Battle of the Kenyan Herbivores: Resource Competition between Native and Domesticated Animals

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ABSTRACT

As humans continue to encroach on native wildlife's habitats, ecologists must observe the effects humans have on native biodiversity. Numerous factors that affect native African herbivore behavior have been studied in the past; however, the interspecific competition between domesticated animals and native herbivore species still needs to be further studied. With the use of camera trap photographs taken on the Mpala Reserve in Kenya, Africa I observed the relationships between camel abundance and native herbivore diversity. For each camera trap, I recorded the maximum number of camels present at one time and the number of native species observed by each camera. I ran linear regression with R commander to test the relationships between camel presence and native herbivore diversity, native browser diversity, and native grazer diversity. I found a significant negative relationship ($p<0.05$) between camel abundance and native browser diversity, which represents a decrease in native biodiversity due to competition with domesticated animals. I also found a weak positive relationship between camel abundance and native grazer diversity, which illustrates the potential for future facilitation between domesticated animals and native herbivores in Africa. I concluded that when domesticated animals compete with native herbivores for resources, native biodiversity drops; however, there is potential for co-existence up to a certain threshold. Further studies must be conducted using camera trap data to observe the relationship between domesticated animals and native African herbivores with low human involvement.

KEYWORDS

Biodiversity, Conservation, Interspecific Competition, Camera Traps, Management

INTRODUCTION

All across diverse African habitats, numerous factors influence native herbivore behavior that can in turn have an effect on biodiversity. These factors include resource availability, seasonal changes, human encroachment, and competition. Unlike the interspecific competition between native and domesticated animals, the effects of resource availability and seasonal changes on native herbivores have been thoroughly studied in the past.

Resource quality and abundance fluctuates between the wet (May-July) and dry seasons (December-February), which could stress native species due to the competition with domesticated animals for viable resources. For example, water areas are a source of attraction for the herbivores, but to different degrees depending on the species (Redfern et al. 2003). The dry season in Africa increases stress on the native herbivores to find viable resources. Certain species, such as impala, show increased selectivity of food options during the dry season, and therefore switch habitats (Fritz et al. 1996). Additionally, herbivores are constrained to habitats closer to water sources during the dry season because of the decrease in viable water sources (Redfern et al. 2003). Herbivore size is yet another factor to consider concerning herbivore behavior. Large herbivores base their foraging behaviors off of resource availability (Riginos and Grace 2008). A study conducted in 2013 in Kenya revealed an increased preference for nature reserves by native herbivores during the dry season. The study concluded that native herbivores favored the nature reserve during the dry season, because this reserve contained more available resources than the pastoral settlement (Kanga et al. 2013). Perhaps, the native herbivores also favored the nature reserve more than the pastoral settlements due to human influences.

As humans expand land use, native habitats continue to shrink leaving native herbivores with fewer resources. In fact, human settlements constricted herbivores to certain areas and at times even excluded certain species from using specific areas (Ogutu et al. 2013). Humans allow livestock to overgraze pastoral settlement areas, which leaves very little resources for native herbivores. A comparison between a pastoral settlement and a nature reserve showed that native herbivores favored the reserve more than the settlement, because domesticated animals consumed all of the resources where humans were present (Kanga et al. 2013). In addition to humans encroaching on native herbivore habitats, the competition created by domesticated animals must also be emphasized since there is less available habitat for native herbivores to forage in without the presence of domesticated animals. In 1995, the Kenyan Long-Term Enclosure Experiment (KLEE) was established to observe long-term effects between native and domesticated herbivores. Barriers were put up to exclude certain species from specific areas, and cattle were allotted timed runs to forage. Two different situations were tested in which no cattle were present or a moderate amount of cattle were present (Young et al. 1998, Riginos et al. 2012). So far, the study has found that livestock have caused a decrease in wildlife abundance. The KLEE project continues on in order to collect more data about the interactions between domesticated animals and wildlife species. Indeed, several aspects of African herbivore life have been studied in the past in order to reflect on foraging behavior. What this research field is generally lacking is the study of interspecific competition with low human involvement.

It is possible that in the past when researchers have conducted counts using transects, they may have interrupted herbivore behavior. By utilizing camera trap photographs, the animals can be observed in their native habitats without human researcher influences in order to observe if native herbivores change their behaviors in the presence of domesticated animals. The camera trap data in this study was collected on the Mpala Nature Reserve in Kenya, Africa. There were cameras set up in two different environments: riparian and upland glades. In these two environments there were varying abundances of camel populations, which could have an effect on native herbivore diversity, including species such as African Elephant, Plains Zebra, Cape Buffalo, Giraffe, and other large mammal species. This study will investigate the central research question: Does the presence of domesticated animals have a negative effect on native herbivore diversity in Kenya, Africa? My research will test the hypothesis that there is a negative relationship between wildlife diversity and camel abundance. Humans continue to encroach on natural habitats everyday without knowing the effects they have on native populations. Often times these effects have a negative impact on biodiversity, which are detrimental and irreversible. This study can identify whether or not domesticated animals and pastoralism have a negative effect on African herbivores in a time where the protection of biodiversity is crucial.

METHODS

Study site

The Brashares lab group collected camera trap photographs on the Mpala Reserve in Kenya, Africa to observe Kenyan herbivore behaviors. The two major habitats in this study were riparian and upland glades (Figure 1). The riparian habitats were all along the river, while the upland glade habitats were in the higher grassland areas (See Appendix A for coordinates). Five different sites were selected in the riparian ecosystem, and four different cameras were set up in each site (Figure 2). Four different sites were selected in the upland glade ecosystem, and three different cameras were set up in each site (Figure 3).

