Resource Use and Conservation: Comparing the Effects of Different Resource Use Regulations on People and Wildlife in Tarangire National Park and Ngorongoro Conservation Area

Lauren Gibson
Stanford University

Abstract

Life for Maasai just outside of Tarangire National Park (TNP) and inside of the Ngorongoro Conservation Area (NCA) involves nearly opposite access rights. The NCA allows the Maasai to graze their cattle, gather natural resources, and create permanent settlements within the park boundaries, while TNP strictly forbids them from living on or gathering resources from the land. These two models of conservation correlate with very different effects on the human standard of living and on wildlife population changes over time. Since its establishment, the NCA has seen more positive changes in human wellbeing and wildlife population numbers when compared to TNP, although the exact reasons behind this phenomenon require further investigation.

Background

The Maasai

The Maasai people, living in the Tarangire and Ngorongoro regions of Tanzania as well as in other regions of East Africa, have traditionally led nomadic lives herding cows, sheep, and goats around the grasslands in order to subsist, mainly on their milk, blood, and meat (Igoe, 2004). Cattle prove their integral role in Maasai society by acting not only as food and livelihood but also as a sort of currency. Exchanges of cows between individuals and between individuals display friendships, family ties, marriages, and more, and a man's wealth can be measured by counting his cows (Igoe, 2004).

Despite their heavy reliance on cattle and rangelands for grazing their cattle, the Maasai people experienced major land losses over the course of the last century due to German and British colonialism and post-colonial international pressures, namely an effort to set aside large swaths of land for conservation purposes. As they were funded by Western non-governmental organizations that hold a specific vision of what conservation should look like, these conservation efforts specifically

exclude indigenous peoples from the landscapes (Neumann, 1998). This proves problematic not only because they limit the overall amount of space available for the Maasai to use as grazing lands, but especially because the lands that are best for wildlife—and therefore the lands targeted for protection—are also the lands that are best for the Maasai cattle. As a result, the Maasai have lost significant tracts of their particularly productive rangelands to protected area gazettement. The local people were frequently forcefully evicted from their land with little or no compensation for their loss, often resulting in poverty (Neumann, 1998). In short, the Maasai have struggled to keep their traditional grazing lands in the face of European conservation ideals that seek to prevent local people from living within and utilizing protected areas.

IUCN Protected Area Designations

The International Union for Conservation of Nature (IUCN) monitors protected areas worldwide, assigning each a category based on the area's conservation focus, scale, and allowance of human use (Table 1; IUCN, 2014). These globally-recognized categories allow for the recognition of and comparison between protected areas beyond national boundaries. Because Tarangire National Park and Ngorongoro Conservation Area vary so significantly in their human resource allowance, they fall into some of the most extreme categories on either end of the spectrum (Category II and Category VI, respectively).

NUMBER	NAME	DESCRIPTION
I	Strict Nature Reserve / Wilderness Area	Protection of an area in which human visitation, use, and impacts are strictly regulated
II	National Park	Protection of a space in which limited human use and recreation are allowed
III	National Monument / Feature	Small-scale protection of national monument
IV	Habitat / Species Management Area	Protection of a specific animal or ecosystem
V	Protected Landscape / Seascape	Protection of an area with environmental, cultural, or aesthetic value
VI	Protected area with sustainable use of natural resources	Protection of an environment as well as human traditional resource use

TABLE 1. IUCN Protected Area Designations (adapted from IUCN, 2014).

Tarangire National Park

The land that is today Tarangire National Park (TNP, Figure 1) historically acted as a dry season watering area for Maasai cattle because of the life-

giving Tarangire River that runs through the region. After the eviction of the Maasai from the area due to its gazettement as a national park in 1970, however, the 2642-square kilometer semi-arid savannah has since acted as a dry season sanctuary solely for wild animals (Kangwana & Ole Mako, 2001). Dozens of mammal species migrate to the park when waters run low in other areas of the Tarangire ecosystem of north-central Tanzania, and the success of this ecosystem therefore relies heavily upon habitat corridors that link the national park itself to other wildlife refuges from which the animals migrate. Unfortunately, though, because the Maasai people were expelled from the national park and now have very little land to allow for subsistence pastoralism, they have settled along the periphery of the park and have begun subsistence farming, effectively cutting off the majority of animal migration routes (Kahurananga & Silkiluwasha, 1997). This threatens the survival of the very species that the national park was intended to protect.

