DETAILED FINAL REPORT

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Introduction

The Mountain Bongo population has suffered a major population crash over the last threedecades as a result of poaching, human encroachment, habitat destruction, and diseases. Thesame threats continue to threaten the remaining population in Kenya. With extremely low, fragmented, and unviable populations in the wild, successful captive breeding remains the only hope to save the species from the verge of extinction. Conservation measures to save this species have focused majorly on captive breeding in zoos in Western countries and at Mount Kenya Wildlife Conservancy in Kenya.

While food and foraging efficiency are key determinants of species reproductive success and survivorship, these attributes have received very little attention for the Mountain bongo both in the wild and in captivity. Thus, inadequate scientific information on the foraging goals of the bongo continues to impede the conservation and management efforts at Mount Kenya Wildlife Conservancy.

Conservancy. Such a challenge is potentially linked to nutritionally related disorders and diseases observed in the captive populations. Thus, with captive breeding and reintroduction as the last conservation intervention to restore and boost population recovery of the bongo in the wild, understanding the foraging goals and the primary food plants fundamental to meet such nutritional goals remains a great priority.

Problem statement

The Mountain Bongo is a critically endangered and rare forest antelope, which is endemic to Kenya and whose fragmented population, of 150 individuals country wide, risk extinction. The bongo has over time been threatened by poaching, disease outbreak and habitat destruction. Due to these threats, the sub-species faces extremely high risk of extinction in the wild. Therefore, captive breeding remains as the reliable conservation and management tool to save the population globally. Previous research carried out on bongo conservation mainly highlighted the plight of the bongo and role of genetics in conserving the sub-species with very little literature onmountain bongo nutrition ecology. Therefore, this study aimed at understanding nutritionalrequirements of the critically endangered mountain bongo (*Tragelaphus Eurycerus spp. isaaci*) at Mount Kenya Wildlife Conservancy.

Objectives

To determine:

(i) The nutritional foraging goals across age-sex classes and seasons of the free-rangingpopulation of the Mountain bongo in Mount Kenya Wildlife Conservancy.
(ii) The important food plant species utilized by the bongos in meeting their nutritionalgoals.
(iii) Compare food resources critical for meeting Bongo's nutritional goals in both theConservancy.

Materials and Methods

Mount Kenya Wildlife Conservancy is located in, Nyeri County, Kenya. The area lies between0˚ 03'N and 37˚09'E at 2387M above sea level. The Conservancy covers an area of 1250 ha Within the Mount Kenya Wildlife Conservancy, bongos are managed in captivity and within the sanctuary where they are managed in a free ranging setting. The area experiences a bimodal rainfall pattern annually with the long rains occurring from March to May and short rains between October and November. Ecologically, the area falls within the Mount Kenya biosphere, which is important for overall biodiversity conservation and also serves as one of the few remaining critical habitats for the critically endangered Mountain Bongo

Data Collection and Analysis

Behavioural data collection

Data was collected using focal animal sampling technique (Altman, 1974). During the morning hours (0600 hrs- 0800 hrs), mid-morning (1000hrs – 1100hrs) and evening (1600hrs- 18hrs) for six consecutive months from October 2022- March 2023 to cover both the wet and dry seasons respectively. Data were collected for five consecutive days two weeks every month.

This involved focal observation while recording data continuously for 10 minutes.

During this period, the activities carried out by the study subject were recorded, with keen interest towards feeding behaviour. Data collected included the plant species the animal was feeding on, the specific plant part eaten, and the time spend feeding.

Feeding was defined as the time when the study subject made physical contact with food to the time it stopped eating or switched to another food item (Kivai, 2018). This was followed by a five-minute resting interval before moving to the next study subject. The study subjects (focal animals) were selected randomly ensuring that no animal from which data was collected twice before all the animals were observed.

Faecal samples were also opportunistically collected. During behavioural sampling, once an animal was observed defecating, the faecal matter was collected into a centrifuge tube and submerged in 99% ethanol for twenty-four hours to sterilize it (Kivai,2018). After this, the ethanol was drained, the faecal sample dried and packaged in the same manner as the plant samples.

