3. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment		X		X			X	X	X	
Leaf Litter	X		X	X	X	X			X	X
Hammocks		X		X			X	X	X	
Foliage Balls	X	X	X						X	
Rock Piles		X					X	X	X	
Coconuts		X					X	X	X	
Elevated forage	X		X		X	X			X	X
Branched floor	X		X		X	X			X	X
Sand piles	X	X	X	X	X	X	X	X		X
Ice Blocks		X					X	X	X	

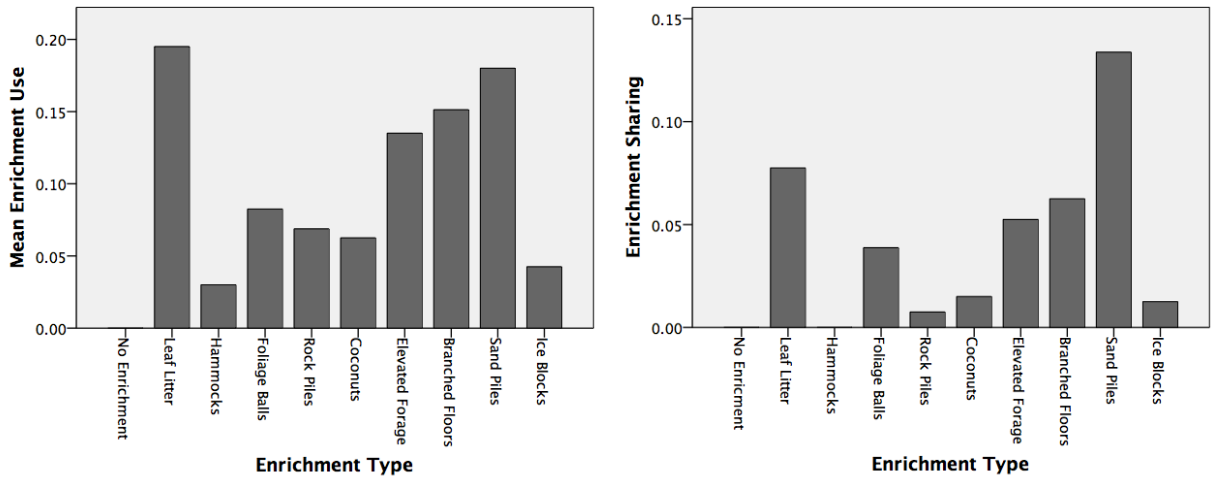


Figure 15. The above figures are for enclosure 3. A) Top left: Mean enrichment use between enrichment types. B) Top right: Mean amount of time spent sharing enrichment compared between enrichment types.

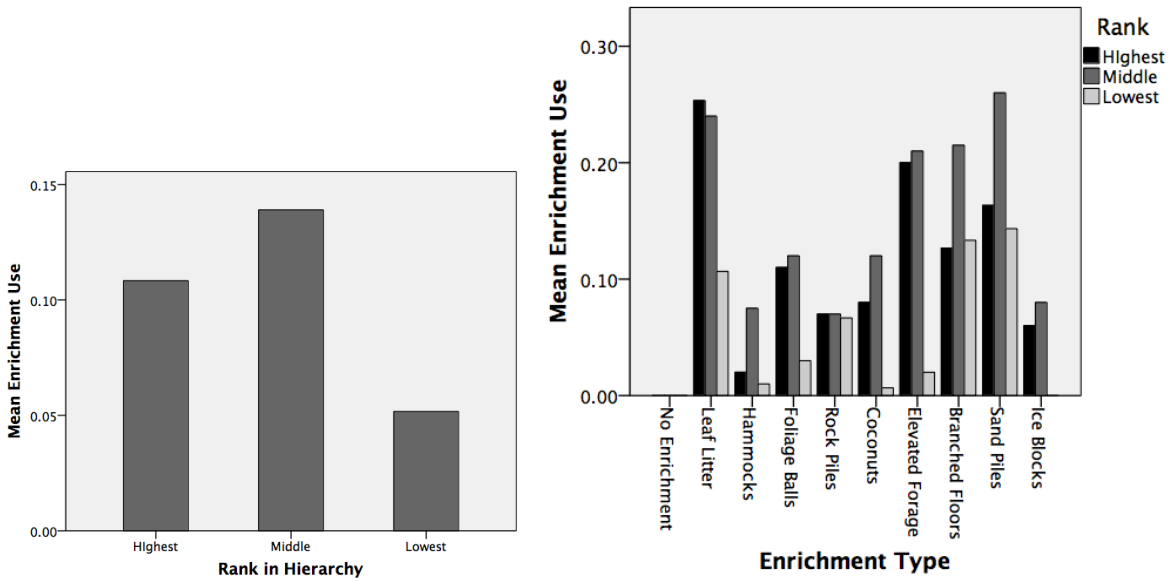


Figure 16. The above figures are for enclosure 3. A) Top left: Mean enrichment use of each rank. B) Top right: Mean enrichment use for each enrichment type compared between rank categories.

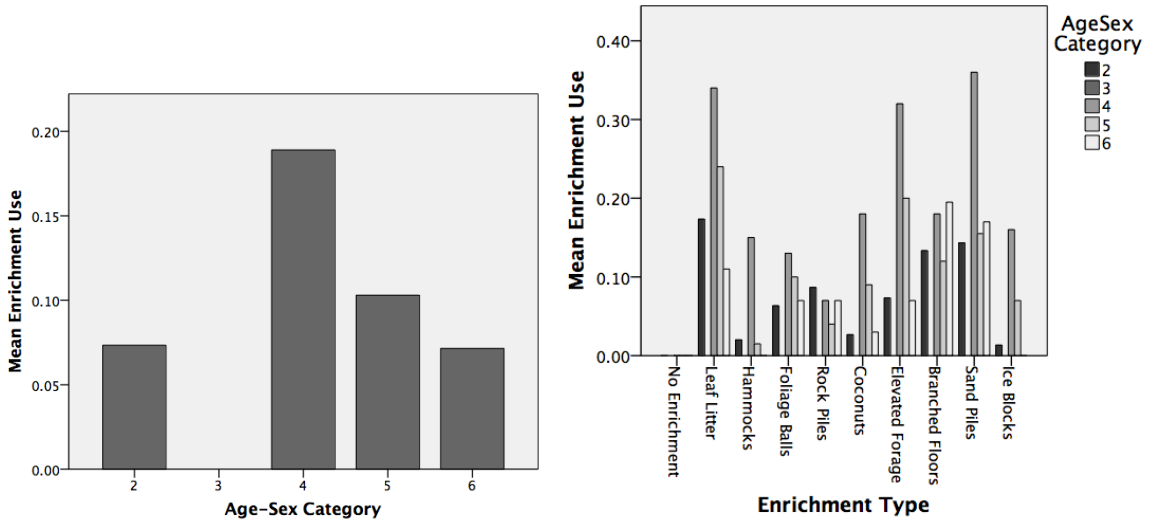


Figure 17. The above figures are for enclosure 3. A) Top left: Mean enrichment use of each Age-sex category B) Top right: Mean enrichment use for each enrichment type compared between Age-sex categories. Key: 2: Infant Male, 3: Juvenile Male, Infant Female, 4: Sub-Adult Male, Juvenile Female, 5: Adult Male, Sub Adult Female, 6: Adult Female

3.3.4 Nursery 1: Enclosure 4

In enclosure 4 enrichment type does significantly affect the amount of time spent using an enrichment (df:1, F:11.069, Sig:0.045). The interaction between enrichment type and age-sex class does not significantly affect the amount of time spent using enrichment. As well, age-sex class does not significantly affect the amount of time spent using an enrichment. The effect of observed rank was not tested on this nursery enclosure. Using a one-way ANOVA significance was found between enrichment types for amount of sharing enrichment (df: 9, F: 13.447, Sig: 0.000). Results of the LSD post hoc can be found below in Table 16. Resting was not determined to be significantly different between enrichment types for this enclosure.

Table 16. Demonstration of the relationships between the enrichment types in the sharing enrichment category of enclosure 4. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment		X	X		X		X	X	X	X
Leaf Litter	X				X			X	X	
Hammocks	X				X			X	X	
Foliage Balls					X			X	X	
Rock Piles	X	X	X	X		X	X		X	X
Coconuts					X			X	X	
Elevated forage	X				X			X	X	
Branched floor	X	X	X	X		X	X			X
Sand piles	X	X	X	X	X	X	X			X
Ice Blocks	X				X			X	X	

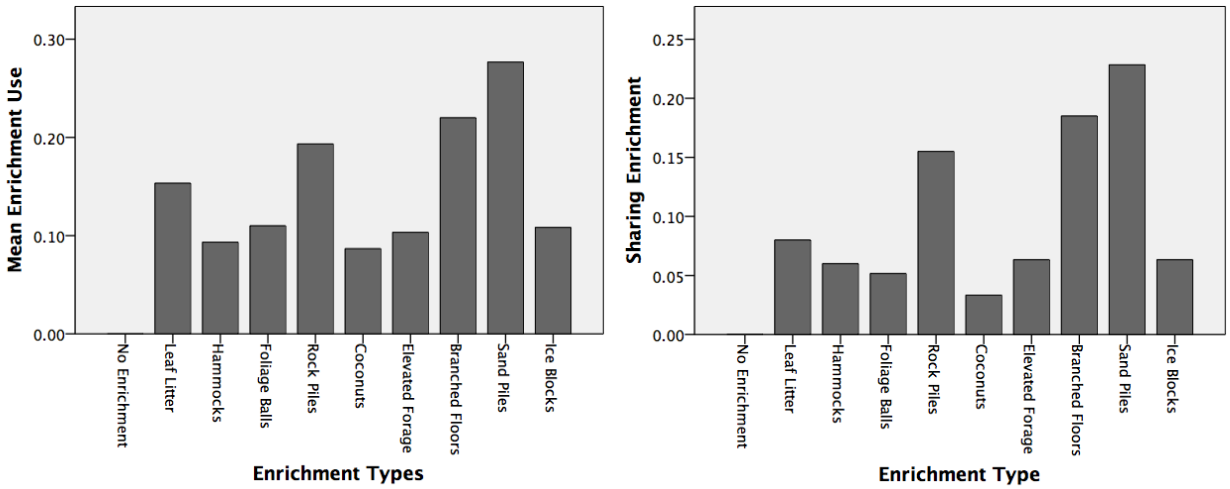


Figure 18. The above figures are for enclosure 4. A) Left: Mean enrichment use of each enrichment type. B) Right: Mean amount of time sharing enrichment compared between enrichment types.

3.3.5 Nursery 2: Enclosure 5

In enclosure 5 enrichment type does not significantly affect the amount of time spent using an enrichment. Analysis of age-sex class could not be completed due to the small sample size of for this data as well the effect of observed rank was not tested on this nursery enclosure. A one-way ANOVA comparing the amount of sharing between enrichment types shows a significant difference

(df: 9, F: 14.104, Sig: 0.000). The results of the post hoc test can be found below in Table 17.

Amount of time resting was not determined to be significantly different between enrichment types for this enclosure.

Table 17. Demonstration of the relationships between the enrichment types in the sharing enrichment category for enclosure 5. Where there is an X there is a significant difference between the two enrichments.