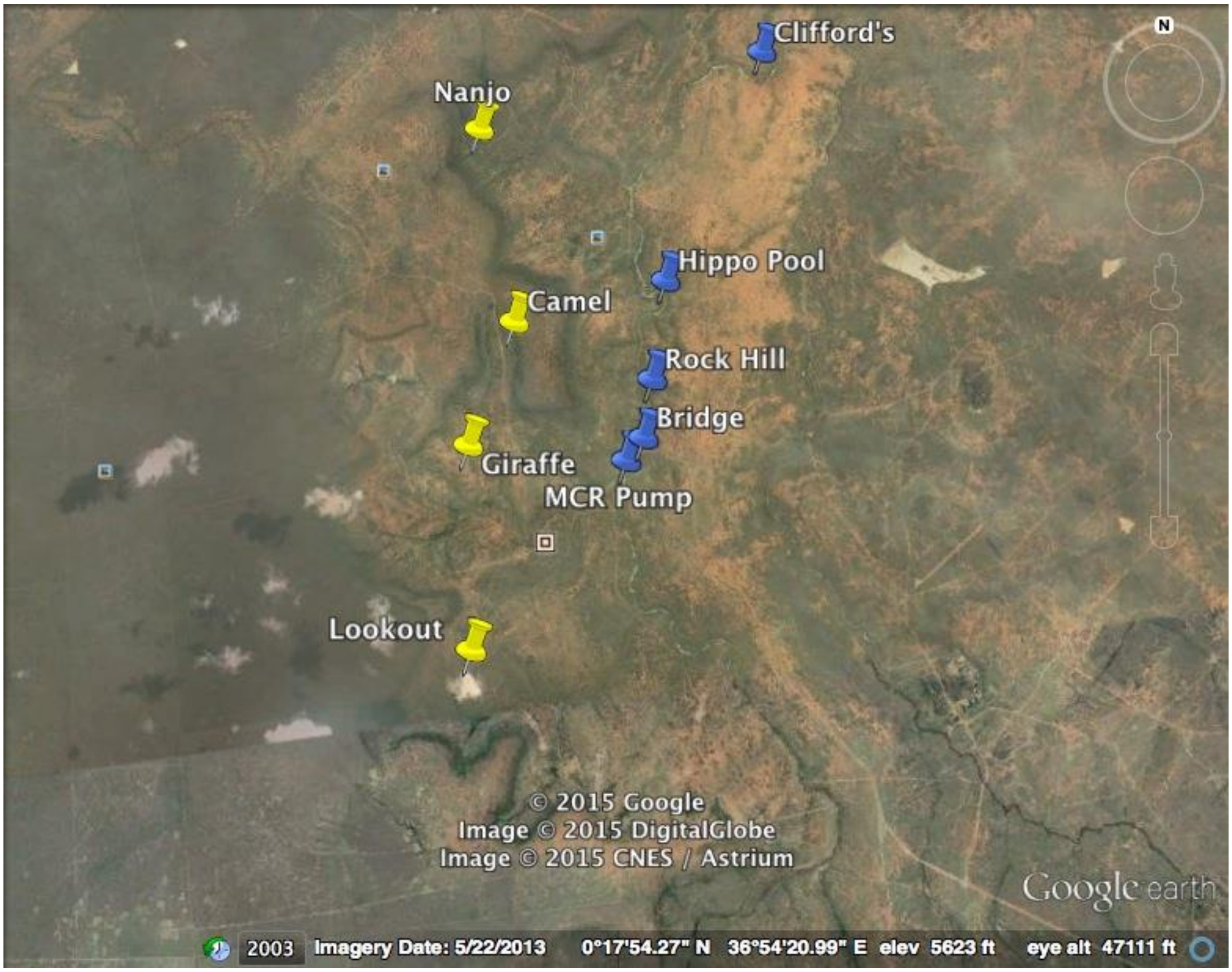

Figure 1: Map of Camera Trap Locations. This map illustrates the locations of each camera trap site. The yellow pins are the upland glade sites and the blue pins are the riparian sites.

Figure 2: Riparian Camera Trap Photograph. This photograph is an example of the riparian habitat.

Figure 3: Upland Glades Camera Trap Photo. This photograph is an example of the upland glades habitat.

Observed species

Native communities of species such as elephant (*Loxodonta africana)*, giraffe (*Giraffa camelopardalis*), impala (*Aepyceros melampus)*, Cape buffalo (*Syncerus caffer)*, Plains (*Equus quagga*) and Grevy's zebras (*Equus grevyi)*, hippopotamus (*Hippopotamus amphibious)*, baboon (*Papio anubis),* bushbuck (*Tragelaphus sylvaticus),* dik dik (*Madoqua kirkii),* eland (*Taurotragus oryx),* greater kudu (*Tragelaphus strepsiceros),* scrub hare (*Lepus saxatillis),* vervet monkey (*Chlorocebus pygerythrus),* waterbuck (*Kobus defassa),* and warthog (*Phachocoerus africanus)* were observed in this study. In addition, domesticated animal populations included camels (*Camelus dromedarius)* in this research experiment.

Data collection

Camera trap photographs were collected by the Brashares group to determine various effects on native herbivore behavior. A camera trap is a camera set up on a tripod that takes a photograph whenever there is movement in the frame. The Brashares lab group has provided me with the camera trap photographs and the extracted data, which included date, time, camera model, site, and camera number from the photographs, and with these photographs I observed camel presence and native herbivore diversity. Camera traps were set up to continuously operate for the months of December, January, and February (the dry season in Kenya) 2013 in the riparian habitat and May, June, and July (the rainy season) 2013 in the upland glade habitat. The Scoutguard, Reconyx, and BolyMedia camera traps took color photographs whenever there was movement in the frame. Therefore, many photographs had to be removed due to misfires by the camera. I recorded the scientific and common names of the species (with a guide provided by the lab group that included older camera trap photographs), number of individuals, and prominent behavior for each photograph in an excel sheet.

Data analysis

My next step was to quantify domestic and wildlife diversity in each camera trap location to observe the relationship between camel counts and diversity. I recorded the maximum number of camels present for each camera trap to quantify camel counts. Once I knew the different counts of camels in each site, I recorded the number of different species present at each camera trap based on their photographs. I then went on to separate the native species into two groups: browsers and grazers. Grazers forage solely on grasses, while browsers will also forage on trees and other plants. I categorized the species as browsers or grazers based on their classification in *The Behavior Guide to African Mammals* (Estes 1991).

I went on to test normality with the Shapiro-Wilk normality test for camel counts, native herbivore diversity, browser diversity, and grazer diversity. Next, I ran a Kruskal-Wallis rank sum test for both camel counts, native herbivore diversity, browser diversity, and grazer diversity to see whether there was a difference between the populations in the riparian habitat and the populations in the upland glade habitat. Finally, I used linear regression to observe the relationship between camel abundance and native herbivore diversity, browser diversity, and grazer diversity (Fox 2005).

RESULTS

Histograms and shapiro-wilk normality tests

The histograms and the Shapiro-Wilk normality tests show whether or not camel counts, native herbivore diversity, browser diversity, and grazer diversity values are normally distributed. I found that all of the distributions were not normally distributed.