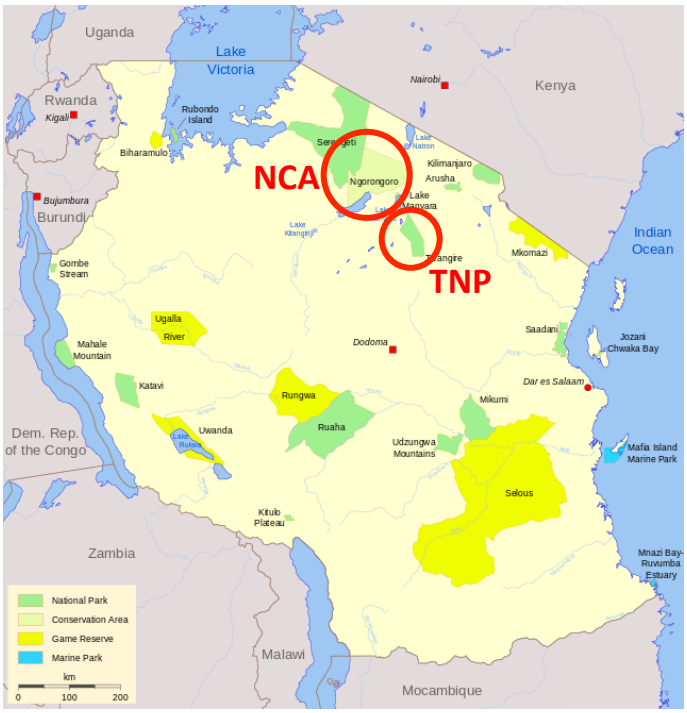

FIGURE 1. Map of Protected Areas of Tanzania. Tarangire National Park (TNP) and Ngorongoro Conservation Area (NCA) are both located in Northern Tanzania and represent pieces of historic Maasai lands (map from Wikepedia.com).

Ngorongoro Conservation Area

Unlike Tarangire National Park, the Ngorongoro Conservation Area (NCA) – a 8292-square kilometer Category VI protected area in the Serengeti-Mara ecosystem of northern Tanzania – was created specifically with human resource use in mind (Charnley, 2005). Though it was

originally a part of Serengeti National Park, the two protected areas separated in 1959 with Serengeti set aside solely for wildlife (with no human use allowed) and Ngorongoro reserved for the Maasai to live in their traditional ways alongside wildlife (Charnley, 2005). This makes the NCA unique among Tanzania's protected areas – a test of whether pastoral peoples and wildlife can indeed coexist without causing harm to one another.

Despite the NCA's strong goals of merging conservation ideals and human wellbeing, the area has been anything but consistent in its resource use policies. As shown in Table 2 below, the Maasai people have been subjected to a series of fluctuating regulations in the last few decades. What is and is not allowed within the park boundaries seems to change frequently, resulting in a less-than-optimal relationship between park officials and the NCA's inhabitants. Additionally, because the area does allow for human settlement, overcrowding has become a serious problem that could threaten both humans and wildlife in the future, and decrease per capita resources (Charnley, 2005). Policies may have to change, yet again, to address these impending issues.

YEAR	EVENT
1959	NCA separates from Serengeti NP to become an independent entity focused on merging indigenous land use with conservation
1974	Maasai people are evicted from the Ngorongoro Crater
1975	Cultivation is banned throughout the NCA
1992	Cultivation ban is revoked
2009	Cultivation is banned throughout the NCA

TABLE 2. Ngorongoro Conservation Area Timeline (from Charnley, 2005 and PAMS Foundation, 2011).

Main Question

How does Tarangire National Park (TNP) compare to the Ngorongoro Conservation Area (NCA) regarding its local standard of living and wildlife conservation effectiveness?

Hypotheses

Hypothesis #1: Ngorongoro Conservation Area has a greater positive effect (or a less negative effect) on local people's standard of living than Tarangire National Park.
Hypothesis #2: Ngorongoro Conservation Area has a greater positive effect (or a less negative effect) on wildlife conservation effectiveness than Tarangire National Park.
Hypothesis #3: Ngorongoro Conservation Area and Tarangire National Park have equal effects on local people's standard of living.