	No Enrichment	Leaf litter	Hammocks	Foliage balls	Rock piles	Coconuts	Elevated forage	Branched floor	Sand piles	Ice blocks
No Enrichment		X			X		X	X	X	
Leaf Litter	X		X	X		X				X
Hammocks		X			X		X	X	X	
Foliage Balls		X			X		X	X	X	
Rock Piles	X		X	X		X		X	X	
Coconuts		X			X		X	X	X	
Elevated forage	X		X	X		X		X		X
Branched floor	X		X	X	X	X	X		X	X
Sand piles	X		X	X		X	X	X		X
Ice Blocks		X			X		X	X	X	

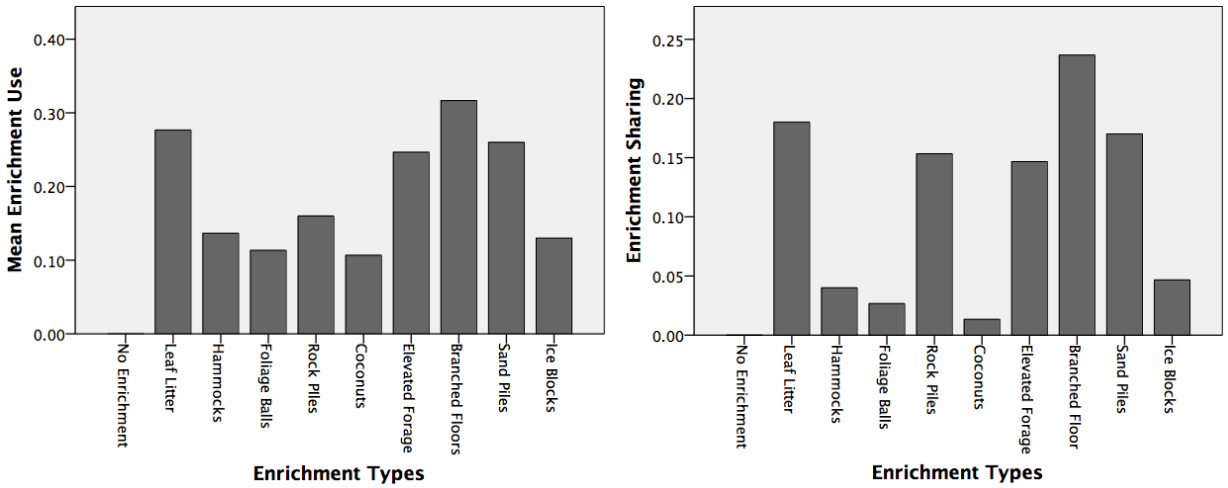


Figure 19. The above two figures are for the enclosure 5. A) Left: Mean enrichment use compared between enrichment use. B) Right: Mean amount of time sharing enrichment compared between enrichment types.

3.4 Results of Enrichment Evaluations

The results of ranking the enrichment using the scoring system can be seen below in Table 18**.** The full details of determining the ranks can be found in Appendix 3. Based on this system the best enrichment in terms of the difficulty to construct, safety and cost is the leaf litter. The worst based on this ranking system were the branched floors and the ice blocks. Leaf litter was very easy to construct, cost very little (only the seeds and nuts), and had low safety concerns for both the monkeys and the staff. Although leaf litter is not reusable, the above facts make leaf litter the most beneficial according to these methods. The branched floors had a medium difficulty of construction, a price that fell mid-range, and a few minor safety concerns towards humans involving the collection of the branches. The increased price combined with the fact that this enrichment was not reusable caused it to be considered one of the least beneficial enrichments at Colobus Conservation. Ice blocks had a low difficulty of construction, the highest price out of all the enrichments, and very low safety concerns towards the monkeys and the staff. The high cost of the fruits and vegetables used in this enrichment combined with the fact that it is not reusable cause ice blocks to be considered one of the worst enrichments at Colobus Conservation. The results of this evaluation cannot be considered on their own for various reasons and therefor will be discussed alongside the behavioural data for a more thorough evaluation and understanding of the enrichment.

Table 18. The rank of enrichment types based on the scoring system. The lower the value the better the enrichment is in terms of difficulty to construct, safety, and cost.

Enrichment	*Rank*
Leaf Litter	7
Hammocks	8
Rock Piles	8
Elevated Forage	8
Sand Piles	8
Foliage Balls	10
Coconuts	11
Branched floors	12
Ice Blocks	12

4. Discussion

4.1 Enrichment Use

4.1.1 Enrichment Use by Enclosures and Species

The most important result of this study showed that enrichment type did have an effect on the use of enrichment by the primates, therefore, certain enrichments were used more than others. When considered as a whole group, enrichment type significantly affected the average use of enrichment. As a whole group the enrichments used the most were the leaf litter, branched floors, and sand piles**.** The enrichments used for the shortest period when available were the hammocks and the coconuts. The animals in different enclosures also showed different preferences for enrichment. The monkeys in enclosure 1 used the hammocks and ice blocks most, while those in enclosure 3 used leaf litter, elevated forage, branched floors, and sand piles. The monkeys in enclosure 4 preferred the branched floors, sand piles, and rock piles. Although not found to be significantly different, the monkeys in enclosures 2 and 5 did have a preference for certain enrichment. The monkeys in enclosure 2 used leaf litter most while those in enclosure 5 used the leaf litter, branched floors, sand piles, and elevated forage most. With enclosure 1 as an exception the top five most used enrichments were the leaf litter, branched floors, sand piles, elevated forage and the rock piles. All five of these enrichments were foraging enrichments, and most of these enrichments were located on the floor of the enclosures.

Since the enclosures at Colobus Conservation are split by species type (with the exception of Pendo who is a sykes in a nursery full of vervets) it makes sense to consider the enclosure results alongside the species results. Species type was also hypothesized to affect the amount of enrichment use. Based on the whole group data we can see that the three species of primates use enrichment in

significantly different amounts. The vervet monkeys appear to generally use enrichment more, as well as they use each individual enrichment more than the other two species. The colobus monkeys generally use enrichment less than the other two species. Each species also demonstrates a preference for a particular type of enrichment. The enrichment the vervets and sykes monkeys prefer are the top five that were mentioned above as the most popular when referring to enclosures; leaf litter, branched floors, sand piles, elevated forage, and rock piles.

These results, as well as supporting the hypotheses made in the study, are well matched with the literature on enrichment. Leaf litter, and other type of foraging enrichments have been proven to be quite popular and effective across primate species (Bryant et al. 1988; Watson et al. 2007; Fuller et al. 2010). In general any enrichment that covered the floor led to beneficial outcomes such as a decrease in aggression and an increase in play behaviours (McKenzie et al. 1986). On top of being preferred, foraging enrichments have been proven to be incredibly successful, promoting an improved psychological wellbeing in both old and new world primates (Bryant et al. 1988). Inversely, the lack of ability to forage has been associated with an increase in animals showing stereotypic behaviours (McKenzie et al. 1986), while the inability to promote foraging behaviour has been proven to be a big reason why releases of primates have previously failed (Watson et al. 2007).

Enrichment literature shows that husbandry routines, especially those aspects dealing with the psychological wellbeing of non-human primates, need to be species specific, and that the environmental needs of a primate will differ between species, even those that are closely related (Seier et al. 2011; Boinski et al. 1994; Young 2003). Objects that have more biological relevance to

a species are likely to be more effective (Robins & Waitt 2011). This is well aligned with the results of my study and supports my hypotheses. Based on these results, in order to make appropriate enrichment you need to have an understanding of the species specific behaviours and natural history (Young 2003; Boinski et al. 1994). Furthermore, since reintroduction is the end goal for the primates at Colobus Conservation the enclosures should mimic the natural environment, for example the colobus monkeys are arboreal, so should not have enrichment that promotes time on the ground, but instead enrichment that promotes foraging in the trees (Maloney et al. 2006).

The results stating that the enclosures containing sykes and vervet monkeys prefer the foraging enrichment on the ground (with exception of the elevated forage) agrees with the life history information for these species. As they are both semi terrestrial species, their skeletal structure and morphological adaptations adapt them for moving between the ground and the trees (Gebo & Sargis 1994), demonstrating that not only are these foraging enrichments preferred but they are successful at promoting species specific behaviour (Fuller et al. 2010; McKenzie et al. 1986) . Wild groups of Wolfs guenons have often been observed foraging through litter on the ground for insects and fallen food (Fuller et al. 2010). A study done on baboons, a semi terrestrial species, showed they also preferred forage type enrichments that were located near the ground (Brent & Belik 1997). Colobus species are arboreal and their life history suggests that they are morphologically designed to forage, feed and spend most of their time up in the trees (Cant 1992). This could also be the reason for the previously mentioned result that overall the colobus monkeys used the enrichment least. As many of the enrichments are located on the ground (5/9), it would make sense that they are not used as often by the colobus monkeys. The two enrichments most used by the enclosure 1 were the hammocks and the ice blocks, both placed off the ground in the trees. This agrees with another study that showed suspension of food enrichment was preferred by arboreal species and created

individuals that spent more time in the trees, again aligning with the idea that the enrichments need to be species specific and promote species specific behaviours (Maloney et al. 2006).

Although in a rehabilitation program it would not be beneficial to promote time spent on the ground by a species that in the wild spends most of its time in the trees, when living in captivity, lack of aversion to the ground creates access to a lot more useable space. This can be important, and should be considered when there are constraints on enclosure size such as those at Colobus Conservation. An interesting result of a study done on arboreal monkeys demonstrated that certain types of substrate could promote an increased use of floor space (McKenzie et al. 1986). Although these enrichments under consideration are not necessarily substrate, when placed in the enclosure they could be considered a substrate and therefore these results can be compared. Since the colobus monkeys still use the enrichment on the ground, although not as much as the other two species, it would seem that the enrichment is decreasing the colobus' aversion to the ground allowing them more access to space.

4.1.1.1 Desirable Qualities

Preference for certain enrichment types could also be due to their physical qualities. The top five enrichments preferred by the sykes and vervet monkeys could be the most used enrichments because they all demonstrated manipulability and destructibility which are qualities associated with preferred enrichments (Bryant et al. 1988). Similar results have also been found in enrichment studies for pigs (Weerd et al. 2006). The substrate type of an enrichment mattered to the primates in a study by Reinhardt and Toberts and could be another reason why certain enrichments were not used as often in this study (1997). Vervet monkeys have been shown to prefer more natural substances in their enrichment, and leaf litter was the most natural based on their pre captive

environments and could attribute to reasons why it was most popular (Watson et al. 2007). Texture, shape, and smell of the enrichment could have also made a difference in the use of enrichment as seen before in other studies of non human primates (Weld et al. 1991). For example, sand piles were the least used enrichment by the colobus monkeys. This could be that they are not exposed to large tires, and sand and therefore they are not as comfortable using it. Often when observing the colobus monkeys with the tire, they seemed to watch the sand filled tire from a distance or even immediately jump up and run away after touching the sand.

Portability of an object has also been demonstrated by the literature as a reason to prefer an enrichment (Westergaard & Fragaszy 1985). In a study on orangutans, the ability to pick an enrichment up and move it around made it more desirable (Westergaard & Fragaszy 1985). Enrichments such as the hammocks and ice blocks may not have been as favoured by the sykes and vervet monkeys due to the fact that they were stuck in one place. Other enrichments such as branches and leaves could be picked up and relocated to a place where an individual could use it and feel safe from its group mates. Other qualities of enrichment that have proved desirable in other studies are the ability to make noise and be “biteable” (Westergaard & Fragaszy 1985). Most of the enrichments at Colobus Conservation, even those that have been shown to be less desirable and occupy less time by the monkeys, are “biteable”. None of the enrichments at Colobus Conservation make any type of noise.

4.1.2 Hierarchy

The results so far show that enrichment type, and species type do play a role in the overall use of enrichment by primate species. To fully understand the interactions between the primates and their enclosures one aspect of their social relationships; dominance hierarchy, needs to be considered.