Camel counts

For camel counts, the Shapiro-Wilk normality test found a non-normal distribution: p= 6.091e-12. Additionally, the histogram for camel counts illustrates that the values do not follow a normal distribution (Figure 1).

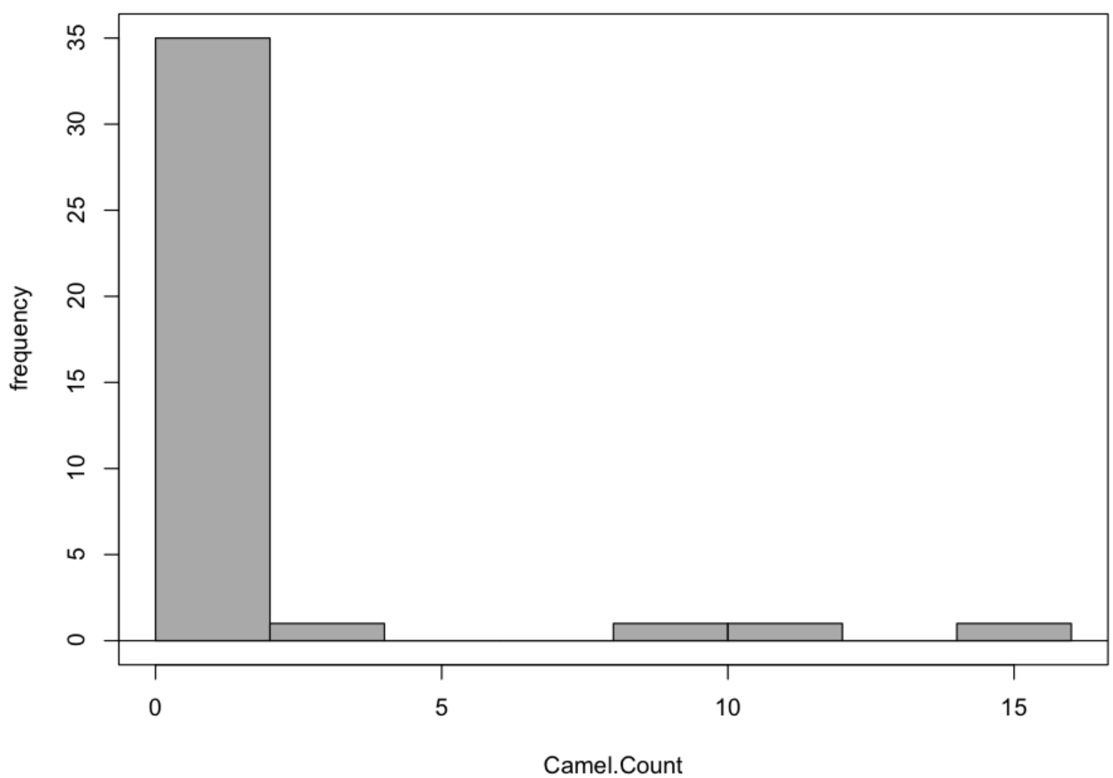

Figure 1: Camel Count Histogram. This figure illustrates that camel count is not normally distributed.

Native herbivore diversity

Similarly, for native herbivore diversity, the Shapiro-Wilk normality test found a non-normal distribution: p=0.002763. The native herbivore diversity histogram also illustrates the non-normal distribution (Figure 2).

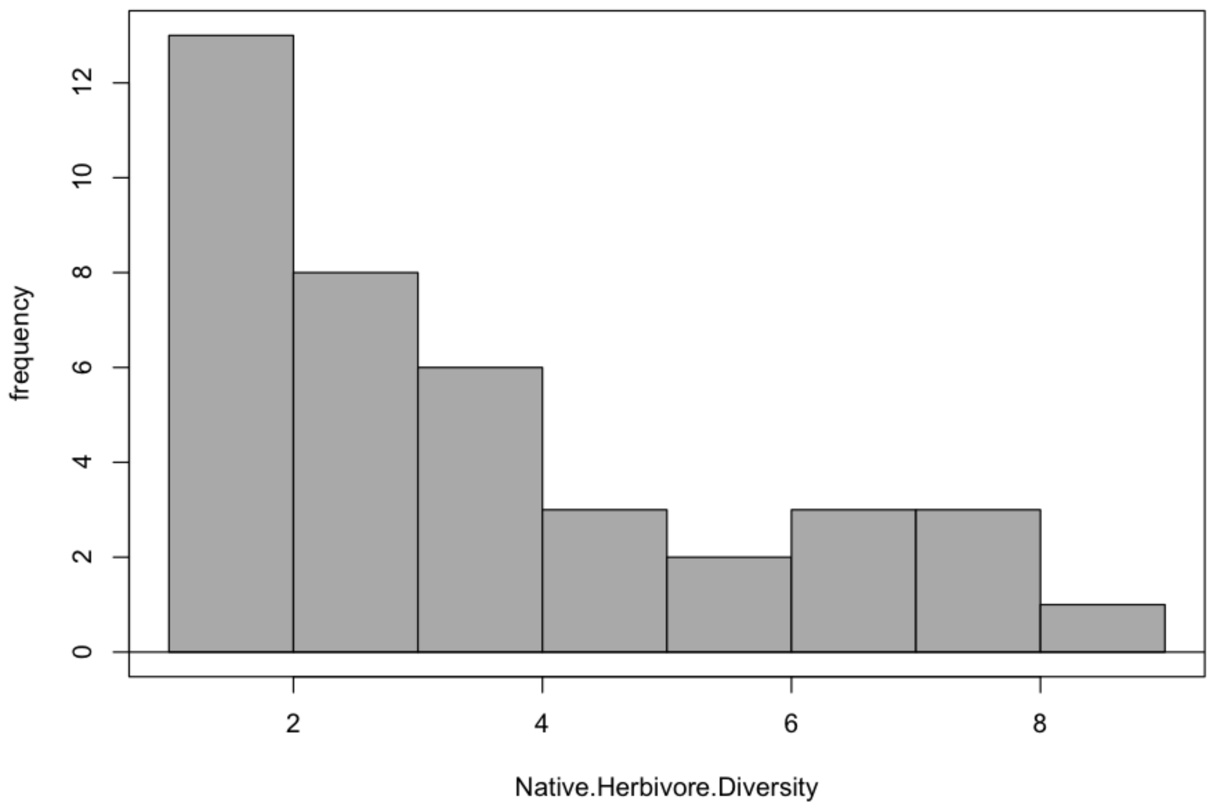

Figure 2: Native Herbivore Diversity Histogram. This figure demonstrates the non-normal distribution of native herbivore diversity.