Hypothesis #4: Ngorongoro Conservation Area and Tarangire National Park have equal effects on wildlife conservation effectiveness.

Hypotheses #1 and #2 will be tested first. If evidence supports both hypotheses, no further hypotheses need to be tested. If evidence fails to support Hypothesis #1, then Hypothesis #3 will be tested. If evidence fails to support Hypothesis #3, then we must assume that evidence supports that TNP has a greater positive effect or a less negative effect on local people's standard of living than does NCA. If evidence fails to support Hypothesis #2, then Hypothesis #4 will be tested. If evidence fails to support Hypothesis #4, then we must assume that evidence supports that TNP has a greater positive effect or a less negative effect on wildlife conservation effectiveness than does NCA. Outcomes in human standard of living and wildlife conservation effectiveness will be evaluated based on the criteria outlined in the "Methods" section below.

Methods

Measuring standard of living

Testing Hypothesis #1 requires creating a measurement of local standard of living that can be used to assess both TNP and the NCA. Although countless factors collectively influence a community's standard of living, only certain aspects of standard of living are researched well enough at the local level in northern Tanzania to be included in this study. Wealth and welfare were chosen as measurements of standard of living for this particular project; wealth is a quantifiable snapshot of how well a community is doing materially at a given moment, while welfare seeks to qualitatively measure overall security of land and resource access over time.

To measure wealth in the local Maasai villages located in the NCA and immediately outside of TNP, per capita livestock units were used. This is an accurate stand-in for per capita GDP because the Maasai economy relies so heavily on cattle rather than cash. Furthermore, approximately 96% of Maasai in the area near Tarangire keep livestock, showing its widespread importance in the Tarangire area. Because the NCA no longer allows cultivation, cattle herding remains a central means of wealth for the Maasai in that area as well (Homewood, Kristjanson, & Trench, 2009). Per capita livestock units can therefore be used as a metric for wealth. Measurements of wealth from the earliest data point available following the establishment of each park (1978 for TNP and 1960 for the NCA) were compared to the final data point available for each park (early 2000's) to find the overall trend in wealth since each park was created.

Welfare was measured based on two smaller categories: land security and resource access. Both of these sub-categories in combination measure a community's ability and willingness to provide its people with consistent resources for survival. Because security is not easy to quantify, qualitative survey data and policy changes over the course of each park's histories

were used to measure observed changes in these aspects of welfare through time.

To determine the net effect of each park on local standard of living, the trends in wealth and welfare are considered collectively to determine whether the park seems to have benefited or harmed the local people overall. If one measure increases while the other decreases, wealth will hold the greater weight: since wealth is measured in cattle in this study, it represents not only wealth but also a food source and a culturally important symbol.

Measuring wildlife conservation effectiveness

To measure the effectiveness of wildlife conservation efforts in each park over time, population sizes of four key terrestrial land mammals at the establishment of the park and at more current times (early 2000s) were recorded. Species used were the African elephant, the black rhinoceros, the migratory wildebeest, and the African lion. Percent population change was calculated so that conservation effectiveness for each of the four species in TNP could be compared to conservation effectiveness of the same four species in the NCA. Measuring percent change rather than comparing species populations helped to eliminate potential biases due to TNP and NCA's different sizes, climates, and ecosystems.

Each of the four species selected for comparison was chosen as a case study to measure the effectiveness of a different aspect of protected area conservation, because each species faces very different survival challenges against which parks are charged with protecting. For example, the black rhinoceros populations in northern Tanzania suffer almost exclusively from poaching. Black rhinoceros population change over time, then, would help to measure how well a protected area can implement and enforce anti-poaching regulations and rescue a species from the brink of extinction. Elephants, in addition to facing poaching threats similar to those of the black rhinoceros, face human-herbivore conflict because of increased elephant crop raids as permanent agriculture joins pastoralism as a main subsistence activity in and around protected areas. Therefore, the change in elephant populations over time reflects each park's success in mediating human-elephant conflicts as well as poaching. Wildebeest populations, on the other hand, do not suffer large percent population decreases from poaching, but they do act as an indicator species for the health of the ecosystem as a whole. If a park's wildebeest populations are healthy, the park has likely protected the ecosystem well. Furthermore, only migratory wildebeest were counted in this study, and the presence of high numbers of migratory wildebeest implies connectivity between the protected area and outside habitats. Finally, lions face danger because of human retaliation killings and ritual killings (Ikanda & Packer, 2008). Measuring a lion population's change over time, then, seeks to account for a park's ability to control human-predator conflict.