Dominance hierarchies play a major role in animal species, especially birds and mammals that live in groups (Jones 1980; Hrdy & Hrdy 1976). In enclosures 2 and 3 the hierarchy did play a role in the use of enrichment. For enclosure 3 there was a difference in enrichment use between all three categories of rank (highest, middle, low). When considered as an interaction with the enrichment type, the rank did not have a significant effect on the enrichment use for enclosure 3, but did have a significant effect on those in enclosure 2. This could mean that in enclosure 3 overall the dominant individuals get more time with the enrichment, but that they do not have a preference for any one enrichment type.

In enclosure 2 when considering rank those that rank in the highest category use the enrichment most. This agrees with most literature saying that higher ranking individuals gain priority access to resources, in this case the enrichment, leading to an unequal distribution of the resources (Sapolsky 2009; Isbell & Young 1993). When considering the rank effect with the enrichment type the higher ranked individuals are no longer showing the greater use of enrichment. This could be due to individual preference of the monkey in this enclosure as there will always be a variation between individuals (Seier et al. 2011). In enclosure 3 the highest ranked individuals are not shown to have the highest use of enrichment. This, unlike the results from enclosure 2, does not agree with literature on hierarchies. One reason this could be is because the assessment of the ranking in that enclosure may not be accurate. For example, if individuals were wrongly placed into the middle category but actually belong in the higher ranking category, this would affect results for the total use of enrichment. As well, this could be caused by individual preference in the enclosures. To have a more accurate understanding of the effect of the hierarchy on enrichment access, a more thorough examination of the hierarchy should be made and then again applied to an enrichment study. Since

it is obvious that hierarchy is playing a role in the use of enrichment at Colobus Conservation it is important to design the enrichment program accordingly. Any enrichment that can be dominated by a higher ranking individual is ineffective at allowing other individuals to benefit. This domination of certain enrichments was demonstrated in a study of guenons at the Edinburgh Zoo (Young 1998). Furthermore, the literature shows that these dominance hierarchies affect resource use more so when a resource is limited (Jones 1980). This would suggest that the hierarchy affect is stronger on enrichment use when there are fewer enrichments in an enclosure. This can be seen in enclosure 2 and 3 with the ice block enrichment. When the ice block enrichment is in an enclosure there are only one or two blocks hung up, as opposed to leaf litter which is spread out on the floor of the enclosure. This means that the ice blocks can be dominated by the higher ranking individuals. Therefore, lower ranking primates would not have access to the enrichment, and would not gain any of the benefits from the enrichment. If there were many more ice blocks spread throughout the enclosure, the resource could be considered not limited and the dominance hierarchy wouldn't have as strong of an effect. For example, with leaf litter the highest ranking individuals use enrichment more so priority access is still occurring but the effect is not as strong, because the lowest ranking category still gets to use the enrichment. This is unlike ice blocks where only dominant individuals get access to enrichment. The hierarchal effect on enrichment use would also be reflected in the levels in which enrichment access is shared in each enclosure.

4.1.3 Sharing Access

The way that primates share access to their resources (enrichment) plays important roles in their social stability (Sushma & Singh 2006). Social stability is especially important in groups of primates living in captivity undergoing rehabilitation for release (Guy et al. 2014; Guy et al. 2012). Therefore, within an enclosure the enrichment should promote the social group by encouraging

affiliative behaviours such as sharing. For the purpose of this study sharing was when an individual used an enrichment at the same time as another individual in the enclosure. Different enrichments were found to promote different levels of sharing in all 5 enclosures at Colobus Conservation. Individuals in enclosure 1 shared enrichment most when it was hammocks and ice blocks. The individuals in enclosure 2 shared the enrichment more for the leaf litter, elevated forage, branched floors, and sand piles. Those in enclosure 3 shared most with the leaf litter and sand piles enrichments. The monkeys in enclosure 4 shared most when rock piles, branched floors, and sand piles were present. Lastly, individuals in enclosure 5 shared most when the enrichments were leaf litter, rock piles, elevated forage, branched floors, and sand piles. In general, it appears that sharing occurred most in the more popular enrichment types in each enclosure. As well, shared access was more common in enrichments that were more abundant, or more dispersed in the enclosure which is supported by the argument above that limited resources are more easily monopolized by dominant individuals (Jones 1980). Similarly, literature on certain foraging models show that the more plentiful the resource that an individual has the more likely it will be shared, or that the others in a social group will have access (Bitetti & Janson 2001). Furthermore, one case in the literature showed that affiliative (sharing) behaviours increased with litter type enrichments for primates (Fuller et al. 2010). This is consistent with the results that those in enclosure 2, 3 and 5, shared access most when leaf litter was in the enclosure. To strengthen findings for which enrichments promote affiliative sharing behaviours, future studies could define a proximity that individuals must fall in to be considered as sharing.

4.1.4 Age-Sex

Past literature shows that animals of different ages and sex behave differently and respond differently to their environment. Therefore, I hypothesized that the primates in this study would

interact differently with the enrichment based on their age-sex class. This hypothesis was only partially supported by my results. The age-sex class of an individual did not significantly affect the amount of time spent using enrichment when considering the whole group data and enclosure 4. Logically it makes sense that the data from enclosure 4; the 1st nursery enclosure, would not show an effect by age-sex class, as most of the individuals in that enclsoure are of similar age and sex. When focusing on enclosure 2, and 3 the age-sex class did affect the amount of enrichment use.

In enclosure 2 the age-sex categories that use enrichment most were 4 and 5; Sub-Adult Male, Juvenile Females, Adult Male, and Sub-Adult Female. In enclosure 3 the age-sex categories that use the most enrichment was category 4 Sub-Adult Males. When comparing the age-sex categories with the individuals in each enclosure the results show that older female individuals generally use enrichment most in enclosure 2, while enclosure 3 demonstrated that the single Sub-Adult Male uses enrichment most. The literature on age and sex effects on enrichment use are fairly inconsistent, although I wasn't able to find many papers showing effects of age and sex specifically on enrichment use in primates. In a study on 2 species of lemurs, it was shown that there was no significant difference of daily activities based on the sex of the individuals (Maloney et al. 2006) while in a study on howler monkeys the age-sex class was found to affect their activity budgets (Prates & Bicca-Marques 2008). Another more current study on a closely related species of primate, the Wolf's guenon, demonstrated that in all cases the adults used the enrichment more, supporting my results for both enclsoures 2 and 3 (Fuller et al. 2010). Additionally, some cases show that females tend to be more aware of enrichment, which could be why in this study females were observed using enrichment more than males (Blois-Heulin & Jubin 2004). Female rhesus macaques were observed to use enrichment that could be manipulated more so than the males, while in

longtail macaques the opposite was found (Lutz & Novak 2005). Lastly, vervet monkeys have previously demonstrated a sex preference for their enrichment types, supporting results from enclosure 2 (Lutz & Novak 2005).

Due to the small amount of available literature on age-sex and enrichment use I also pulled results from studies on other mammal species such as mice, pigs, and pandas where effects of sex and age on enrichment use have been studied. In a study on captive pandas it was determined that sex did not have an effect on responsiveness to enrichment while age did (Swaisgood et al. 2001). For mice, behaviours caused by enrichment had a strong correlation with sex (Lin et al. 2011). Different behaviours were shown to be increasing or decreasing in male mice, while others demonstrated increases and decreases for females (Lin et al. 2011; Stam et al. 2008). Lin et al. found that behaviours linked to enrichment differed between male and females in mice, which they stated could be caused by internal biological functions (Lin et al. 2011). With pigs gender was found to have no effect on enrichment use, while age did (Docking et al. 2008). Overall, I believe that the data on age-sex effect on enrichment use requires more evaluation. Furthermore, the effect of age and sex should be considered on a species specific basis as the results appear to differ greatly. When choosing enrichment age and sex should always be considered alongside factors such as species, and hierarchy as these appear to have stronger effects on enrichment choice.

4.2 Activity Budgets

4.2.1 Colobus Monkey Activity Budgets

Comparing activity budgets of captive animals with their counterparts in the wild is a common way used to assess their wellbeing (Young 2003; Boinski et al. 1994). Therefore, activity budgets were created for each of the three species of primates at Colobus Conservation. The activity budget for

the colobus monkeys showed that a large amount of their time was spent on feeding (29.8%) followed by resting (23.3%). They also spent a large amount of time in the other category (26.6%) which was mostly dominated by vigilance behaviours. The colobus monkeys spent a much smaller amount of time on social behaviours (6.8%) and moving around the enclosure (4%). The colobus observed spent almost no time being aggressive (0.04%). This activity budget is very similar to that of a wild black and white colobus. In the wild, colobus have been shown to have an activity budget of 42% feeding, 32% resting, 20% moving, 5% social behaviour and 1% other (Mammals of the world). Both activity budgets are similar in that most of the colobus' time was spent resting and feeding. The discrepancy between the other category could be due to the fact that different behaviours were considered as part of the other category for each study.

The above colobus monkey activity budget from my study is an average of all the activity budgets of each colobus individual for each enrichment type. When the activity budgets were compared between enrichment type the results supported the hypothesis that the enrichment would change the activity budget by altering amount of time in each category. This result also coincides with the literature which says some enrichments alter behaviour more effectively, or in different ways than others (Tarou & Bashaw 2007). Resting by colobus monkeys was only seen to be different between two of the enrichment types, the leaf litter and the coconuts but overall did not change with the enrichment type. The social category overall did not differ with the enrichment type although there were a few enrichments that showed very different mean amounts of social behaviour. Social behaviour by colobus monkeys was at its lowest when the hammocks were in the enclosure and at its highest when the foliage balls were in the enclosure. As the social category of the activity budget does not indicate that they are not sharing enrichment this could indicate that they prefer the

hammocks, and therefore are spending less time with social behaviours and more time with that enrichment. This would coincide with the results that hammocks are favored. This could indicate that for the movement category of the activity budget colobus monkeys spent significantly different amounts of time moving between enrichment types. They spent the most amount of time moving when there was no enrichment present and the least amount of time moving when the hammocks and the ice blocks were present. Again, this aligns with the above result that the hammocks and the ice blocks were the most used enrichment types by the colobus monkeys. When these two enrichments were present the colobus spent less time moving around and more time focused on the enrichment. The promotion of more time moving around by the no enrichment category may at first be seen as a benefit of having no enrichment, but in fact could demonstrate that when there was no enrichment in the enclosure the colobus monkeys were bored and were moving around their enclosure aimlessly to occupy their time.

4.2.2 Vervet Monkey Activity Budgets

The vervet monkey activity budget revealed that they spent most of their time on feeding (41.23%) followed by resting (15.2%) and enrichment use (13.55%). A large amount of their activity budget was also the other category (12.86%), dominated by vigilant behaviours. This large amount of vigilant behaviour around their social group and towards their social group is very common in gueno species that live in similar types of social groups (Young 1998). The vervet monkeys spent a small proportion of their time on social behaviours (7.73%) and moving (13.55%). Similar to the colobus the vervets monkeys spent almost no time on aggression (0.19%). Wild activity budgets of vervets found in previous studies are very similar to the activity budget found in this study. In one study the wild vervets spent the largest proportion of time resting (44.35), followed by feeding and

foraging (26.3%). The time spent moving was 14.2%, social activities 10.7%, and lastly other at 4.5% of the activity budget (Saj et al. 1999).

The results of the vervet monkey activity budgets also supports the hypothesis that the enrichment type would alter the activity budgets. Resting by vervet monkeys differed significantly between many enrichments. Resting appears to be greatest when the enrichments leaf litter, foliage balls, branched floors, and sand piles are present. This does not match with the fact that earlier it was shown that most of these enrichments were of the top 5 most used by enclosure 2, 4 and 5. It could be that as they are the most used enrichment types the resting is high because they need to recuperate after enrichment use but that seems unlikely and at this point I have no support for that claim. The social behaviour category of the vervet monkey activity budgets did significantly differ between enrichment types. The most social behaviours are demonstrated during the presence of no enrichment, ice blocks, foliage balls and rock piles. Similarly, to what was seen by the colobus monkeys, the least used enrichments by the vervets presented with the highest percentage of social behaviours. Again I believe this demonstrates that when the enrichment is not present and when less preferred enrichment is in the enclosure they have more time for social behaviours.