Browser diversity

The Shapiro-Wilk normality test for browser diversity found a non-normal distribution: p=0.01048. The histogram for browser diversity shows the non-normal distribution (Figure 3).

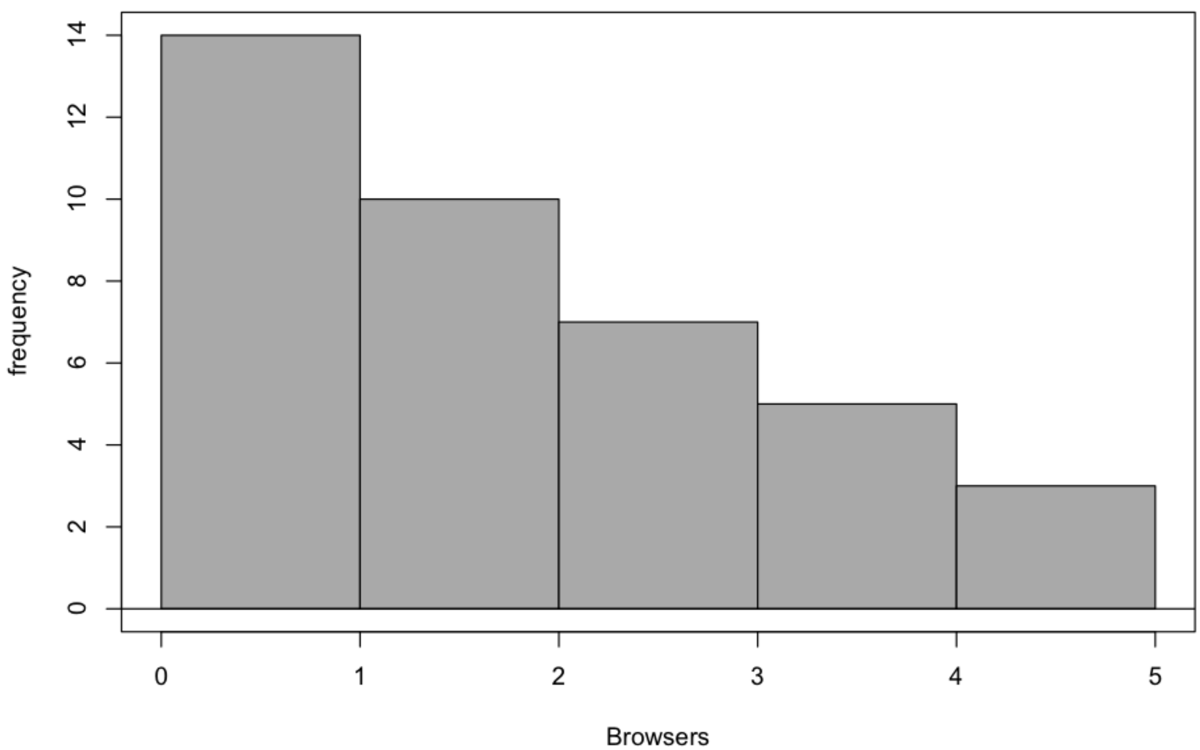

Figure 3: Browser Diversity Histogram. This figure shows that browser diversity in not normally distributed.

Grazer diversity

Finally, the Shapiro-Wilk normality test for grazer diversity found a non-normal distribution: p=0.002643. The histogram for grazer diversity demonstrates the non-normal distribution (Figure 4).

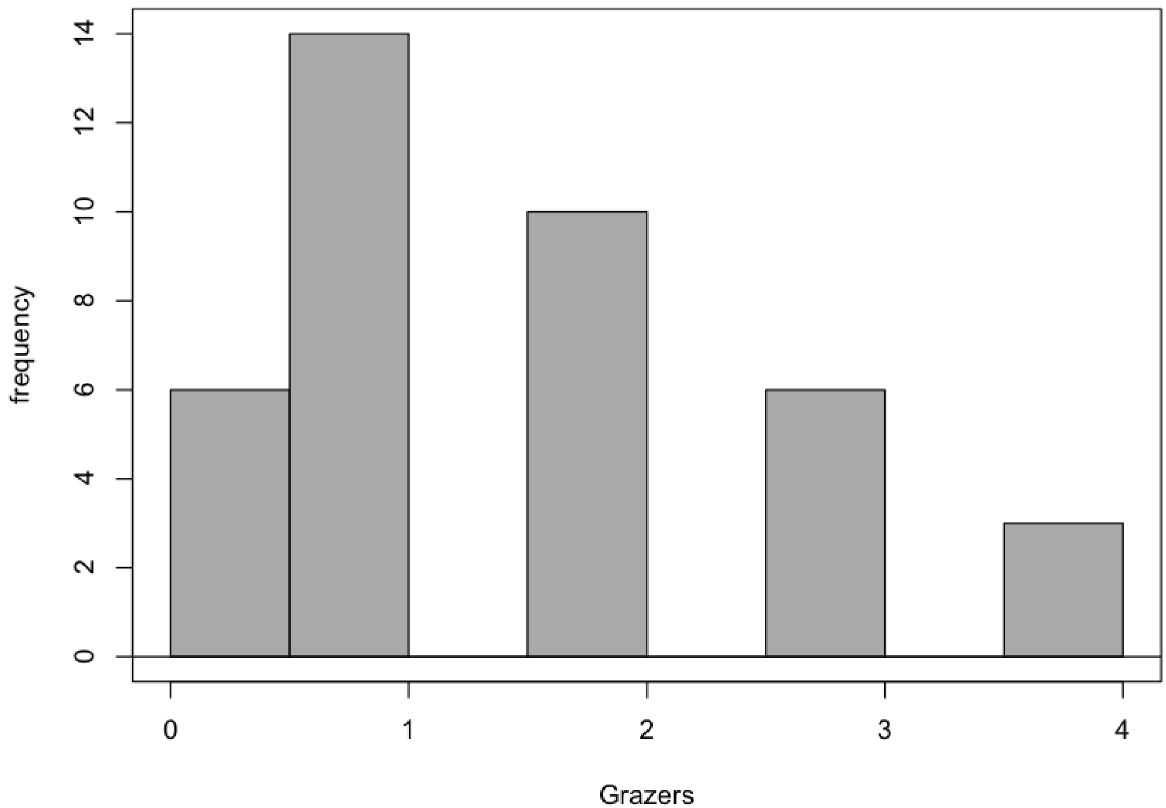

Figure 4: Grazer Diversity Histogram. This figure illustrates that grazer diversity is not normally distributed.

