Current Research Journal of Biological Sciences 4(4): 471-476, 2012
ISSN: 2041-0778

Submitted: March 14, 2012 Accepted: April 20, 2012 Published: July 10, 2012

Impacts of Wildlife-Livestock Interactions in and around Arusha National Park, Tanzania

[1]David D. Maleko*, [2]Gabriel N. Mbassa, [3]Wilson F. Maanga and [3]Emanuel S. Sisya
[1]Department of Animal Science and Production, Sokoine University of Agriculture, P.O. Box 3004, Morogoro, Tanzania
[2]Department of Veterinary Anatomy, Sokoine University of Agriculture, P.O. Box 3016, Morogoro, Tanzania
[3]Tanzania National Parks, P.O. Box 3134, Arusha, Tanzania

Abstract: The study on the impacts of wildlife-livestock interactions within and around Arusha National Park (Tanzania) was conducted in 2010. The purpose was to investigate on the factors influencing these interactions and their respective impacts to the conservation initiatives and the wellbeing of local communities around Arusha National Park (ANAPA). Data collection methods included structured questionnaires, checklists and researcher's personal field observations. A sample of 60 households was randomly selected from three (3) villages namely Ngurdoto, Ngongongare and Engarenanyuki that are directly bordering the park. Data were analyzed by using SPSS 16 computer program. Five factors influencing wildlife-livestock contacts were identified, the most significant being wildlife habitat loss and drought. Generally, no diseases were identified inside the park but to livestock keepers; the tick-borne disease, East Coast Fever (ECF) was a great threat as it caused large economic losses. This was more worsened with the ECF's high case fatality rate coupled with unaffordable treatment costs to most livestock keepers (68% of respondents). About 623 cattle deaths that happened in the study villages in year 2009 and 2010 were attributed to ECF. However, in the northern Tanzania including Arusha region where ANAPA is located, there was a severe drought in the same years (2009/10) that might have predisposed the livestock to disease conditions and ultimate deaths. Elephants (*Loxodonta africana*), warthogs (*Phacochoerus africanus*), buffaloes (*Syncerus caffer*), vervet monkeys (*Chlorocebus pygerythrus*) and dik dik (*Madoqua kirkii*) were identified to be the wildlife species that frequently interacted with livestock in the outskirts of the park. Spotted hyena (*Crocuta crocuta*) was pointed out to be the most problematic wild carnivore that attacks goats and sheep, mostly during night times. It is recommended that further encroachment of wildlife protected areas and blockage of wildlife migratory routes should be halted, range improvement practices should be promoted, public education on the effects of wildlife-livestock interactions should be provided to the local people. Preponderantly, prophylactic measures that include dipping in acaricide and vaccination against diseases of domestic animals should be facilitated. Preferably, this should be incorporated into the park outreach programs in order to combat the diseases. Nonetheless, livestock diseases are still potential threat to wildlife conservation initiatives, therefore efforts should be made to control them if sustainable wildlife conservation is to be attained.

Keywords: Conservation, East Coast Fever (ECF), impacts, interactions, wildlife-livestock

INTRODUCTION

In past few decades there has been high human population increase coupled with higher demand of land for settlement, agriculture, waste disposal and other activities that alter natural surroundings such as mining and industries. This is contrary to the pre-industrial era, in which both human and livestock populations were relatively low and widely dispersed (Boyd *et al*., 1999). Thus, the available land allowed management of livestock in extensive way through shifting (nomadism) which reduced the risks of diseases transmissions and depredation by wild predators (Rasmussen, 1999). This form of land use was generally highly compatible with wildlife conservation, as they both required large, uncultivated tracks of land. That means, any communal land reserved for cattle was most likely to be utilised for wildlife as well (Sinclair, 1974). This can be exemplified by Ngorongoro Conservation Area (NCA) that is under multiple land use system where Maasai pastoralists and their livestock (cattle, sheep and goats) co-exist with wildlife.

However, Malignant cattarhal fever a disease that is carried and transmitted by wildebeests particularly during calving periods (Plowright, 1964), is still a serious threat in this ecosystem as cattle have dropped from about 286,000 in 1988 to about 136,000 recently (Kinyanjui, 2011). Pasture inadequacy during dry season is among the

Corresponding Author: David .D. Maleko, Department of Animal Science and Production, Sokoine University of Agriculture, P.O. Box 3004, Morogoro, Tanzania

major livestock depopulation factors, due to livestock being out-competed by wildlife in particular wildebeests (Homewood *et al*., 1987; Kinyanjui, 2011). This is based on the fact that during wildebeest calving period (wet season), cattle are displaced by wildebeest from the grazing plains and pastoralists bring them back in next dry seasons and find the wildebeests have already depleted all the quality forage, culminating into cattle starvation and eventual deaths in years of severe drought.