4.2.3 Sykes Monkey Activity Budgets

The activity budget for the sykes monkeys revealed that they spent most of their time on feeding (41.48%), followed by resting (20.16%), and other (13.78%). The other category is again dominated by vigilant behaviours. Similarly to the vervet monkeys, the sykes spend a large amount of time being vigilant towards their group members and their environment which is often seen when observing their wild counterparts (Young 1998). A smaller portion of their activity budget was spent on social behaviours (3.75%), moving (11.36%) and enrichment use (9.53%). Similar to both

the colobus and the vervets observed, the sykes monkeys spent very little time on aggressive behaviours (0.37%). Another study of sykes monkeys revealed a similar activity budget in that feeding occupied the greatest amount of time (Butynski 1990). The time spent resting was slightly different as it showed the wild sykes spent much less time resting than the sykes at Colobus Conservation (Butynski 1990). Another study done on wild female sykes monkeys revealed an activity budget comparable with mine. Social behavior 7.4%, resting 42%, feeding 33% and locomotion 11% (Pazol & Cords 2005). Butynski reported an activity budget of ~35.43% on feeding and foraging, 23.9 scanning, 20.55% climbing, 10.2% resting, 1.03% foraging, 1.67% auto groom, 8.1% grooming, and 24.01% on miscellaneous (Butynski 1990).

The sykes monkeys also supported the hypothesis that activity budgets would be altered by the enrichment type. The only category that differed significantly between types was the enrichment use. The difference in social behaviour between enrichment types was only revealed using the post hoc test. Social behaviour was at its highest for sykes monkeys when there was no enrichment, foliage balls, and ice blocks. This again supports the idea that when there is no enrichment, or when there is an enrichment that is not used as much by this species than they can spend more time engaged in social behaviours.

4.2.4 Aggression

Amongst the primates located at Colobus Conservation there was very little aggression witnessed during the study period. Aggression was only observed as 0.04% of the activity budget for the colobus monkeys, 0.19% for the vervets, and 0.37% for the sykes monkeys. Aggressive behaviour for the colobus was only witnessed during observation for one enrichment type and that was foliage balls. For the vervet monkeys' aggression was highest during the elevated forage. Elevated forage is

easily dominated by one individual and therefore more aggression could occur as submissive individuals try to gain access to the enrichment. Aggressive behaviour did not differ for the sykes monkey, meaning no single enrichment promoted more aggression between individuals in the sykes enclosure. The aggressive behaviours witnessed were those such as chasing individuals around the enclosure for short, or prolonged periods of time. Usually dominants chasing subordinates. Lunging or biting at other individuals as well as eye threats also occurred. These aggressive instances mostly occurred when food or enrichment was in the enclosure. Reasons that the agnostic behaviour levels were not very high in these enclosures could be due to the fact that food was often widely distributed in the enclosure and not confined to a certain area. This wider distribution of food has been showed to cause lower levels of agnostic behavior versus when the food is distributed in a single area (Young 1998). As well, enrichment associated aggression has been shown to occur less often when there is enough enrichment to go around (Brent & Belik 1997). These results, similar to those of Westergaard and Fragaszy, are considered a positive finding because the enrichment is not interfering with the social group in an immense negative way (Westergaard & Fragaszy 1985). The results of low aggression in sykes monkeys are also consistent with the literature on wild sykes, showing that there is very little agnostic behavior in their troops (Klass & Cords 2015). Low levels of aggressive behavior have also been recorded for many colobus species (Klass & Cords 2015).

There were instances of aggression that occurred when observations were not being made that therefore did not show in the activity budgets of these primates. Aggression was sometimes seen just after observations had been made, or during days or periods of time when I was not conducting my study. This underestimation of behaviours such as aggression is a common downfall of the scan sampling methodology (Altman 1974; Martin & Bateson 2007). Although it gives an excellent

overview of the entire activity budget it becomes lacking and underestimates more cryptic behaviours such as aggression. Continuous sampling methods would provide much more accurate and thorough results for levels of aggression (Martin & Bateson 2007). This aside, aggression is a necessary aspect of social bonding and "restrained" aggression is even important in building relationships (de Waal 1986). Therefore, combining aggression witnessed during the observations and aggression witnessed ad libitum outside of my observation periods, the aggressive behaviours of the monkeys at Colobus Conservation fall into quite normal ranges and don't appear to be anything that could be a problem for release or anything signifying a problem in the troops social stability.

4.2.5 Stereotypic Behaviour Present at Colobus Conservation

One result of enclosures that lack novelty, lack complexity and do not allow control by their inhabitants is stereotypic behaviour (Swaisgood et al. 2001). Stereotypic behavior is defined as a repetitive behavior that is unvarying and used as a coping mechanism when captive environments provide inadequate stimulation (Mason et al. 2007). The presence of stereotypic behavior in the primates at Colobus Conservation is very minimal. Only one of the individuals found at Colobus Conservation displays obvious stereotypic behavior, that individual being Betsy. Betsy, is an adult female colobus monkey who came to Colobus Conservation after being found abandoned by her troop. During my observations I made note of a behaviour where she continually rotates her arm, up and down, as if scratching her underarm. This behaviour is repeated whenever humans are around. The other staff at Colobus Conservation have also noticed this behaviour. Betsy's behaviour is caused by a very intense hand rearing schedule when she was brought into Colobus Conservation. This was due to the fact that she was one of the first colobus infants who survived being hand reared and therefore the protocol had not yet been developed. A study done quantifying stereotypic

behaviour in captive animals showed that out of all primate species in captivity almost 40% demonstrated some sort of non locomotor behaviour similar to Betsy's hand motion (Mason et al. 2007).

4.3 Combining Enrichment Qualities and Behavioural Data

When considering the behavioural data alongside the enrichment evaluations there are no enrichments that I would suggest be removed from the enrichment program at Colobus Conservation. Although I would suggest that Feathers be used as an enrichment of opportunity, meaning that when feathers can be found and collected they should be added to the enclosures. There were of course some enrichments that stood out and should be mentioned.

4.3.1 Leaf Litter

Leaf litter was among the enrichments that stood out. Leaf litter could be used to forage, eat, and it could be picked up and carried around. Leaf litter was the most used enrichment by enclosures 2, 3 and 5 with high levels of sharing and minimum levels of aggression. The leaf litter cost very little in price and had no safety concerns. Its manipulability, portability and naturalistic appearance make it a top preference for many monkeys. Leaf litter that promotes foraging behaviours has also been mentioned to be beneficial for training animals in species specific behaviours for a successful release. Based on the behaviour results, the enrichment evaluations and the literature on foraging enrichment, I would say that leaf litter is the best enrichment at Colobus Conservation and I would suggest its further distribution to all the enclosures.

4.3.2 Ice Blocks

Ice blocks were also among the list of enrichments that stood out. Ice blocks promoted foraging and were hung from parts of the enclosure that required the monkeys to develop balance and stability to reach. Based on the behavioural data it appears that the colobus monkeys used the ice block

enrichment the most. As an arboreal species the ice blocks were excellent at promoting foraging while not encouraging the colobus to be comfortable on the ground. Ice blocks did not encourage high levels of aggression but could be dominated by a single individual since there were either only one or two hung in an enclosure. Ice blocks were the most expensive, due to the fact that they contained fruit and vegetables. They had very little safety concerns but took the longest to make because they needed to be left overnight to freeze. An interesting feature of the ice block enrichment was that they melted. This caused a unique problem in that this enrichment could only be used for a very short and specific period of time. When the ice had melted, there was nothing left to enrich the enclosure. Unlike for example branched floor, when all the seeds are gone the branches still remain to be eaten and played with. This short window of opportunity could have affected the appearance of use of this enrichment in enclosures 2 and 3. It may have appeared throughout this study that it was only used for a short time when really it was just because it was only available for that time. I think ice blocks should continue to be an enrichment provided in the enrichment schedule at Colobus Conservation for all primates as it was a very unique enrichment and does not cause any obvious problems. If possible many smaller ice blocks could be provided allowing for all individuals to gain access.

4.3.3 Other Enrichments

Although the other enrichments fell in the middle in terms of enrichment use there are a few that have interesting qualities worth pointing out. The hammocks enrichment did not promote very high levels of sharing except for in enclosure 1. Hammocks were often dominated by a single individual which prevents all other individuals from benefiting. This was also seen with the coconut enrichment. Rock piles were interesting in that they posed a unique safety concern for the primates because if one of the monkeys got any part of their limbs caught under the rocks while they forage

they could be easily injured. I think that this safety concern can be avoided as long as rock piles are not piled high from the ground. Sand piles, hammocks, and elevated forage are the only enrichments that had a semi naturalistic appearance. The tires and containers that are used to contain the sand for the sand piles are human objects, hammocks are made of fabric, and the elevated forage is sometimes hung in plastic baskets. The presence of tires, buckets, baskets and fabric could encourage released primates to approach human properties which could become problematic. This should be evaluated in further research although under the circumstances it would be hard to exclude every aspect of manmade objects from the enrichment program.

4.4 Implications for Other Facilities Housing these Species of Non human Primate

Although the results of this study can be considered specific to the individuals and the environment at Colobus Conservation this data can also be used by other animal housing facilities with these or similar species. This study adds to the behavioural understanding of the black and white colobus, the vervets and the sykes monkeys. It allows for the continued improvement of captive care for primates through improving enrichment knowledge. This paper provides a thorough examination of nine separate enrichment devices, some physical, some foraging. It adds to the current literature proving that forage type enrichments are promoting species specific foraging behaviours as well as reducing stereotypies and aggression. Using this paper, animal care facilities that house non human primates could choose enrichment for the same or similar species and could use the enrichment evaluations to learn how to make these enrichments. Overall this study allows for the better understanding of environmental enrichment and a continued improvement of captive primate welfare.

4.5 Suggestions for the Future

Due to the short time period of this study I was unable to determine if the background of an individual affects their use, and preference of enrichment. Therefore, for future research at Colobus Conservation I would suggest that an analysis of how an animal's history affect the enrichment use. For example, do primates that are ex pets respond differently to enrichment than primates who were found abandoned? And do they have differing success rates in release because of this? This question was also posed by Watson who wanted to know if behavioural types affect the enrichment success, and therefore the release success (2007).

I also believe a more thorough analysis of behaviour or activity budget could be done between periods of the day when enrichment is available and when it isn't. One author suggested that in order to fully understand the effectiveness of enrichment it would be necessary to compare the activity budgets of animals during the part of the day in which they have enrichment and the part of the day in which they do not (Swaisgood et al. 2001). Lastly Colobus Conservation could attempt to try adding different enrichments to their schedule followed by a replication of this study.

5. Conclusion and Recommendations

Based on results from this study it can be concluded that enrichment type will have an effect on its use because certain species, certain ages, and certain genders of animals may have a different preference for enrichments. As well, my research adds to the literature that enrichment should be species specific and designed with a large knowledge of the natural history and the specific demands of each animal. The low levels of stereotypic behaviours, aggression and high enrichment use support the idea that the enrichment at Colobus Conservation is highly affective. I will add that

research suggests that the psychological wellbeing of an individual non human primate is affected by the enclosure size, control of the environment, social system, and enclosure complexity (Seier et al. 2011; Schapiro et al. 1997). Therefore, the apparent wellbeing of the primates at Colobus Conservation is not only due to the enrichment program, but also the size and complexity of the enclosures, the fact that enrichment is rotated, and the fact that they are socially housed primates. In conclusion my study showed that the enrichment devices in Colobus Conservation's enrichment program are inexpensive, easy to obtain, create or purchase, and most importantly effective.