With these results on animal population increases or decreases, the net effect on wildlife conservation over the history of the protected area was determined. Each species was weighted equally in this net effect calculation, because each stands as a separate species representing a different but equally important conservation challenge that the protected areas both face. A net positive impact on wildlife conservation was recorded if more percent increases than percent decreases were noted. More decreases than increases signified a net negative, and an equal number of increases and decreases resulted in a net neutral effect. Finally, the net effects of each park were compared to identify which protected area was more effective in its wildlife conservation efforts.

Results

Investigation of human standard of living over time

Wealth

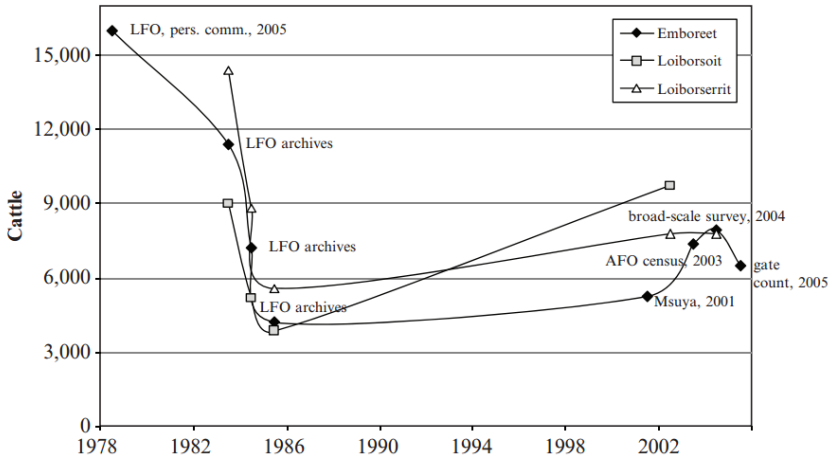

Fig. 7.4 Cattle census in Emboreet, Loiborsoit and Loiborsirret 1983–2005

FIGURE 2. Cattle numbers over time in areas neighboring Tarangire NP (from Homewood et al., 2009).

According to Homewood *et al.* (2009), Maasai villages surrounding Tarangire National Park experienced a net decrease in total number of cattle since 1978, which was eight years after the establishment of the park. Simultaneously, human populations in these same areas increased, indicating a decrease in per capita cattle and therefore a decrease in wealth near TNP.

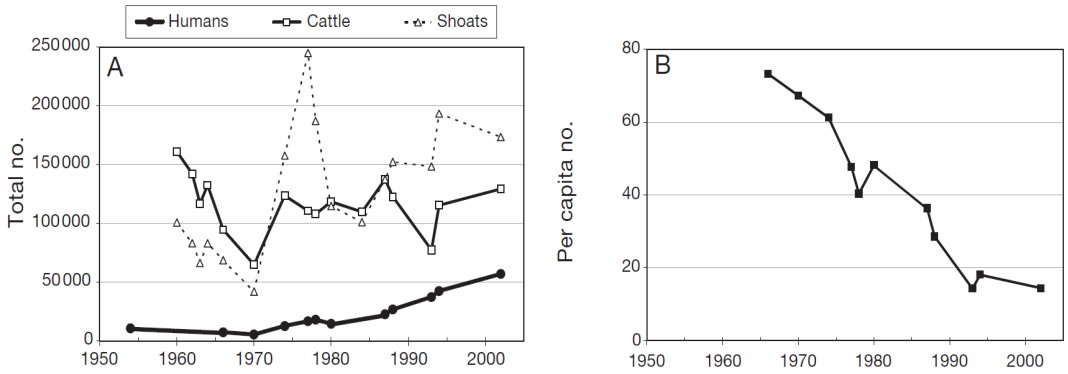

Fig. 6. Population trends in the NCA and livestock per capita.
(A) Total number of Maasai, cattle and shoats in the NCA.
(B) Per capita number of 'shoat equivalents' in the NCA.
Each cow is considered to be equal to 5 shoats

FIGURE 3. Per capita livestock in Ngorongoro Conservation Area over time (from Ikanda & Packer, 2008).