The current increase in demographic pressure accompanied with climate change and variability is amplifying stresses to animals due to habitat shrinkage that tends to limit access to key resources for living including water, pasture and mineral salts (Daszak *et al*., 2001; Olff and Grant, 2008). Consequently, wildlife-livestock (hereafter W-L) conflicts are primarily focused on access to grazing and water in dry seasons. Young *et al*. (1978) and Bourn and Blench (1999) stipulated out that predation and diseases that results from W-L contacts are significant issues to livestock owners. Thus, leading to livestock keepers to resent wildlife and persecute them whenever possible. A good example is African wild dogs (*Lycaon pictus*) that have become endangered species due to human persecution and diseases such as rabies and canine distemper that are normally carried by domestic dogs (Rasmussen, 1999; Lindsey *et al*., 2005).

There are a lot of studies that have attempted to assess socio-economic to ecological impacts of human-wildlife conflicts and diseases interface (Kruuk, 1980; Bourn and Blench, 1999; Daszak *et al*., 2001; Thompson *et al*., 2010). However, still there is a dearth of information regarding the impacts of W-L interactions in a broad perspective. It was the overall aim of this study to contribute into filling up this knowledge gap. This was done through investigating the factors influencing W-L interactions and their respective impacts to the conservation initiatives and the well being of local communities around ANAPA. Specific objectives were; to identify the possible causes and effects of the W-L interactions, to identify the possible diseases that can be transmitted following W-L interactions and the extent (prevalence) in the study area. These objectives were important for setting a premise for determining the measures/interventions required to reduce the problems associated with W-L interactions.

Proper understanding of key drivers behind W-L is of paramount in helping the key stakeholders particularly; wildlife managers, livestock keepers, land use planners and policy makers to formulate informed plans and policies for sustainable wildlife conservation without compromising with livestock production.

MATERIALS AND METHODS

Study area characterization:

Location: The study was conducted in 2010 at Arusha National Park, (Tanzania) which is located in Arusha region, in northern Tanzania. The park lies between latitudes 03º12′ to 03º18′ south and longitude 36º45′ to 36º56′ east. The park can be accessed by road from Arusha town, which is about 32 km away. The park covers an area of 552 KM^2. This area includes the slopes of Mount Meru in western part, the Momela lakes at the centre and Ngurdoto Crater in the east.

Climate: The park falls under tropical-humid to sub-humid climate; rainfall is above 600 mm per annum. Annual atmospheric temperatures vary between 15-34ºC whereby the warmer period is between December to March and cooler period is somewhere between June to September.

Vegetation: Vegetation on the Mount Meru and Ngurdoto Crater is essentially montane forest; highest trees include *Podocarpus*, *Xymalous* and *Ilex* spp. Most of the park area is forested; on the hills or stony soils is where *Juniperus capensis* and *Dodonia viscosa* can be found. Bushland, shrubland and thickets are dominated by *Diospeyros abyssinica* and *Olea hochstetteri* spp. Grasses found include *Cynodon dactylon*, *Pennisetum clandestum*, *Eleusine jaegerii* and *Cymbogon afronadus* in the grasslands and forest glades (ANAPA, Undated).

Animal species: There are more than 40 species of mammals, 500 birds of birds, 24 reptiles and 10 species of amphibians. Large mammals include grazers like Buffaloes (*Syncerus caffer*), warthogs (*Phacochoerus africanus*), Hippo (*Hippopotamus amphibius*), zebra (*Equis burcheli*) and waterbucks (*Kobus e. defassa)*. Browsers on woody plants include elephants (*Loxodonta africana*), giraffe (*Giraffa camelopardalis*), dik dik (*Madoqua kirkii*) and small red forest duiker (*Cephalophus natalensis*). The park has few predators, since there are neither lions (*Panthera leo*) nor cheetahs (*Acinonyx jubatus*), only hyenas (*Crocuta crocuta*) and leopards (*Panthera pardus*) exist (ANAPA, Undated).

Human population and economic activities: ANAPA is encircled by human settlements with exception of most of the western side where Mount Meru is situated. The main ethnic groups that reside in villages adjacent to the park boundary are Arusha and Meru people. Popular immigrants include Maasai and Chagga people. Major economic activities are agriculture and livestock keeping. Educational wise, the majority of the villagers have at least primary school education while others have gone through adult education programmes.

Methodology: The study was based on both literature review and field research in order to capture relevant information. The actual data collection was preceded by reconnaissance survey inside and around the park. This was important for the researcher to get acquainted with

the incidences, causes and impacts of W-L interactions in the study area.

Primary data: The actual data collection involved administering of a structured questionnaire having both closed and open ended questions to 20 households that were randomly selected from each of the three (3) research villages, namely Ngurdoto, Ngongongare and Ngarenanyuki. A total of 60 respondents from the three research villages were interviewed.