6.List of references

Altman, J., 1974. Observational study of behaviour: sampling methods. *Behaviour*, 49, pp.227–267.

Baker, K., 2007. Enrichment and primate centers: closing the gap between research and practice. *Journal of Applied Animal Welfare Science*, 10(1), pp.49–54.

Bennett, A.J. et al., 2010. Multidimensional cost-benefit analysis to guide evidence-based environmental enrichment: providing bedding and foraging substrate to pen-housed monkeys. *Journal of the American Association for Laboratory Animal Science : JAALAS*, 49(5), pp.571–577.

Blois-Heulin, C. & Jubin, R., 2004. Influence of the presence of seeds and litter on the behaviour of captive red-capped mangabeys Cercocebus torquatus torquatus. *Applied Animal Behaviour Science*, 85(3–4), pp.349–362.

Boinski, S. et al., 1994. The Behavioral Profile and Environmental Enrichment of a Squirrel Monkey Colony. *Laboratory Primate Newsletter*, 33(4), pp.1–4.

Brent, L., 2007. Life-long well being: applying animal welfare science to nonhuman primates in sanctuaries. *Journal of applied animal welfare science*, 10(1), pp.55–61.

Brent, L. & Belik, M., 1997. The response of group-housed baboons to three enrichment toys. *Laboratory animals*, 31(1), pp.81–85.

Bryant, C.E., Rupniak, N.M. & Iversen, S.D., 1988. Effects of different environmental enrichment devices on cage stereotypies and autoaggression in captive cynomolgus monkeys. *Journal of medical primatology*, 17, pp.257–269.

Butynski, T., Kingdom, J. & Kalina, J., 2013. *Mammals of Africa* 11th ed., London: Bloomsbury Publishing.

Butynski, T.M., 1990. Comparative ecology of blue monkeys (Cercopithecus mitis) in high- and low-density subpopulations. *Ecological Monographs*, 60(1), pp.1–26.

Cant, J.G.., 1992. Positional behavior and body size of arboreal primates: A theoretical framework for field studies and an illustration of its application. *American Journal of Physical Anthropology*, 88(3), pp.273–283.

Colobus Conservation, 2012. History. *Colobus Conservation*.

Dickie, L., 1998. Environmental enrichment for Old World primates with reference to the primate collection at Edinburgh Zoo. *International Zoo Yearbook*, 36(1), pp.131–139.

Docking, C.M. et al., 2008. The influence of age on the use of potential enrichment objects and synchronisation of behaviour of pigs. *Applied Animal Behaviour Science*, 110(3–4), pp.244–257.

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), pp.141–149.

Fashing, P.J. et al., 2007. Activity and ranging patterns of Colobus angolensis ruwenzorii in Nyungwe forest, Rwanda: Possible costs of large group size. *International Journal of Primatology*, 28(3), pp.529–550.

Fuller, G. et al., 2010. Examining deep litter as environmental enrichment for a family group of wolf's guenons, Cercopithecus wolfi. *Zoo Biology*, 29(5), pp.626–632.

Gebo, D.L. & Sargis, E.J., 1994. Terrestrial adaptations in the postcranial skeletons of guenons. *American journal of physical anthropology*, 93(3), pp.341–371.

Gilby, I.C., Pokempner, A.A. & Wrangham, R.W., 2011. A direct comparison of scan and focal sampling methods for measuring wild chimpanzee feeding behaviour. *Folia Primatologica*,

81(5), pp.254–264.
Guy, A.J. & Curnoe, D., 2013. Guidelines for the rehabilitation and release of vervet monkeys. *Primate Conservation*, 27(1), pp.55–63. Available at: http://www.bioone.org/doi/abs/10.1896/052.027.0103.
Guy, A.J., Curnoe, D. & Banks, P.B., 2014. Welfare based primate rehabilitation as a potential conservation strategy: Does it measure up? *Primates*, 55(1), pp.139–147.
Guy, A.J., Stone, O.M.L. & Curnoe, D., 2012. The release of a troop of rehabilitated vervet monkeys (chlorcebus aethiops) in KwaZulu-Natal, South Africa: Outcomes and Assessment. *Folia Primatologica*, 82, pp.308–320.
Hoelzer, G.A., Morales, J.C. & Melnick, D.J., 2004. Dispersal and population genetics of primate species. In B. Chapais & C. M. Berman, eds. *Kinship and Behaviour in Primates*. Oxford: Oxford University Press, pp. 109–131.
Honess, P.E. & Marin, C.M., 2006. Enrichment and aggression in primates. *Neuroscience and Biobehavioral Reviews*, 30(3), pp.413–436.
Hrdy, S.B. & Hrdy, D.B., 1976. Hierarchical relations among female Hanuman langurs (Primates: Colobinae, Presbytis entellus). *Science*, 193, pp.913–915.
Husband, S., Mayo, L.K. & Sodaro, C., 2008. Environmental enrichment. *N/A,* pp.1-22.
Isbell, L. & Young, T., 1993. Social and ecological influences on activity budgets of veret monkeys, and their implications for group living. *Behavioral Ecology and Sociobiology*, 32(6), pp.377–385.
Jones, C.B., 1980. The Functions of Status in the Mantled Howler Monkey , Alouatta palliata GRAY : Intraspecific Competition for Group Membership in a Folivorous Neotropical Primate. , 21, pp.389–405.
Klass, K. & Cords, M., 2015. Agonism and dominance in female blue monkeys. *American Journal of Primatology*, 77(12), pp.1299–1315.
Kulpa-Eddy, J. a, Taylor, S. & Adams, K.M., 2005. USDA perspective on environmental enrichment for animals. *ILAR journal / National Research Council, Institute of Laboratory Animal Resources*, 46(2), pp.83–94.
Lin, E.J.D. et al., 2011. Environmental enrichment exerts sex-specific effects on emotionality in C57BL/6J mice. *Behavioural Brain Research*, 216(1), pp.349–357.
Lutz, C.K. & Novak, M.A., 2005. Environmental Enrichment for Nonhuman Primates: Theory and Application. *ILAR Journal*, 46(2), pp.178–191.
Maloney, M.A. et al., 2006. Effects of Three Food Enrichment Items on the Behavior of Black Lemurs (Eulemur macaco macaco) and Ringtail Lemurs (Lemur catta) at the Henson Robinson Zoo, Springfield, Illinois. *Journal of Applied Animal Welfare Science*, 9(2), pp.111–127.
Martin, P. & Bateson, P., 2007. *Measuring Behaviour: An Introductory Guide* Third., Cambridge: Cambridge University Press.
Mason, G. et al., 2007. Why and how should we use environmental enrichment to tackle stereotypic behaviour? *Applied Animal Behaviour Science*, 102(3–4), pp.163–188.
McKenzie, S., Chamove, A.S. & Feistner, A.T.C., 1986. Floor-coverings and hanging screens alter arboreal monkey behavior. *Zoo Biology*, 5, pp.339–348.
Miller, K.A. & Mench, J.A., 2005. The differential effects of four types of environmental enrichment on the activity budgets, fearfulness, and social proximity preference of Japanese quail. *Applied Animal Behaviour Science*, 95, pp.169–187.
Mowry, C.B. & Campbell, J.L., 2001. *AZA Nutrition Advisory Group TAG / SSP Husbandry Notebook Nutrition Section Lemur catta (Ring-tailed lemur)*. American Association of Zoos

and Aquariums.
Nelson, R.J. & Mandrell, T.D., 2005. Enrichment and nonhuman primates: “first, do no harm”. *ILAR journal / National Research Council, Institute of Laboratory Animal Resources*, 46(2), pp.171–177.
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), pp.566–577.
Prates, H.M. & Bicca-Marques, J.C., 2008. Age-sex analysis of activity budget, diet, and positional behavior in Alouatta caraya in an orchard forest. *International Journal of Primatology*, 29(3), pp.703–715.
Quirke, T. & O’Riordan, R.M., 2013. Evaluation and Interpretation of the Effects of Environmental Enrichment Utilizing Varying Degrees of Sampling Effort. *Zoo Biology*, 32(3), pp.262–268.
Reinhardt, V. & Toberts, A., 1997. Effective feeding enrichmnet for non human primates: a brief review. *Animal Welfare*, 6, pp.1–8.
Robins, J.G. & Waitt, C.D., 2011. Improving the welfare of captive macaques (Macaca sp.) through the use of water as enrichment. *Journal of applied animal welfare science : JAAWS*, 14(1), pp.75–84.
Ruskell, A.D. et al., 2015. Effect of bungee-carcass enrichment on behavior and fecal glucocorticoid metabolites in two species of zoo-housed felids. *Zoo Biology*, 34(2), pp.170–177.
Saj, T., Sicotte, P. & Paterson, J.D., 1999. Influence of human food consumption on the time budget of vervets. *International Journal of Primatology*, 20(6), pp.974–977.
Sapolsky, R.M., 2009. The Influence of Social Hierarchy on Primate Health. , 648(2005).
Schapiro, S.J. et al., 1997. A comparison of the effects of simple versus complex environmental enrichment on the behaviour of group-housed, subadult rhesus macaques. *Animal Welfare*, 6(1), pp.17–28.
Schoene, C. & Brend, S., 2002. Primate sanctuaries -- a delicate conservation approach. *South African Journal of Wildlife Research*, 32(2), pp.109–113.
Seier, J. et al., 2011. The effect of housing and environmental enrichment on stereotyped behavior of adult vervet monkeys (Chlorocebus aethiops). *Lab animal*, 40(7), pp.218–24.
Stam, N.C. et al., 2008. Sex-specific behavioural effects of environmental enrichment in a transgenic mouse model of amyotrophic lateral sclerosis. *The European journal of neuroscience*, 28(4), pp.717–23.
Sushma, H.S. & Singh, M., 2006. Resource partitioning and interspecific interactions among sympatric rain forest arboreal mammals of the Western Ghats, India. *Behavioral Ecology*, 17(3), pp.479–490.
Swaisgood, R.R. et al., 2001. A quantitative assessment of the efficacy of an environmental enrichment programme for giant pandas. *Animal Behaviour*, 61, pp.447–457.
Tarou, L.R. & Bashaw, M.J., 2007. Maximizing the effectiveness of environmental enrichment: Suggestions from the experimental analysis of behavior. *Applied Animal Behaviour Science*, 102(3–4), pp.189–204.
De Waal, F.B., 1986. The integration of domiannce and social bonding in primates. *The quarterly review of biology*, 61(4), pp.459–479.
Watson, L.M., Watters, J. V. & Meehan, C.L., 2007. Responses of captive Barbados green monkeys (Cercopithecus aethiops sabus) to a variety of enrichment devices. *Laboratory Primate Newsletter*, 102(3–4), pp.364–379.

Weerd, H.A.V. d et al., 2006. Effects of species-relevant environmental enrichment on the behaviour and productivity of finishing pigs. *Applied Animal Behaviour Science*, 99(3–4), pp.230–247.
Weld, K., Metz, B. & Erwin, J., 1991. Environmental enrichmnet for (Macaca fascicularis): effects of shape and substance of manipulable objects. *American Journal of Primatology*, 24, p.139.
Westergaard, G.C. & Fragaszy, D.M., 1985. Effects of manipulatable objects on the activity of captive capuchins. *Zoo Biology*, 4, pp.317–327.
Young, R.J., 1998. Behavioural Studies of Guenons at Edinburgh Zoo. *International Zoo Yearbook*, 36(1), pp.49–56.
Young, R.J., 2003. *UFAW Animal Welfare Series: Environmnetal Enrichmnet for Captive Animals*, Oxford: Blackwell Publishing.