In the Ngorongoro Conservation Area, cattle populations have remained approximately steady while numbers of sheep and goats have risen slightly, as demonstrated by Ikanda & Packer(2008) (Fig. 3). However, the increasing human population still leads to an overall decrease in per capita cattle and shoats between the time of park establishment and the early 2000s. The NCA therefore also experienced a net decrease in wealth since its creation.

Welfare

Land security:

The Maasai inhabitants of Ngorongoro Conservation Area experience little land security because of the park's continuously changing land use policies. Even though the area was specifically set aside for human use, the NCA now bans cultivation within its borders and has increasing overcrowding pressures that add to an individual's concern over the availability of land (Charnley, 2005). Similarly, the areas surrounding Tarangire National Park provide the local people with little in the way of guaranteed land rights. As agriculture becomes more common around the periphery of the national park, less and less land remains available for grazing. The people of both the NCA and TNP have limited land security, which also translates to limited security of cattle-based livelihoods.

Resource access:

With its status as an IUCN Category VI protected area, Ngorongoro Conservation Area must protect resource use rights within its borders. These rights have been increasingly restricted over the course of the park's history, but some rights, including grazing rights, water rights, and settlement rights are still present. Tarangire National Park, on the other

hand, provides its locals with no resource access. This gives the NCA the upper hand in the resource access category.

			NCA	TNP	PA with advantage	Overall advantage
Local standard of living	Welfare	Land security	Limited	Limited	None	NCA
		Resource access	Limited	None	NCA	
	Wealth	(Measured in per capita cattle)	Decrease	Decrease	None	

TABLE 3. Summary of TNP's and NCA's effects on local Maasai standards of living.

Investigation of wildlife conservation effectiveness over time

	1960s	Early 2000s	Net change	Overall effect
African elephant	300[A]	300[A,B]	0%	Positive
Black rhinoceros	100[A]	30[A]	- 70%	
Migratory wildebeest	200,000[A]	1,100,000[A]	+ 450%	
African lion	15[A]	200[A]	+ 1233%	

TABLE 4. Ngorongoro Conservation Area's wildlife conservation effectiveness (A from Swanson, 2007; B from Boone & BurnSilver, 2002).

In the Ngorongoro Conservation Area, African elephant populations showed no change between the time that the conservation area was established and the present day. This is surprising considering the huge crash in elephant populations across Africa that took place in the 1980s due to poaching. The lack of a drop in elephant populations in the NCA suggests effective anti-poaching strategies within the park.

However, black rhinoceros populations decreased dramatically during this same period, which could indicate that anti-poaching efforts were not as impactful as they might seem based on the elephant data. Rhinoceros represent some of the most endangered and highly sought after species in the world, however, and simply saving them from local extinction is significant in itself.

Migratory wildebeest and African lions experienced incredible population booms in the Ngorongoro Conservation Area. Though this may initially look like a result of pure conservation effort, upon deeper inspection, the initial 1960s population sizes were actually unusually low for both species due to disease (rinderpest for wildebeest and blood-sucking flies for the lions). The increase, then, represents a recovery from a period of abnormally low numbers back to a more normal population size (Swanson, 2007). The conservation area policies likely aided in species recovery, however, especially considering that the presence of migratory wildebeest indicates a healthy ecosystem and that the presence of increasing numbers of lions suggests plentiful prey and minimal human-lion conflict. Overall, the NCA experienced a net positive effect on animal populations based on the data collected for these four representative species.

	1972	**2000**	**Net change**	**Overall effect**
African elephant	3558[A]	2385[B]	- 33%	Negative
Black rhinoceros	90[A]	0[A]	- 100%	
Migratory wildebeest	40,000[C]	5000[C]	- 87.5%	
African lion	No data	294[D]	Unknown	

TABLE 5. Tarangire National Park's wildlife conservation effectiveness (A from Kahurananga & Silkiluwasha, 1997; B from Foley & Faust, 2010; C from Morrison, 2011; D from Ryen & Soresina, 2003).

Though Tarangire National Park is famous for its elephants, their populations have declined since the park first opened its gates. This decrease likely resulted from elephant deaths due to poaching. Also supporting the possibility that TNP lacks sufficient anti-poaching enforcement are the data on the black rhinoceros, which went extinct within Tarangire.