Kruskal-Wallis rank sum test

The Kruskal-Wallis rank sum test shows whether or not there is a difference between populations in the riparian habitats and the upland glade habitats.

Camel counts

Because the p-value is not significant (p=0.09899), there is no difference in camel populations between the two habitats.

Native herbivore diversity

Because the p-value is significant (p=0.0388), there is a statistically significant difference between native herbivore diversity between the two habitats.

Browser diversity

Because the p-value is not significant (p=0.3742), there is no difference between diversity levels of browsers in the two habitats.

Grazer diversity

Because the p-value is significant (p=0.006339), there is a difference between the riparian and upland glade habitats.

Linear regression

I found that camel abundance's relationship with native herbivore diversity varied based on how the native herbivore species were categorized.

Camel counts versus native herbivore diversity

The linear regression for camel counts versus native herbivore diversity had multiple R^2=0.03169, adjusted R^2=0.005515, p=0.2783. The p-value is higher than 0.05, which means the data is not statistically significant, and the low R^2 values show that the line of best fit does not represent the relationship between camel counts and native herbivore diversity well. However, the scatterplot for camel counts versus native herbivore diversity does illustrate a negative relationship between the two variables (Figure 5).

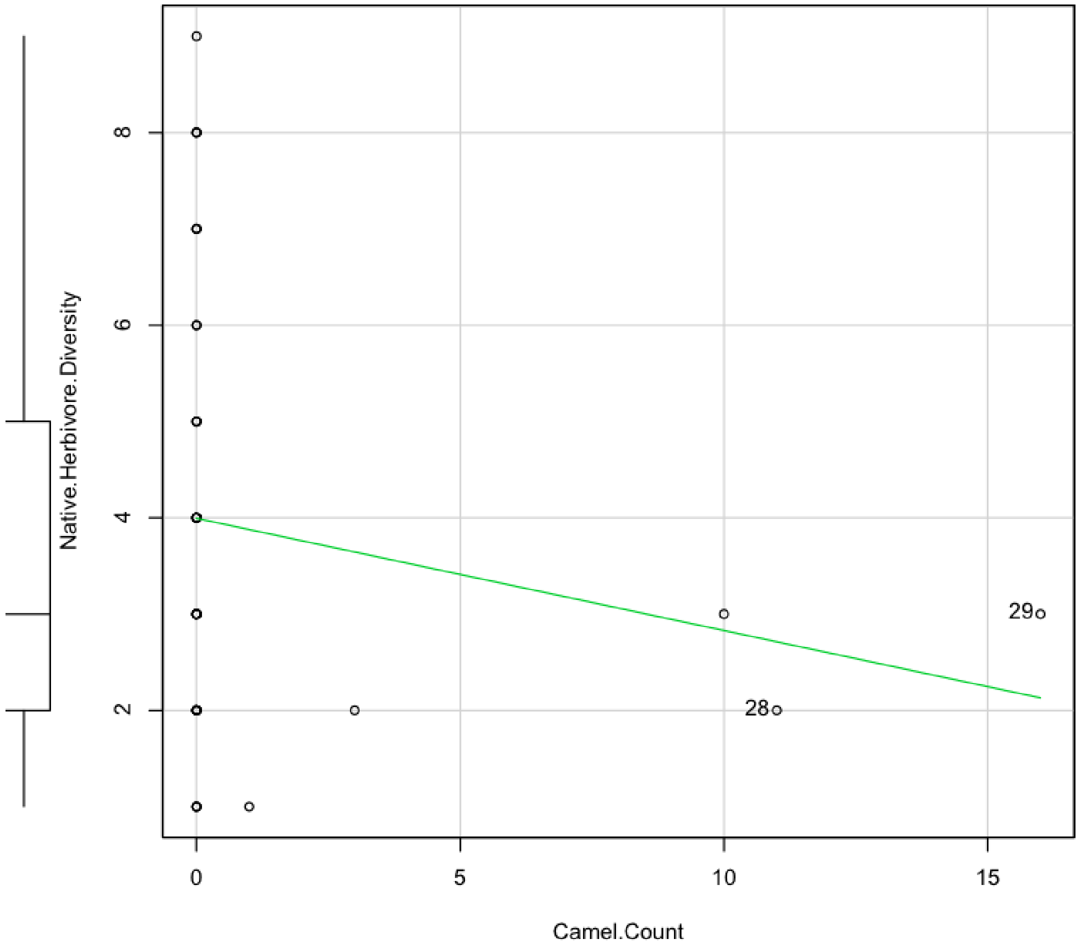

Figure 5: Camel Count vs. Native Herbivore Diversity Scatterplot. This figure demonstrates the negative relationship between camel abundance and native herbivore diversity.

Camel counts versus browser diversity

The linear regression for camel counts versus browser diversity had multiple R^2=0.1028, adjusted $R^{2=}$0.07851, p=0.04663. The p-value is lower than 0.05, which means that the relationship is statistically significant, and the high R^2 values show that the line of best fit does describe the relationship between camel counts and browser diversity well. Additionally, the scatterplot for camel counts versus browser diversity illustrates a negative relationship (Figure 6).