7. Appendices

Appendix 1-Full List of Primates Involved in Study

ID	Enclosure	Species	Sex	Age
Betsy	Colobus Troop	Colobus	Female	Adult
Tumbo	Colobus Troop	Colobus	Female	Adult
Kuishi	Colobus Troop	Colobus	Male	Infant
Amani	Colobus Troop	Colobus	Male	Infant
Whitecap	Colobus Troop	Colobus	Male	Juvenile
Sang	Sykes Troop	Sykes	Female	Sub-Adult
Valentine	Sykes Troop	Sykes	Female	Adult
Pett	Sykes Troop	Sykes	Female	Adult
Felice	Sykes Troop	Sykes	Male	Adult
Legend	Sykes Troop	Sykes	Male	Juvenile
Chale	Sykes Troop	Sykes	Male	Infant
Ogelea	Sykes Troop	Sykes	Male	Infant
Haki	Sykes Troop	Sykes	Male	Infant
Mwangaza	Vervet Troop	Vervet	Female	Adult
Molly	Vervet Troop	Vervet	Female	Juvenile
Eva	Vervet Troop	Vervet	Female	Sub-Adult
Chafu	Vervet Troop	Vervet	Female	Sub-Adult
Uji	Vervet Troop	Vervet	Female	Sub-Adult
Izzy	Vervet Troop	Vervet	Female	Juvenile
Lionel	Vervet Troop	Vervet	Male	Juvenile
Burrito	Vervet Troop	Vervet	Male	Juvenile
Laila	Nursery 1	Vervet	Female	Infant
Lily	Nursery 1	Vervet	Female	Infant
Kadogo	Nursery 1	Vervet	Female	Infant

Shujaa	Nursery 1	Vervet	Female	Infant
Kilifi	Nursery 1	Vervet	Female	Juvenile
Pendo	Nursery 1	Sykes	Male	Infant
Ginger	Nursery 2	Vervet	Female	Juvenile
Kaya	Nursery 2	Vervet	Female	Juvenile
Sparkle	Nursery 2	Vervet	Female	Juvenile

Appendix 2- Ethogram

CODE	BEHAVIOUR	DESCRIPTION
AGGRESSIVE BEHAVIOURS		
SA	Severe Aggression	biting, prolonged chasing
MA	Moderate Aggression	chasing, aggressive wrestling, screaming
MLA	Mild Aggression	eye threat, lunging, supplanting
AFFILIATIVE BEHAVIOUR		
PL	Play	one or more animals lunge, grapple, wrestle or chase for at least 1 sec in absence of aggression or intense submission; play face may or may not be present.
SP	Solicited Play	direct play face toward, pounce on, or initiate grapple with partner, in absence of ongoing play with partner
GR	Grooming	cleaning the fur of other monkey
BGR	Being Groomed	Having fur cleaned
SB	Sexual Behaviour	Any of the following: presenting, mounting, copulation
SOLITARY ACTIVITY		
AU	Auto grooming	One individual is cleaning itself
SO	Solitary Play	Play activity with no other monkey involved
VG	Scan group	Vigilance towards other non human primates in their enclosure.
VP	Scan Person	Being observant towards a human to the extent that they are not doing anything else. May be accompanied by vocalizations.
VO	Scan Outside	Vigilence towards another primate outside of the enclosure, either in another enclosure or a wild monkey (does not include humans). May be accompanied by vocalizations.

INFANT ASSOCIATED BEHAVIOURS		
ON	Climb on	Climb on body of conspecific, all four limbs are on other monkey
OF	Climb off	Voluntarily climb off conspecifics body
NU	Nurse	Have mouth on females nipple for greater than one second
ENRICHMENT BEHAVIOURS		
UE	Use Enrichment	at or use (sniff, bite, chew, gouge, handle, pounce on, grapple with, or otherwise manipulate enrichment object) an enrichment item which no other animal is currently holding, eating from, or occupying
SHE	Share enrichment	eat or use (sniff, bite, chew, gouge, handle, pounce on, grapple with, or otherwise manipulate enrichment object) an enrichment item from which another is simultaneously eating, using or occupying without removing any part from another individual's mouth or hands
OTHER		
FO	Foraging	the act of searching for and handling food
FE	Feeding	Placing anything in mouth and swallowing
L	Locomotion	any movement vertical, horizontal or on ground that does not involve chasing
D	Drinking	Putting water in mouth and swallowing
RS	Resting Social	being still while not eating, eyes closed or open, sunbathing while in contact with other individuals
RA	Resting alone	being still while not eating, eyes closed or open, sunbathing while not in contact with other individuals

Appendix 3-Colobus Conservation Enrichment Evaluations

Completed by: Samantha Palmer
May 6th –July 26th

Instructions:

Fill in this sheet for each enrichment to compile into one document for Colobus Conservation. After document is filled in use sections 6,8,9,11 to score the enrichment. For questions 6,8,11 use the value circled as the score for that question and for question 9 answering yes gets 1 point and no gets 3. At the end you can effectively rank the enrichments in order of best enrichment having the lowest score and worst having the highest score.
Note: Prices are a bulk price for all elements of enrichment because separating the price of seeds and fruit and all other items was difficult without exact measurements used in each enrichment.

Evaluating Enrichment

1. Enrichment Name: Leaf Litter Floor

2. Enrichment Type: Feeding/ Foraging

3. Materials Required:
   - Leaves
   - Seeds
   - Rake

4. Methods of Enrichment Construction:

A rake is used to collect dry leaves from around the Colobus Conservation property. Wet leaves are avoided when possible. The leaves are collected in sacks. Then they are distributed among the enclosures. Seeds and nuts are mixed among the leaves to promote foraging. As well there are naturally insects in the forage.

5. Time to prepare: 35 minutes (raking and collecting).

6. Difficulty to construct taking into consideration time (Five being the hardest):

1 **2** 3 4 5

7. Initial Cost: 0 KSH

8. Price Range (Five being most expensive):

1 2 3 4 5

9. Reusable: Yes / **No**

10. Safety Concerns: None towards either monkey or human.

11. Level of Safety (5 being least safe):

1 2 3 4 5

12. Additional Notes:

In the nursery enclosures there needed to be wooden floors added so that the wild monkeys could not steal the food through the floor of the enclosure.

13. Photographs:

Final Score for this enrichment: 7

Evaluating Enrichment

1. Enrichment Name: Hammocks

2. Enrichment Type: Structural

3. Materials Required:
   - String
   - Blankets, Sheets, fabric of any kinds

4. Methods of Enrichment Construction:

Gather string and fabric of some kind (sheets, pillow case, towel etc.). Tie string to each corner of the fabric, making sure to double not. Hammocks for the larger primates require stronger knots as they weigh more and put more strain on the hammock.

5. Time to prepare: 25 minutes

6. Difficulty to construct taking into consideration time (Five being the hardest):

1 2 **3** 4 5

7. Initial Cost:

String – 350 KSH
All fabric is donated.
Total= 350 KSH

8. Price Range (Five being most expensive):

1 **2** 3 4 5

9. Reusable: **Yes** / No
Hammocks can be removed from the enclosure and washed unless they have been destroyed by the monkeys.

10. Safety Concerns:
Towards humans: using a knife to cut rope
Towards Monkeys: Getting appendages stuck in rope.

11. Level of Safety (5 being least safe):

1 **2** 3 4 5

12. Additional Notes:

This enrichment was given to all the enclosures.

13. Photographs:



Final Score for this enrichment: 8

Evaluating Enrichment

1. Enrichment Name: Foliage Balls

2. Enrichment Type: Feeding/ Foraging

3. Materials Required:
   - branches
   - seeds/ nuts

4. Methods of Enrichment Construction:
Branches are collected. They are then twisted and tied into bunches. They are placed in the enclosure in different areas with seeds and nuts stuffed in them.

5. Time to prepare: 35 minutes.

6. Difficulty to construct taking into consideration time (Five being the hardest):

1 2 **3** 4 5

7. Initial Cost:

Seeds-5000 KSH
Nuts-7500 KSH
Total= 12500

8. Price Range (Five being most expensive):

1 2 **3** 4 5

9. Reusable: Yes / **No**

10. Safety Concerns:
None.

11. Level of Safety (5 being least safe):

1 2 3 4 5

12. Additional Notes:

13. Photographs:

Final Score for this enrichment: 10

Evaluating Enrichment

1. Enrichment Name: Rock Piles

2. Enrichment Type: Feeding/ Foraging

3. Materials Required:
   - Rocks
   - Seeds and Nuts

4. Methods of Enrichment Construction:

Rocks are collected and made into a pile in the enclosures. Then seeds are distributed amongst the rocks to promote foraging.

5. Time to prepare: 20 minutes

6. Difficulty to construct taking into consideration time (Five being the hardest):

1 2 3 4 5

7. Initial Cost:

Seeds-5000 KSH
Nuts-7500 KSH
Total= 12500

8. Price Range (Five being most expensive):

1 2 **3** 4 5

9. Reusable: **Yes** / No
The rocks can be reused. Need more seeds.

10. Safety Concerns:

Monkeys may catch fingers under rocks.

11. Level of Safety (5 being least safe):

1 2 **3** 4 5

12. Additional Notes:

In the nursery enclosures there needed to be wooden floors added so that the wild monkeys could not steal the food through the floor of the enclosure.

13. Photographs:

Final Score for this enrichment: 8

Evaluating Enrichment

1. Enrichment Name: Coconuts

2. Enrichment Type: Feeding/ Foraging

3. Materials Required:
   - Coconuts
   - Seeds and Nuts
   - String

4. Methods of Enrichment Construction:

Coconuts must be collected from areas around Colobus Conservation such as the beach. When not collected coconuts are purchased. When coconuts aren't available baobab fruit can be used instead. Then holes are to be drilled into the coconut so that it can be hung in the enclosure.

5. Time to prepare: 45 minutes

6. Difficulty to construct taking into consideration time (Five being the hardest):

1 2 3 **4** 5

7. Initial Cost:

Coconuts- 20KSH (X 8) =160KSH
String-350KSH
Seeds-5000KSH
Nuts- 7500KSH
Total= 13,010KSH

8. Price Range (Five being most expensive):

1 2 3 **4** 5

9. Reusable: **Yes** / No

Coconuts/ baobab fruit can be hung in the enclosures multiple times.

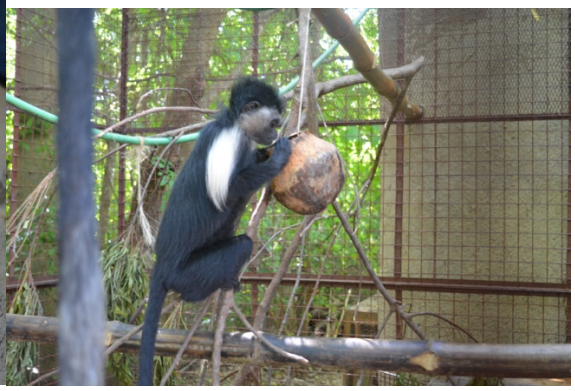
10. Safety Concerns:
Monkeys: Getting appendages caught on rope.

11. Level of Safety (5 being least safe):

1 **2** 3 4 5

12. Additional Notes:

13. Photographs:



Final Score for this enrichment: 11

Evaluating Enrichment

1. Enrichment Name: Elevated Forage

2. Enrichment Type: Feeding/ Foraging

3. Materials Required:
   - Baskets (as natural looking as possible)
   - Seeds and nuts
   - Forage (leaves/ twigs)
   - String

4. Methods of Enrichment Construction:
Baskets are collected. The straw ones are the best as they appear more natural. Forage is also collected using a rake. Forage is added to each basket and then the baskets are hung in the enclosures. Seeds and nuts are added to the forage.