Nutritional analysis

Plant samples were simultaneously with the behavioural sampling. Once an animal was observed feeding on a specific plant species, a ribbon was tied on the plant species to act as a mark. Then during the five minutes resting intervals, the specific plant parts were collected, weighed for their wet weight using a scientific weighing machine and packaged in zip-lock bags ready for processing. Methods outlined by Rothman *et al*. (2012) were followed. The dried samples were milled using Willey Mill machine to 1mm particle size at lower Kabete animal nutrition laboratory before actual nutritional analysis. During analysis, the foods were analysed for the major food macronutrients.

Results and Discussion

Feeding behaviour

Seasonal behavioural data collected and analysed revealed that Mountain Bongo behavioural patterns slightly varied across the wet and dry season. Figure 1. A welch two sample t-test however illustrated that there was no statistically significant difference in time spent feeding during the wet and dry season (t=-0.75471, df=2551.6, p=0.4505).

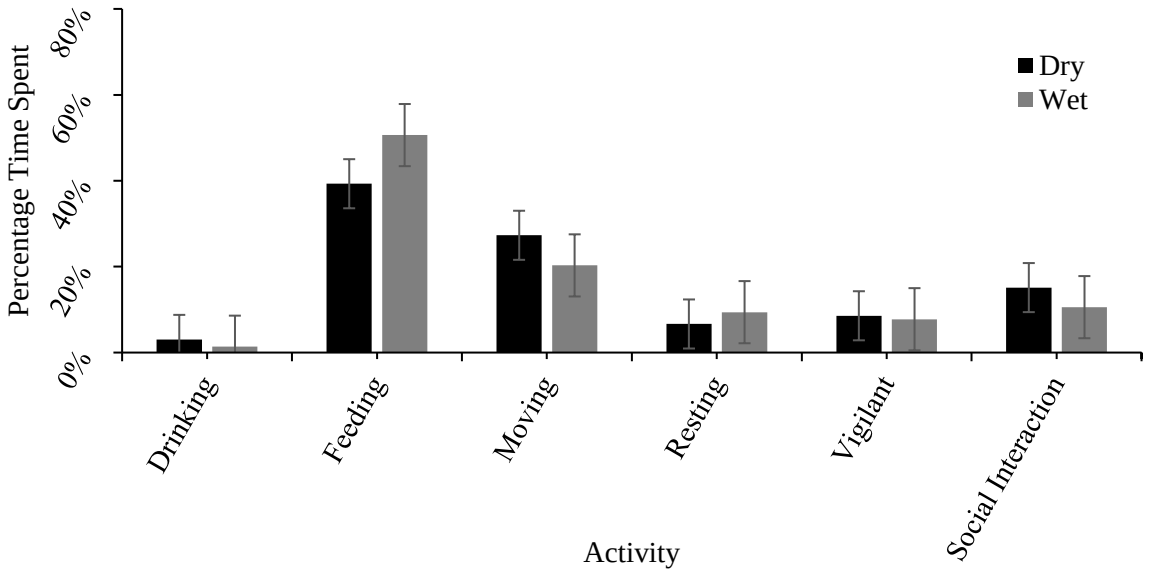

Figure 1: Seasonal variation in feeding behaviour of the Mountain Bongo compared to other behavioural activities.

Mountain Bongos spend most of their time feeding followed by moving. The movement could be interpreted as searching for food to meet their energy requirements (Leuthold, 2012). The body size of herbivores is directly proportional to the energy requirements of the animal meaning that the larger the animal the higher the demand for energy requirements by the body.

Nutritional Composition of the Mountain Bongo Food Plants at Mount Kenya Wildlife Conservancy

Nutrient analysis (%) of food plants foraged by the Mountain Bongo in the conservancy across the wet and dry seasons revealed a significant difference (p<0.05) in the concentration of Neutral Detergent Fibre ($f_{(6,53)}$ = 13.88, p=0.00) and Total non-structural carbohydrates ($f_{(6,53)}$ = 21.93, p=0.00) while all other nutrients tested showed no significant difference (p>0.05) as shown on Table 1. The highest TNC levels were observed in shrubs (46.25±1.97) while grass showed the least (6.17±1.79) This explained the high inclusion of shrubs in Mountain Bongo diet as a key source of energy. The least concentration of Neutral detergent fibre (NDF) was detected in herbs (17.57±1.65) while results on crude protein showed highest occurrence in herbs (16.89±2.31).