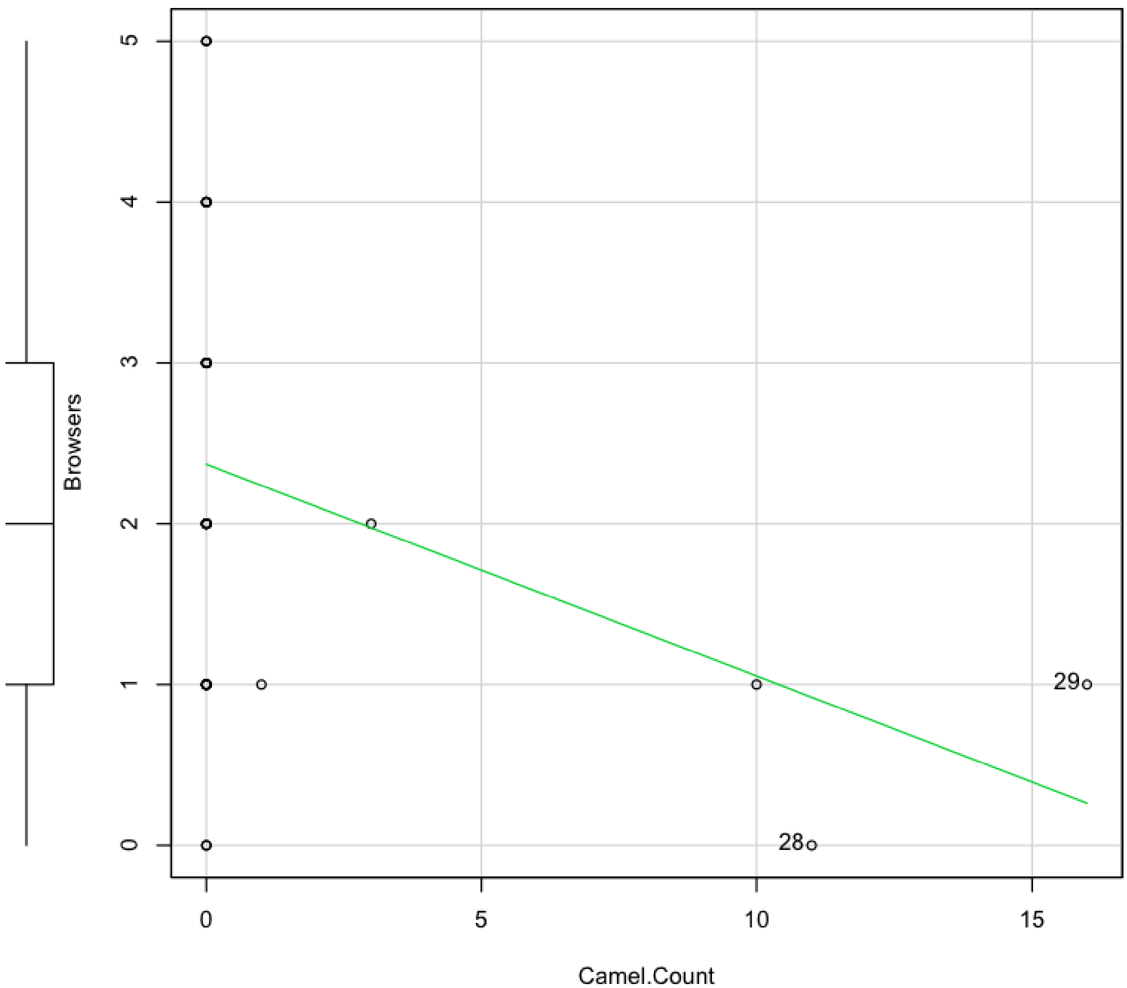

Figure 6: Camel Count vs. Browser Diversity Scatterplot This figure demonstrates the statistically significant negative relationship between camel abundance and browser diversity.

Camel counts versus grazer diversity

The linear regression for camel counts versus grazer diversity had multiple R^2 =0.001995, adjusted R^2=-0.02498, p=0.7872. The p-value is higher than 0.05, which means the data is not statistically significant, and the low R^2 values show that the line of best fit does not represent the relationship between camel counts and grazer diversity well. The scatterplot for camel count versus grazer diversity illustrates a weak positive relationship between camel counts and grazer diversity (Figure 7).

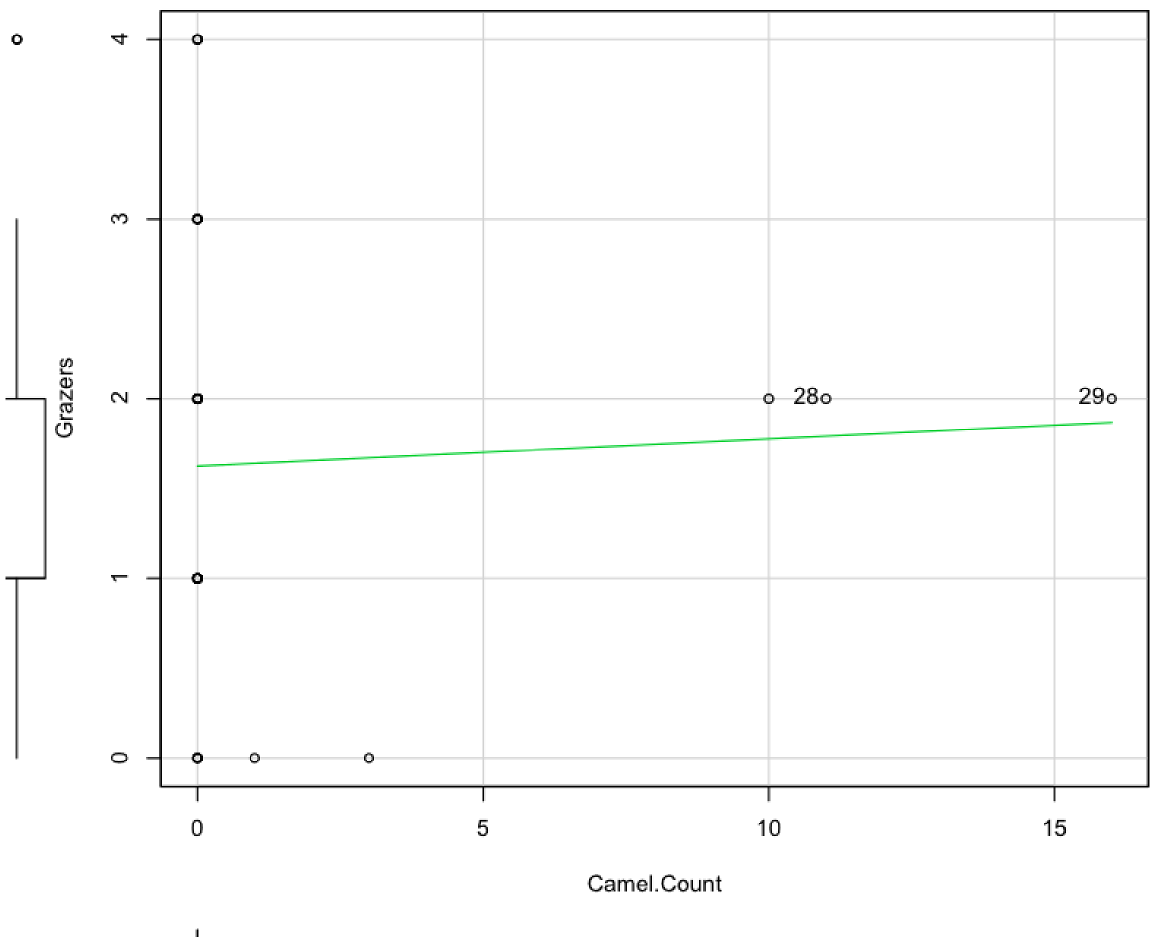

Figure 7: Camel Count vs. Grazer Diversity Scatterplot. This figure illustrates the lack of a negative relationship between camel abundance and grazer diversity.