5. Time to prepare: 35 minutes

6. Difficulty to construct taking into consideration time (Five being the hardest):

1 **2** 3 4 5

7. Initial Cost:

Seeds- 5000KSH
Nuts-7500KSH
Basket-200KSH
Total=12,700KSH

8. Price Range (Five being most expensive):

1 2 **3** 4 5

9. Reusable: Yes / No
The baskets can be reused.

10. Safety Concerns:
Monkey: Getting appendages stuck in basket.

11. Level of Safety (5 being least safe):

1 **2** 3 4 5

12. Additional Notes:

13. Photographs:

Final Score for this enrichment: 8

Evaluating Enrichment

1. Enrichment Name: Branched Floors

2. Enrichment Type: Feeding/ Foraging

3. Materials Required:
   - Branches
   - Seeds and nuts
   - Tools to cut

4. Methods of Enrichment Construction:
Branches are cut down from the Colobus Conservation property. They are then distributed amongst the enclosures on the floor. Seeds and nuts are tossed on top to encourage foraging.

5. Time to prepare: 20 minutes

6. Difficulty to construct taking into consideration time (Five being the hardest):

1 2 **3** 4 5

7. Initial Cost:

Seeds-5000KSH
Nuts-7500KSH
Total=12,500

8. Price Range (Five being most expensive):

1 2 **3** 4 5

9. Reusable: Yes / **No**

10. Safety Concerns:

For humans: Staff may fall when climbing for higher branches, or may injure themselves when using panga to cut branches.

11. Level of Safety (5 being least safe):

1 2 **3** 4 5

12. Additional Notes:

13. Photographs:

Final Score for this enrichment: 12

Evaluating Enrichment

1. Enrichment Name: Sand Piles

2. Enrichment Type: Feeding/ Foraging

3. Materials Required:
   - Sand
   - Buckets/ tires
   - Seeds and nuts

4. Methods of Enrichment Construction:
Sand is collected by staff from around Colobus Conservation. In the two enclosures with the mesh floor buckets are used to put sand in, but in all the other enclosures sand is poured into a tire laid on the ground. Once sand is poured in seeds and nuts are mixed into sand.

5. Time to prepare: 30 minutes

6. Difficulty to construct taking into consideration time (Five being the hardest):

1 2 **3** 4 5

7. Initial Cost:

Seeds-5000KSH
Nuts-7500KSH
Total: 12,500KSH

8. Price Range (Five being most expensive):

1 2 **3** 4 5

9. Reusable: **Yes** / No
Sand is not reusable but tire and buckets are.

10. Safety Concerns:
None.

11. Level of Safety (5 being least safe):

1 2 3 4 5

12. Additional Notes:

13. Photographs:


Final Score for this enrichment: 8

Evaluating Enrichment

1. Enrichment Name: Ice Blocks

2. Enrichment Type: Feeding/ Foraging

3. Materials Required:
   - Water
   - String
   - Fruit/ Vegetables
   - Seeds and nuts
   - Tupperware containers
   - Knives

- Shredder

4. Methods of Enrichment Construction:

Collect Containers as well as fruits, vegetables, seeds, nuts. One container per enclosure. Making note that colobus have a different diet than the sykes and vervet monkeys. Chop fruit and vegetables. Fill each container almost half way with fresh (not salt) water. Place vegetables, fruits nuts and seeds in each container in the water. Add a string making sure to push it far enough into the water and food mixture that it stays when frozen. Different strings are used for different monkeys as some eat the entire rope and it can end up in their digestive system. Leave the containers in the freezer over night till frozen solid. The next day hang the ice treats in the individual enclosures.

5. Time to prepare: 1 hour to chop all fruit and vegetables and add water and food to each container. Then left over night to freeze.

6. Difficulty to construct taking into consideration time (Five being the hardest):

1 **2** 3 4 5

7. Initial Cost:

Seeds-5000KSH
Nuts-7500KSH
Avg. Fruit/Veg (those sold as per piece)-70.5
Avg. Fruit/Veg (those sold as per kg)-103.75
Estimated 20 fruits and vegetables used = (70.5+103.75) *20=3488KSH
Total=15,988KSH

8. Price Range (Five being most expensive):

1 2 3 4 **5**

9. Reusable: Yes / **No**

10. Safety Concerns:
Towards humans: Use of knifes and shredder can cause injury if not careful.
Towards Monkeys: Ropes can end up being eaten and end up in digestive tract.

11. Level of Safety (5 being least safe):

1 **2** 3 4 5

12. Additional Notes:

This enrichment was given to all enclosures.

13. Photographs:

Final Score for this enrichment: 12

Ranking Enrichment

Enrichment	Rank
Leaf Litter	7
Hammocks	8
Rock Piles	8
Elevated Forage	8
Sand Piles	8
Foliage Balls	10
Coconuts	11
Branched floors	12
Ice Blocks	12

Appendix 4- Individual Activity Budgets for Each Enrichment

Enrich Type	**ID**	**Aggression**	**Feeding**	**Resting**	**Social**	**Moving**	**Enrichment**	**Other**
No Enrich.	Betsy	0	32	22	5	4	0	38
	Tumbo	0	30	24	2	7	0	38
	Kuishi	0	42	11	13	5	0	29
	Amani	0	36	22	7	9	0	7
	WC	0	30	24	11	11	0	24

	Mwa	0	35	31	9	7	0	17
	Molly	0	49	5	16	15	0	15
	Eva	0	47	16	4	20	0	13
	Chafu	0	43	15	6	22	0	15
	Uji	0	37	30	9	9	0	15
	Izzy	0	52	11	7	11	0	19
	Lionel	0	44	18	15	15	0	9
	Burrito	0	50	11	17	11	0	11
	Sang	0	29	13	5	20	0	33
	Val	0	16	45	4	16	0	18
	Pett	2	40	20	0	16	0	22
	Felice	0	45	24	4	13	0	15
	Legend	2	52	9	7	13	0	18
	Chale	0	33	42	0	2	0	24
	Oge	0	31	42	2	5	0	20
	Haki	0	31	33	7	13	0	16
	Ginger	0	27	53	2	0	0	18
	Kaya	0	30	9	4	28	0	30
	Sparkle	0	27	27	7	9	0	29
	Laila	0	51	13	9	13	0	15
	Lily	0	80	2	11	4	0	4
	Kadogo	0	66	9	13	4	0	9
	Shujaa	0	57	25	2	0	0	2
	Kilifi	0	49	4	15	29	0	4
	Pendo	0	62	15	11	9	0	17
Leaf Litter	Betsy	0	24	34	0	4	4	34
	Tumbo	0	14	42	0	4	8	32
	Kuishi	0	24	12	18	4	16	26
	Amani	0	20	32	8	4	16	20
	WC	0	20	30	16	2	12	20
	Mwa	0	18	12	4	18	26	22
	Molly	0	38	6	10	12	16	18
	Eva	0	30	6	0	4	40	20
	Chafu	2	32	4	4	8	34	16
	Uji	0	34	18	2	6	28	12
	Izzy	0	36	12	6	2	32	12
	Lionel	0	28	6	6	6	34	20
	Burrito	0	43	8	8	0	25	16
	Sang	0	33	0	2	14	20	31
	Val	0	16	22	2	34	8	18
	Pett	2	35	8	4	10	14	27
	Felice	4	27	12	2	18	29	8
	Legend	0	41	2	2	6	35	14
	Chale	0	27	44	0	8	17	4
	Oge	0	35	44	0	10	8	2

	Haki	0	37	12	0	14	29	8
	Ginger	0	38	14	0	3	35	11
	Kaya	0	38	5	3	16	22	16
	Sparkle	0	38	14	3	3	27	16
	Laila	0	65	4	4	0	22	4
	Lily	0	61	4	17	0	13	4
	Kadogo	0	52	4	22	4	13	4
	Shujaa	0	39	9	9	0	13	30
	Kilifi	0	26	4	13	35	17	4
	Pendo	0	48	13	17	0	13	9
Hammock	Betsy	0	31	35	0	2	2	29
	Tumbo	0	31	27	0	2	0	40
	Kuishi	0	44	6	4	2	17	27
	Amani	0	31	25	2	0	23	19
	WC	0	29	17	2	0	33	19
	Mwa	0	27	31	6	21	0	15
	Molly	0	32	13	23	11	2	19
	Eva	0	59	8	8	14	0	10
	Chafu	2	35	19	13	15	2	15
	Uji	0	38	25	10	8	0	19
	Izzy	0	50	19	8	4	0	19
	Lionel	0	44	13	10	19	0	15
	Burrito	0	38	23	13	8	2	17
	Sang	0	56	0	6	15	3	21
	Val	0	50	24	0	18	0	9
	Pett	0	67	3	0	15	0	15
	Felice	0	56	21	0	9	0	15
	Legend	0	47	12	0	12	15	15
	Chale	0	56	32	0	3	0	9
	Oge	0	38	32	6	9	3	12
	Haki	0	56	12	3	9	3	18
	Ginger	0	40	40	0	2	13	6
	Kaya	0	44	13	2	21	8	13
	Sparkle	0	42	17	4	2	21	15
	Laila	0	54	19	2	4	10	10
	Lily	0	60	15	2	2	13	8
	Kadogo	0	52	13	8	4	21	2
	Shujaa	0	35	19	2	4	2	16
	Kilifi	0	31	10	6	38	4	10
	Pendo	0	46	23	0	17	8	6
Foliage Balls	Betsy	0	33	24	4	7	7	24
	Tumbo	0	28	39	7	2	7	17
	Kuishi	0	38	14	22	6	14	2
	Amani	0	35	28	13	6	9	9
	WC	0	41	32	13	4	9	2

	Mwa	0	19	26	17	8	8	23
	Molly	0	33	4	30	2	13	19
	Eva	0	37	22	7	20	4	7
	Chafu	4	39	15	11	9	7	13
	Uji	0	41	22	20	4	11	2
	Izzy	0	44	22	15	7	0	11
	Lionel	0	46	20	15	6	7	6
	Burrito	0	43	17	9	2	6	24
	Sang	0	45	18	3	13	13	10
	Val	0	30	23	8	28	3	10
	Pett	0	38	28	3	10	10	13
	Felice	0	34	34	12	5	7	7
	Legend	0	38	15	13	5	13	18
	Chale	0	33	48	8	3	3	8
	Oge	0	30	48	3	10	3	8
	Haki	0	38	23	13	5	13	10
	Ginger	0	39	33	0	6	0	22
	Kaya	0	28	13	2	30	11	17
	Sparkle	0	35	13	4	7	22	19
	Laila	0	48	13	6	11	9	13
	Lily	0	48	19	7	6	13	7
	Kadogo	0	50	15	15	2	15	4
	Shujaa	0	30	20	11	2	9	11
	Kilifi	0	43	9	7	24	9	7
	Pendo	0	50	19	2	13	7	9
Rock Piles	Betsy	0	25	31	5	4	2	33
	Tumbo	0	25	27	7	0	7	33
	Kuishi	0	40	7	15	7	7	24
	Amani	0	33	20	5	5	15	22
	WC	0	39	19	17	6	9	11
	Mwa	0	25	22	16	9	5	22
	Molly	0	35	13	15	11	13	15
	Eva	0	39	15	7	19	9	11
	Chafu	0	33	7	15	2	15	29
	Uji	0	35	20	13	4	11	18
	Izzy	2	45	18	5	7	7	15
	Lionel	2	40	16	13	5	9	15
	Burrito	0	42	7	11	5	13	22
	Sang	0	40	5	4	18	2	31
	Val	0	35	16	11	20	7	11
	Pett	0	45	9	4	15	7	20
	Felice	0	35	33	0	9	5	18
	Legend	2	56	11	4	6	7	15
	Chale	0	35	27	4	9	7	18
	Oge	0	36	29	2	11	5	16