Even migratory wildebeest, which do not face the same level of poaching threats as the rhinoceros or elephants do, have seen decreasing numbers. Because Tarangire evicted all people from the national park back in 1970, many of these people settled along the borders of the park, creating a type of barrier of agriculture around it (Kahurananga & Silkiluwasha, 1997). This captures wildebeest either outside of or inside of the park, turning a once-connected ecosystem into a series of fragmented pieces of habitat. Therefore, fewer wildebeest from outside of the park have been able to enter TNP during the dry season during which they have historically passed through the region.

Unfortunately, few data exist related to lion populations in Tarangire National Park before the late 1990s, which makes it impossible to calculate an accurate percent increase or decrease for this species. However, even if the lion populations have increased over this time period, the heavy tolls that the other three animal populations have suffered would still likely lead to a net negative effect on wildlife in Tarangire National Park since the year of its establishment.

A note on the limitations of wildlife census data

Wildlife census data is inherently difficult to replicate and to confirm, especially considering that the methods for acquiring such data have changed dramatically between the establishment of the protected areas in this study and the present day. With the increase in technology in this time period, counts have likely become more accurate and more efficient. While early censuses might have had larger standard errors and potentially underestimated population size because less technology and fewer resources were accessible for use in wildlife conservation, current censuses have smaller standard errors and more accurately reflect the true number of individuals in any given species present. Therefore, the population changes recorded in the above tables might show population declines as less extreme than they truly were.

Because census data contains so many potentially discrepancies of methods, data for any given species in any given area was taken from the same source whenever possible (i.e., the population count of migratory wildebeest in TNP in 2000 was acquired from the same paper that yielded the population count of migratory wildebeest in TNP in 1972).

The only species for which this pairing of data was not possible were the African elephants of TNP and the African lions of TNP. In the case of the elephant, no paper was found to contain information about population size in both 1972 and 2000. However, the data from both individual sources used appears to be reliable because of the organizations gathering the information. The elephant census in 2000 was gathered by Tanzania Wildlife Conservation Monitoring, a long-standing group that is widely cited for their wildlife population counts (Foley & Faust, 2010). The census in 1972 was an aerial census, a commonly-used and generally accurate practice to count large mammals like elephants (Kahurananga & Silkiluwasha, 1997). Because these elephant population numbers from 1972 and from 2000 come from the most reliable sources available, they were used for comparison in this study even though they originate from separate papers. In the case of the African lions in TNP, no data was found for lions in TNP in 1972, so no paper comparing population numbers in 1972 to population numbers in 2000 existed.

		NCA	TNP	PA with advantage	Overall Advantage
Local standard of living	Welfare	Decrease	Decrease	NCA	NCA
	Wealth	Decrease	Decrease	None	
Wildlife conservation effectiveness	Elephant	0%	- 33%	NCA	NCA
	Black rhinoceros	- 70%	- 100%	NCA	
	Wildebeest	+ 450%	- 87.5%	NCA	
	Lion	+ 1233%	Unknown	NCA	

TABLE 6. Overall comparison of TNP's and NCA's effects on local standard of living and wildlife conservation effectiveness over time.

Conclusions

Based on the data collected, Hypothesis #1 is tentatively supported, and Hypothesis #2 is strongly supported. Ngorongoro Conservation Area is likely better for local people's standard of living and is considerably better for wildlife conservation effectiveness when compared to Tarangire National Park.

However, it is important to note that NCA being "likely better" for local people's standard of living is in comparison to TNP's effect on local standard of living; when looking at welfare and wealth change within NCA from the time before the park existed to the present day, there seems to be a marked negative effect on standard of living. Although NCA's negative effect is of a lesser magnitude than TNP's negative effect, neither appears to successfully merge human needs with wildlife protection. Similarly, based on this data, neither NCA nor TNP show entirely positive effects on protection of various important species. Significant strides still need to be made in protected areas to conserve species while ensuring human wellbeing.

To confirm this initial study, a more comprehensive look at human standard of living would have to be taken, perhaps including a standard numerical measurement such as Human Development Index rather than the more subjective qualitative measurements used above. Furthermore, a larger number of species would need to be researched to see more overall trends in wildlife population sizes over time.