Table 1: Composition of macro nutrients (%) in different plant life forms foraged by mountain Bongo in Mount Kenya Wildlife Conservancy

	Lipids	CP	NDF	ADF	TNC
Climber	4.70±0.34	16.27±1.92	31.94±2.35	21.08±1.93	36.74±2.64
Grass	3.28±0.63	14.39±0.55	64.30±0.42	26.45±2.34	6.17±1.79
Herb	3.99±0.52	16.89±2.31	31.10±2.16	17.57±1.65	34.38±3.61
Sedge	3.07±0.00	11.83±0.00	58.00±0.00	27.8±0.00	18.99±0.00
Shrub	3.50±0.50	13.15±1.59	29.16±1.81	18.53±1.34	46.25±1.97
Tree	5.00±0.99	12.59±1.91	33.48±2.59	23.56±2.76	42.68±2.77
p-value	0.423	0.616	0.000	0.073	0.000

KEY: CP – Crude proteins, NDF– Neutral Detergent Fibre ADF – Acid detergent fibre, TNC– Total Non-structural Carbohydrates

Classification of plant types foraged into families revealed significantly different (p <0.05) levels of nutrient composition in NDF with highest levels family Poaceae (64.30±0.42) and lowest Euphorbiaceae (18.37±0.00) shown in (Appendix 6). Averagely, Urticaceae was most nutrient dense, and was the most preferred in the dry season, when the animals experienced fewer food choices (Krivan & Eisner, 2003).

Protein Composition

Top ten plants rich in crude proteins were compared for crude protein composition across the wet and dry season (Figure 2).

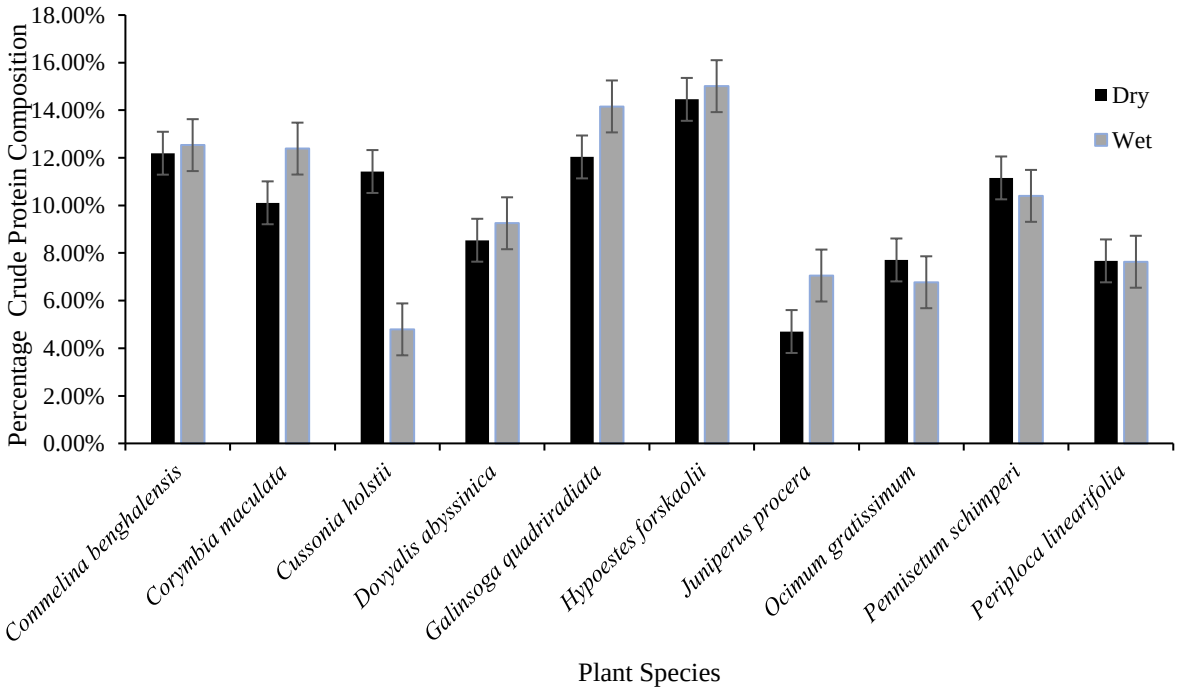

Figure 2: Seasonal variation in crude protein composition for top ten plant species in crude protein composition