DISCUSSION

As humans increasingly manipulate native wildlife's habitats, wildlife ecologists must investigate the effects humans have on native wildlife's behaviors. My project specifically focused on the effects of domesticated animals on native herbivore diversity. My central research question of -"does the presence of domesticated animals affect native herbivore diversity?"- was valid to attempting to uncover whether or not domesticated animals are harming native populations. Through the use of camera trap data, I was able to observe that camel abundance had differing relationships with native herbivores based on how the native species were categorized.

The significant negative relationship between camels and native browser species supported my hypothesis that camel presence causes a decrease in native herbivore diversity. There was also a negative relationship between camels and native herbivore species as a whole, which supports my hypothesis; however, this relationship was not statistically significant. Surprisingly, there was a very weak positive relationship between camels and grazer species, which refutes my hypothesis. In the past, numerous factors, such as water and resource availability, have been studied to observe their effects on native wildlife behavior; however, the interspecific competition between domesticated animals and native herbivores is still a new area of study for wildlife ecologists.

Relationship between camel abundance and native herbivore diversity

The potential negative relationship between camel counts and native herbivore diversity suggests that domesticated animals limit native herbivore diversity. A similar study found that livestock used more habitat for foraging than the native wildlife used, which resulted in a decrease of available resources for wildlife and a decrease in native biodiversity (Du Toit and Cumming 1999). Native species that compete more heavily with domesticated animals were found to favor nature reserves over ranches, because they avoided competition with the cattle on the ranch land (Ogutu et al. 2014). Kanga et al. (2013) used biomass and species richness to observe that native species avoided areas heavily populated with domesticated animals. The KLEE experiment illustrated that the presence of cattle caused a decrease in zebra presence, because the cattle would heavily forage the enclosed areas. However, the presence of elephants helped limit the cattle's foraging, which allowed the presence of zebras to increase (Young et al. 2005). Indeed, native herbivore diversity has decreased in all areas except wildlife reserves that are heavily protected from human manipulation (Hopcraft 2000). This may be due to overlapping niches between domesticated animals and native herbivore species. The overlapping niches led to increased interspecific competition between livestock and native species, which caused a decrease in native biodiversity (Prins 2000). I was surprised that there was not a significant negative relationship between camel abundance and native herbivore species as a whole. Perhaps, the weak positive relationship between camel abundance and grazer diversity caused the relationship between camel abundance and native herbivore diversity as a whole to not be significant. However, there was a significant relationship between camel abundance and native browser diversity.

Relationship between camel abundance and browser diversity

I found it surprising that out of the three linear regression tests, it was the browser diversity that showed the significant negative relationship. Whether a species is a grazer or a browser affects their choice of foraging habitats (McNaughton and Georgiadis 1986). Giraffes, who are a browser species, tend to forage on the higher canopy areas to avoid competition with smaller browsers (Cameron and du Toit 2005). Therefore, I assumed that the giraffes would use this same method with the camels. However, that was not the case for my project since there was a negative relationship between camel presence and browser diversity. Additionally, browsers and grazers forage on different species of plants, which can explain why camel abundance affects the two types of species differently (Gordon 2003). However, I expected camels to affect grazers more than browsers, because the domesticated animals are also grazers. Perhaps, the browser species' greater affinity to riparian habitats due to greater available browsing materials led to the decrease of their presence in the upland glade habitats (Smit et al. 2007). What was even more surprising than the significant negative relationship between camel abundance and browser diversity, was the weak positive relationship between camel counts and grazer diversity.

Relationship between camel abundance and grazer diversity

The lack of a negative relationship between camel abundance and native grazer species supports the argument that perhaps facilitation can occur between domesticated animals and native herbivore species up to a certain threshold. Domesticated animals favor habitats similar to those of grazing species such as zebras (Voeten and Prins 1999). In fact, native populations in a conservation area in Tanzania did not suffer a limit of diversity due to shared land use with domesticated animals (Homewood and Rodgers 1991). On the contrary, Prins (2000), found that native species numbers were negatively affected by domesticated animal numbers due to competition and human activities. Additionally, impala suffered from interspecific competition with domesticated animals, which caused the impala to change their habitat preference (Fritz et al. 1996). Currently, there is a larger amount of evidence that supports the idea of domesticated animals limiting the presence of native herbivore species rather than facilitating the native herbivores' presence.

Limitations

Since my thesis project was the observance of wildlife with low human involvement, there were limitations that would not be found in previous studies. Studies observing the effects of domesticated animals on native species used methods such as transects and enclosure experiments, which could have potentially included human interference. My camera trap photographs provided a new method of observing wildlife without human interference. My main limitation of my project was that the camera traps were not set up for long enough periods of time. I was not able to observe how long it took for native species to reemerge after the domesticated animals vacated the sites. I also had many days where there were no camels present, which could have skewed my linear regression results. My limitations can be easily remedied and lead to future research on the subject.

Future directions

Future research should be conducted on the relationship between domesticated animals and native herbivore diversity in Africa with the use of camera trap photographs. The camera traps should be set up for more than a few days at a time in order to perhaps study whether certain species of wildlife avoid areas populated by camels for longer after the camels evacuate the site than other native species. The significant negative relationship between camel counts and browser diversity illustrates that more camera trap studies must be conducted to prove whether domesticated animals are limiting the diversity of browsers, grazers, and native herbivores as a whole. Perhaps, if future projects are able to record days where both camels and native herbivores are present, then they can compare the foraging times of native herbivores on days when camels are present versus on days when camels are not present. This research could attempt to answer whether or not the presence of domesticated animals limit foraging times of native herbivores. The study of the effects of domesticated animals on native wildlife species is still a relatively new area for wildlife ecologists; therefore, many future studies must be conducted to observe whether or not domesticated animals are a threat to native biodiversity.