	Haki	0	34	27	0	2	20	17
	Ginger	0	37	10	12	15	15	12
	Kaya	0	34	12	12	5	24	12
	Sparkle	0	32	27	5	7	12	17
	Laila	0	39	10	7	7	27	10
	Lily	0	37	17	12	7	22	5
	Kadogo	0	15	22	7	2	22	10
	Shujaa	0	27	2	2	41	17	10
	Kilifi	0	49	12	5	5	15	15
	Pendo	0	37	14	2	6	8	33
Coconuts	Betsy	0	24	16	2	6	10	42
	Tumbo	0	41	12	14	4	22	27
	Kuishi	0	37	14	4	0	10	35
	Amani	0	47	6	12	6	10	18
	WC	0	27	35	2	14	2	20
	Mwa	0	53	20	4	4	8	10
	Molly	0	35	8	8	18	16	14
	Eva	2	39	16	6	8	10	18
	Chafu	0	45	31	8	2	2	12
	Uji	0	51	6	8	16	4	14
	Izzy	0	57	6	6	8	4	18
	Lionel	0	57	18	6	4	4	10
	Burrito	0	51	10	14	4	10	10
	Sang	0	35	8	8	18	16	14
	Val	0	37	27	10	16	0	10
	Pett	0	47	14	4	16	6	12
	Felice	2	48	15	0	17	2	17
	Legend	0	53	8	0	8	18	12
	Chale	0	45	29	0	8	0	18
	Oge	0	45	22	0	8	2	22
	Haki	0	43	29	2	8	6	10
	Ginger	0	47	18	2	0	6	27
	Kaya	0	43	8	6	18	14	10
	Sparkle	0	45	14	2	2	12	24
	Laila	0	55	8	10	4	8	14
	Lily	0	63	6	6	4	14	6
	Kadogo	0	67	4	12	2	10	4
	Shujaa	0	46	13	6	4	6	4
	Kilifi	0	41	6	8	29	10	6
	Pendo	0	59	14	4	10	4	8
Elevated Forage	Betsy	0	18	29	0	2	4	47
	Tumbo	2	16	18	0	2	10	53
	Kuishi	0	28	16	6	6	6	38
	Amani	0	32	22	10	0	12	24
	WC	0	41	20	6	0	14	20

	Mwa	2	26	14	12	0	20	26
	Molly	0	33	2	20	4	37	4
	Eva	0	49	25	0	8	8	10
	Chafu	4	33	6	6	0	33	18
	Uji	2	43	22	6	4	16	8
	Izzy	0	51	16	6	6	8	14
	Lionel	0	45	22	12	2	6	14
	Burrito	0	49	12	12	4	12	12
	Sang	0	40	2	4	12	21	19
	Val	0	37	22	6	12	4	20
	Pett	0	53	14	0	12	10	12
	Felice	2	51	16	2	4	18	8
	Legend	2	39	6	2	10	31	10
	Chale	0	38	34	2	16	0	10
	Oge	0	35	35	0	12	2	16
	Haki	0	45	14	2	12	20	8
	Ginger	0	41	29	0	0	10	20
	Kaya	0	39	10	0	8	31	12
	Sparkle	0	31	16	0	4	31	18
	Laila	0	39	18	2	8	14	20
	Lily	0	54	8	6	0	12	20
	Kadogo	0	55	14	4	2	20	6
	Shujaa	0	37	16	8	2	2	8
	Kilifi	2	33	10	12	29	8	6
	Pendo	0	55	12	2	12	6	14
Branched Floor	Betsy	0	24	36	2	5	7	25
	Tumbo	0	25	34	4	0	7	30
	Kuishi	0	27	13	9	11	16	25
	Amani	0	32	23	11	4	11	20
	WC	0	21	30	7	5	13	23
	Mwa	0	25	29	4	11	18	14
	Molly	0	32	14	7	4	20	23
	Eva	0	46	13	5	7	23	5
	Chafu	0	34	7	5	16	21	16
	Uji	0	30	20	7	5	21	16
	Izzy	0	54	9	5	7	18	7
	Lionel	0	39	14	7	4	20	16
	Burrito	0	43	11	11	4	23	9
	Sang	0	45	10	0	14	3	28
	Val	0	30	19	2	28	14	7
	Pett	0	50	0	0	7	25	18
	Felice	2	33	19	0	16	21	9
	Legend	0	42	16	5	5	19	14
	Chale	0	36	31	2	5	14	12
	Oge	0	33	35	5	12	12	5

	Haki	0	40	19	9	9	14	9
	Ginger	0	27	27	0	0	41	5
	Kaya	0	27	7	2	15	24	24
	Sparkle	0	32	10	2	0	29	27
	Laila	0	34	29	5	5	12	15
	Lily	0	37	17	5	2	27	12
	Kadogo	0	39	20	7	2	27	5
	Shujaa	0	29	34	2	0	20	5
	Kilifi	0	24	12	2	29	27	5
	Pendo	0	37	29	7	2	22	2
Sand Piles	Betsy	0	25	30	2	6	2	36
	Tumbo	0	21	45	2	0	0	32
	Kuishi	0	28	17	8	0	9	38
	Amani	0	32	21	9	6	11	21
	WC	0	32	23	11	8	11	15
	Mwa	0	23	42	2	8	15	11
	Molly	0	42	13	8	0	28	9
	Eva	0	49	21	4	11	11	4
	Chafu	0	25	2	0	2	49	23
	Uji	0	47	17	9	8	9	9
	Izzy	0	62	6	6	9	6	11
	Lionel	0	62	15	2	2	13	6
	Burrito	0	51	17	11	4	9	8
	Sang	4	42	4	0	19	8	23
	Val	0	31	31	5	10	18	5
	Pett	4	50	12	4	12	15	4
	Felice	0	45	18	0	15	23	0
	Legend	0	35	5	3	10	35	13
	Chale	0	40	25	3	10	15	8
	Oge	0	45	20	13	5	10	8
	Haki	0	25	25	5	18	18	10
	Ginger	0	36	26	2	2	25	9
	Kaya	0	28	17	6	13	28	8
	Sparkle	4	36	17	6	4	25	9
	Laila	0	43	17	2	0	26	11
	Lily	0	42	4	4	2	45	4
	Kadogo	0	42	13	4	4	36	2
	Shujaa	0	42	6	4	2	28	9
	Kilifi	0	32	0	6	42	13	8
	Pendo	0	45	21	0	13	17	4
Ice Blocks	Betsy	0	22	24	0	2	15	37
	Tumbo	0	17	22	2	2	13	44
	Kuishi	0	32	17	4	4	13	30
	Amani	0	37	20	6	0	13	24
	WC	0	31	19	11	0	13	26

	Mwa	0	20	22	19	7	15	17
	Molly	0	30	6	31	4	19	11
	Eva	0	52	15	7	11	0	15
	Chafu	2	36	23	11	4	6	19
	Uji	0	48	24	9	4	0	15
	Izzy	0	52	7	13	9	6	13
	Lionel	0	50	11	15	7	0	17
	Burrito	0	47	23	15	6	2	8
	Sang	2	46	7	5	5	12	22
	Val	0	28	15	10	28	0	20
	Pett	0	60	12	5	17	0	7
	Felice	0	63	20	5	2	2	7
	Legend	3	55	8	8	0	15	13
	Chale	0	37	39	0	2	0	22
	Oge	0	41	36	5	5	0	13
	Haki	0	54	10	5	15	5	7
	Ginger	0	43	37	2	4	2	13
	Kaya	0	28	19	7	13	26	7
	Sparkle	0	43	19	6	2	11	20
	Laila	0	44	20	7	4	19	6
	Lily	0	57	13	2	4	20	4
	Kadogo	0	66	9	6	0	11	8
	Shujaa	0	48	20	6	2	2	11
	Kilifi	0	37	7	4	31	11	9
	Pendo	0	59	17	4	7	0	13

Appendix 5- Ethics Forms

OXFORD BROOKES UNIVERSITY

Faculty Ethics form HSS.E2

Faculty of Humanities and Social Sciences

Application for ethics approval for a research project involving human participants

Undergraduates and Foundation Degree Students:
Before completing this form, the ethics review checklist (Faculty form HSS.E1) should have been completed to establish whether this additional application for ethics approval is required. If ethics approval is required, you should complete this form, sign it and submit it to the Faculty Research Ethics Officer, Maja Cederberg at mcederberg@brookes.ac.uk. A decision form, E3 will then be returned to you by e-mail.

Master's Students:
You should complete this form before you start your project and submit it to your supervisor. If he or she is unable to sign it at this stage, the form will be referred to the Faculty Research Ethics Officer, as above, who may seek further information and clarification from you. A decision form, E3, will then be returned to you by e-mail.

All students should refer to the University Code of Practice on Ethical Standards for Research involving Human Participants, available at www.brookes.ac.uk/res/ethics and Faculty guidelines, which are included in the relevant on-line module or course handbook. You should bind a copy of the approved form in your final project or dissertation submission.

---

1. Name of Principal Investigator (Student): Samantha Palmer

   E-mail address: 15056602@brookes.ac.uk

2. Name of Supervisor and e-mail address: Catherine Hill
   E-mail address: cmhill@brookes.ac.uk

3. **Working Project Title:** Evaluation of the enrichment program for three species of primates at the Colobus Conservation rehabilitation center in Kenya.

4. Project Type (please specify course and give module number): Master's dissertation

   P20107 Final Project

1

5.	Background to and rationale of proposed research:	N/A
6.	'Gatekeeper' permission If you are conducting your research within an organisation external to Brookes, such as a school or company, has permission been obtained? Attach a copy of the letter or e-mail giving permission	Permission received from Colobus Conservation as this is a project they have requested I complete.
7	Methods of data collection: Attach a copy of your draft questionnaire, interview schedule or observation guidelines	Data will be collected using observation methods. Instantaneous scan sampling will be done from outside the enclosures of the captive primates.
8	Participants involved in the research: Include the target number, age range, source and method of recruitment and location of the research	N/A, no human participants
9	Are participants in a dependent relationship) as an unequal power relationship) with the researcher? If yes, what steps will you take to ensure that participation is entirely voluntary and is not influenced by this relationship?	N/A
10.	Potential benefits of the proposed research:	This project has a large potential to improve the captive care and therefore the welfare of primates in any sort of captive environment.
11	Potential adverse effects of the proposed research and steps to be taken to deal with them: These are defined as risks greater than those encountered during normal day to day interactions and could include possible psychological stress or anxiety	As I am not altering the normal schedule for enrichment of the primates and I will be observing them from outside their enclosure at a reasonable distance I do not believe there will be any adverse effects of my research.
12.	Plan for obtaining informed consent: Please attach copy of your participant	N/A

	information sheet and consent form (Note consent forms are not needed for questionnaires)	
13.	Steps to be taken to ensure confidentiality of data: Outline steps to be taken to ensure confidentiality, privacy and anonymity of data during collection and publication of data	N/A
14	Debriefing and/or feedback to participants What debriefing and support will participants receive after the research? How will findings of the research be made available to them?	N/A
15	Data storage and security How will you ensure safe data storage during fieldwork and after publication?	Data will be stored on my personal computer and external hard drive and will only be used for dissertation unless otherwise allowed by Colobus Conservation.

All materials submitted will be treated confidentially.

I have read and understood the University's Code of Practice on Ethical Standards for Research involving Human Participants

Signed: Palmer — Principal Investigator /Student

Signed: C.M. Hill — Supervisor

Date: 10/3/2016