Most studies have considered protein to be the limiting nutrient in the diet of browsers yet an important component for growth, reproduction and milk production among other biological processes (De Gabriel, 2014). For the Mountain Bongo, *Hypoestes forskaolii*. Br from the plant family Acanthaceae showed highest concentration of crude protein (15.01% during the wet season and 14.46% during the dry season. This

justifies the high inclusion in diet with 2.50% and 2.47% during the wet and dry seasons respectively. *Galinsoga quadriradiata* was second highest in crude protein composition (14.16% for the wet season and 12.04% for the dry season) explaining why it had the highest inclusivity in diet during the wet season.

Conclusion

Understanding the seasonal fluctuations Mountain Bongo feeding behaviour and in plant nutrition is critical in informing conservation decisions at Mount Kenya Wildlife Conservancy. Conservation efforts should concentrate on protecting and reintroducing important plant species that give Mountain Bongos vital nutrients. Mountain Bongos uses seasonal dietary adjustments to cope with shifting food availability. because of their diet's adaptability, they may be able to survive at difficult times like the dry season It is essential for captive breeding operations to comprehend the nutritional needs of Mountain Bongos. To ensure the health and reproductive success of captive individuals, diets that closely resemble the nutrient profiles of their wild counterparts must be provided.

Mountain Bongo habitats should be restored with plants species that provide essential nutrients across the wet and dry season. This will promote the drive towards achieving a ten percent tree cover within the country. Habitat restoration shall not only provide suitable habitats for the Mountain Bongo but also combat the global effects of climate change.

Recommendations

This study only acts as a baseline study on Mountain Bongo feeding and nutrition ecology and recommends the following:

i. Long term behavioural and nutritional monitoring studies both at Mount Kenya Wildlife Conservancy and for wild populations this is key in promoting healthy and stable populations and will inform the conservation of other endangered species facing the risk of extinction.
ii. Habitat restoration that will involve growing plant species rich in nutrients that are necessary for Mountain Bongo population growth.
iii. Carry out further nutritional analysis to determine the micronutrients (Vitamins, Minerals and ions) in Mountain Bongo diet.

REFERENCES

Altmann, J. (1974). Observational study of behaviour: sampling methods. Behaviour, 49(3-4), 227266.

DeGabriel, J. L., Moore, B. D., Felton, A. M., Ganzhorn, J. U., Stolter, C., Wallis, I. R., ... & Foley, W. J. (2014). Translating nutritional ecology from the laboratory to the field: milestones in linking plant chemistry to population regulation in mammalian browsers. *Oikos*, *123*(3), 298-308.

Kivai, S. (2018). Effects of food nutritional and mechanical properties on foraging of juvenile in wild Tana River mangabeys, Cercocebus galeritus, Kenya (Doctoral dissertation, RutgersUniversity-School of Graduate Studies).

Křivan, V., & Eisner, J. (2003). Optimal foraging and predator–prey dynamics III. *Theoretical population biology*, *63*(4), 269-279.

Leuthold, W. (2012). African ungulates: a comparative review of their ethology and behavioural ecology

NationalWildlifeCensusReport2021https://kws.go.ke/file/3550/download?token=L8M6oawm(Accessed on 9th September 2021)

Rothman, J. M., Vogel, E. R., & Blumenthal, S. A. (2012). Diet and nutrition. Primate ecology and conservation: a handbook of techniques. Oxford University Press, Oxford, 195-212.

APPENDIX: **FIELD GALLERY**

Plate 1 Packaging and labelling plant samples

Plate 2 Mountain Bongos feeding.

Plate 3 Education and awareness for school group.

Plate 4 Community outreach program.