Broader implications/conclusion

As wildlife habitats continue to further diminish, ecologists must begin to observe how humans affect native biodiversity before it is too late. My camera trap research illustrated that camel abundance had a negative effect on native browser diversity, which calls for more observant studies of competition between domesticated animals and native wildlife in Africa. By using camera trap data, I was able to demonstrate that wildlife can be observed with low human involvement. I believe that by studying the relationship between domesticated animals and native species, ecologists can create proper management advice for the owners of the camels in Africa. Based on my results, I would suggest that the owners of domesticated animals should limit foraging times when browser species are located in the vicinity. Perhaps, future studies will be able to fully comprehend the competition between domesticated animals and native wildlife. My project is the starting point for future projects to use camera trap photographs in Kenya, Africa to observe interspecific competition and protect biodiversity before it reaches its tipping point.

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REFERENCES

Cameron, E.Z. and J.T. du Toit. 2007. Winning by a Neck: Tall Giraffes Avoid Competing with Shorter Browsers. The American Naturalist 169:130-135.

Du Toit, J.T., and D. H. M. Cumming. 1999. Functional significance of ungulate diversity in African savannas and the ecological implications of the spread of pastoralism. Biodiversity and Conservation 8:1643-1661.

Estes, R. D. 1991. The Behavior Guide to African Mammals Including Hoofed Mammals, Carnivores, Primates. University of California Press, Berkeley and Los Angeles, CA.

Fox, J. 2005. The R Commander: A Basic Statistics Graphical User Interface to R. Journal of Statistical Software, 14(9): 1-42.

Fritz, H., De Garine-Wichatitsky, M., and Letessier, G. 1996. Habitat use by wild and domestic herbivores in an African savanna woodland: the influence of cattle spatial behavior. Journal of Applied Ecology 33:589-598.

Gordon, I. J. 2003. Browsing and grazing ruminants: are they different beasts? Forest Ecology and Management 181:13-21.

Homewood, K.M. and W.A. Rodgers. 1991. Maasiland ecology: pastoral development & wildlife conservation in Ngorongoro, Tanzania. Cambridge University Press, Cambridge, UK.

Hopcraft, D. 2000. Wildlife Land Use and the Great Experiment. Pages 267-275 *In* Prins, H.H.T., J.G. Grootenhuis, and T.T. Dolan, editor. Wildlife Conservation by Sustainable Use, Kluwer Academic Publishers, New York.

Kanga, E. M., Ogutu, J. O., Piepho, H. P., and Olff, H. 2013. Hippopotamus and livestock grazing: influences on riparian vegetation and facilitation of other herbivores in the Mara Region of Kenya. Landscape Ecology 9:47-58.

McNaughton, S. J., and N. J. Georgiadis. 1986. Ecology of African Grazing and Browsing Mammals. Annual Review of Ecology and Systematics 17:39-65.

Ogutu, J. O., R. S. Reid, H. P. Piepho, N. T. Hobbs, M. E. Rainy, R. L. Kruska, J. S. Worden, and M. Nyabenge. 2013. Large herbivore responses to surface water and land use in East African savanna: implications for conservation and human-wildlife conflicts. Biodiversity and Conservation 23:573-596.

Ogutu, J.O., R.S. Reid, H.P. Piepho, N.T. Hobbs, M.E. Rainy, R.L. Kruska, J.S. Worden, and M. Nyabenge. 2014. Large herbivore responses to surface water and land use in an East African savanna: implications for conservation and human-wildlife conflicts. Biodiversity and Conservation 23:573-596.

Prins, H. H. T. 2000. Competition Between Wildlife and Livestock in Africa. Pages 51-80 *In* Prins, H.H.T., J.G. Grootenhuis, and T.T. Dolan, editor. Wildlife Conservation by Sustainable Use, Kluwer Academic Publishers, New York.

Redfern, J. V., R. Grant, H. Biggs, and W. M. Getz. 2003. Surface-water constraints on herbivore foraging in the Kruger National Park, South Africa. Ecology 84:2092-2107.

Riginos, C., and J. B. Grace. 2008. Savanna tree density, herbivores, and the herbaceous community: bottom-up vs. top-down effects. Ecology 89:2228-2238.

Riginos, C., L. M. Porensky, K. E. Veblen, W. O. Odadi, R. L. Sensenig, D. Kimuyu, F. Keesing, M. L. Wilkerson, and T. P. Young. 2012. Lessons on the relationship between livestock husbandry and biodiversity from the Kenya Long-term Exclosure Experiment (KLEE). Pastoralism: Research, Policy, and Practice 2:10.

Smit, I. P. J., C. C. Grant, and B. J. Devereux. 2007. Do artificial waterholes influence the way herbivores use the landscape? Herbivore distribution patterbs around rivers and artificial surface water sources in a large African savanna park. Biological Conservation 136:85-99.

Voeten, M.M. and H.H.T. Prins. 1999. Resource partitioning between sympatric wild and domestic herbivores in the Tarangire region of Tanzania. Oecologia 120:287-294.

Young, T. P., B. Okello, D. Kinyua, and T. M. Palmer. 1998. KLEE: a long-term multi-species herbivore exclusion experiment in Laikipia, Kenya. African Journal of Range and Forage Science 14:92-104.

Young, T. P., Palmer, T. M., and Gadd, M. E. 2005. Competition and compensation among cattle, zebras, and elephants in a semi-arid savanna in Laikipia, Kenya. Biological Conservation 122:351-359.

APPENDIX A: Camera Trap Coordinates

Riparian

Bridge: 0.300994 N, 36.90768951213498 E

Clifford's: 0.3448 N, 36.9211756372577 E

Rock Hill: 0.307427 N, 36.90864661890435 E

Hippo Pool: 0.318412 N, 36.91013867874721 E

MRC Pump: 0.298519 N, 36.90581056344806 E

Upland Glades

Nanjo: 0.335398 N, 36.889673256367075 E

Giraffe: 0.300138 N, 36.88893501361596 E

Lookout: 0.278394 N, 36.88955870246289 E

Camel: 0.313646 N, 36.89387177979222 E