Despite the finding that an IUCN Category VI protected area that allows resource use is better for people and animals than the IUCN Category II protected area that excludes humans, a test for correlation versus causation would have to be undertaken before making any sweeping policy recommendations. Resource use policies may not be the reason behind why wildlife populations are increasing in Ngorongoro and decreasing in Tarangire. Nonetheless, this study does already display the generally negative impacts that protected areas of different kinds can have on an indigenous population. Regardless of whether banned resource use contributed to Tarangire's decline in wildlife populations, it is clear that local people have suffered declines in standard of living due to national park policies – and even due to resource-friendly conservation area policies – for very little gain in wildlife wellbeing. Those in charge of Tanzania's protected areas could benefit from experimenting with more generous land and resource use policies and recording changes in animal numbers over time to see if human populations can actually benefit from protected areas while still maintaining healthy ecosystems within the parks. Wildlife health and human health are linked; protecting the rights of one should not mandate compromising the well-being of the other.

Acknowledgements

The author would like to thank Drs. Susan Charnley and William Durham for their support and feedback throughout this project. Clementine Jacoby and Eric Mattson also played an integral role in providing invaluable advice and comments on the study. The author would also like to acknowledge the Stanford Alumni Association and Sophomore College program, without which the hands-on travel aspect of this project could not have been completed. Additionally, the alumni and students in the class gave incredible inspiration and encouragement, and without them, the author would not have become as passionate about these issues and about finding realistic solutions that take into consideration the wellbeing of both local peoples and the local wildlife.

References

Charnley, S. (2005). From Nature Tourism to Ecotourism? The Case of the Ngorongoro Conservation Area, Tanzania. *Human Organization*, *64*(1), 75-88.

Foley, C. A. H., & Faust, L. J. (2010). Rapid population growth in an elephant Loxodonta africana population recovering from poaching in Tarangire National Park, Tanzania. *Oryx, 44*(2), 205–212.

Global Livestock Collaborative Research Support Program. (2002). *Integrated assessment results to support policy decisions in Ngorongoro Conservation Area, Tanzania.* Davis, California: Boone, R. B., & BurnSilver, S. B.

Homewood, K., Kristjanson, P., & Trench, P. C. (2009). *Staying Maasai? Livelihoods, Conservation, and Development in East African Rangelands*. New York: Springer.

Igoe, J. (2004). *Conservation and Globalization: A Study of National Parks and Indigenous Communities from East Africa to South Dakota.* Belmont, CA: Thomson/Wadsworth.

Ikanda, D., & Packer, C. (2008). Ritual vs. retaliatory killing of African lions in Ngorongoro Conservation Area, Tanzania. *Endangered Species Research, 6*, 67-74.

IUCN. (2014). IUCN Protected Area Categories System. *International Union for Conservation of Nature*.

Kahurananga, J., & Silkiluwasha, F. (1997). The migration of zebra and wildebeest between Tarangire National Park and Simanjiro Plains, northern Tanzania, in 1972 and recent trends. *African Journal of Ecology, 35*(3), 179-185.

Kangwana, K. & Ole Mako, R. (2001). Conservation, livelihoods & the intrinsic value of wildlife: Tarangire National Park, Tanzania. In M.W. Murphree & D. Hulme (Eds.), *African wildlife and livelihoods: the promise and performance of community conservation* (148-158).

Morrison, T. A. (2011). *Demography and Movement of Migratory Wildebeest (*Connochaetes taurinus*) in Northern Tanzania.* (Unpublished doctoral dissertation). Dartmouth College, Hanover, NH.

Neumann, R. P. (1998). *Imposing Wilderness: Struggles over Livelihood and Nature Preservation in Africa.* Berkeley: U of California.

PAMS Foundation. (2011). *First Enhancing Our Heritage Assessment at Ngorongoro Conservation Area*. Arusha, Tanzania: Clark, K., Lotter, W., Runyoro, V., Mushi, H., Mande, R., Sweddy, H., Gadiye, D., & Stolton, S.

Swanson, L. A. (2007). *Ngorongoro Conservation Area: Spring of Life.* (Unpublished master's dissertation). University of Pennsylvania, Philadelphia, PA.

Tarangire Lion Project. (2003). *Tarangire Lion Project (TLP) Report*. Tarangire, Tanzania: Ryen, M., & Soresina, A.