Additionally, semi-structured questionnaire (checklists) were administered to the park and district officials to elicit any information regarding; W-L overlaps, possible causative factors, damages such as diseases and predation resulted from these contacts. The informal discussions were done by the village leaders or key informants with experience on impacts of W-L interactions.

Villages were selected based on the following criteria; villages adjacent to the park boundary and with large herds of cattle, villages with land use conflicts with the park with regard to grazing hassles and finally villages where anecdotal information indicates that wildlife migratory routes used to exist.

Secondary data: Secondary data was collected from the village offices, park ecology section, district livestock office and district veterinary office (Arumeru District). In which any written information on livestock diseases, deaths and compensations that are related to W-L interactions was recorded.

Data analysis: Statistical Package for Social Sciences (SPSS) 16 which is a computer based program was used to analyse the questionnaires to provide descriptive statistics results (frequency, means and standard errors).

RESULTS AND DISCUSSION

Factors influencing wildlife-livestock interactions: The following factors were found to be main sources/drivers for W-L interactions in the study area:

- **Keeping of livestock in proximity to the park boundary:** The three (3) surveyed villages were mainly inhabited by meru, arusha, chagga and maasai ethnic groups. Sixty three per cent (63%) of the respondents were mixed farmers involved in livestock keeping and crop production as their livelihood strategy (Table 1).

  Ngurdoto village which is located in south-eastern side of the park had an average of 1-5 cattle per household that were mainly zero grazed due to land scarcity. In which, there was no open areas available for grazing. The prevalence of ECF disease in this village was also a limiting factor; due to the fact that favourable buffalo's habitat inside the park is located close to this village.

  Ngongongare village in the south-western part of the park consisted of an average of 1-20 heads of cattle per household. This was found to be facilitated by availability of open areas for grazing since there were some open patches of unoccupied land. The open lands were not suitable for cultivation because the soil is alkaline and too stony.

  Ngarenanyuki village in the northern part consisted of at least >20 heads of cattle per household which are grazed within the open areas in the communal lands. Also, the inhabitant mainly maasai and arusha people were cultivating seasonal crops such as maize and beans. Thus, farms were providing additional fodder and additional areas for grazing after crop harvesting

Table 1: Economic activities of the people living around ANAPA

Economic activities	Frequency	(%)
Agriculture and livestock keeping	38	63
Livestock keeping	17	28
Tourism, beekeeping and business	5	9

- **Adverse climatic conditions:** Short rains and long dry conditions were found to force livestock keepers to search for water and green pastures elsewhere including in the protected areas. Livestock keepers deliberately graze cattle in western part of ANAPA during dry seasons due to limited alternatives. About 586 heads of cattle belonging to pastoralists from Olkokola, Sambasha, Timbolo and Olmotonyi villages were apprehended inside the park in the year 2009 (Mbisse, 2010). Likewise, extreme drought conditions forces wildlife to leave the park to agricultural and pastoral land in search of pasture and water, where they meet livestock.
- **Encroachment on wildlife corridors/migratory routes:** Some wildlife species such as wildebeests and elephants are migratory in nature and usually have permanent routes. Once their migratory routes are blocked by human settlements, cultivation and livestock keeping they come into contact with domestic animals. For example, the study observed that the wildlife corridors joining ANAPA and Kilimanjaro National Park (KINAPA) have already been blocked by human activities including the West Kilimanjaro livestock ranch. This has facilitated W-L contacts when wildlife are trekking through this corridor in search of life necessities such as pasture, water and mineral licks.
- **Wildlife habitat loss:** Land use changes lead to continuous dwindling of ecosystems. This reduces the buffer zones for shock absorption and therefore increasing edge effect in which once the animal is just a short distance out of the park boundary, it is already within the agricultural fields where it meets

with livestock. It was observed that ANAPA currently lacks buffer zones. With accordance to Beier and Noss (1998) habitat connectivity and buffer zones are important to wildlife for surviving stressful conditions and ensuring appropriate gene flow.

- **Animal behaviour:** Some wildlife species such as elephants are nomadic with broad home ranges. They thus frequently leave the park to private or communal lands where they overlap with livestock over resources such as forage, water and space. For example, elephants were reported to forage within village land at Ngurdoto even during wet seasons, when there is enough pasture inside the park.

Impacts of wildlife-livestock interactions: Andrewatha and Birch (1954) exerted that whenever wildlife and livestock species come into contact; either competition for limited resources, predation or diseases transmission between them will occur. Below are the observed effects of these interactions to the park and livestock in the study area:

Competition between wildlife and livestock: Indirect competitions do occur due to the fact that wild ungulates such as buffaloes and warthogs are natural hosts of ticks which are vectors of various diseases which exert a strong negative control over the livestock in the area. Thus livestock keepers tend to avoid the areas which are used by wildlife for fear of diseases or being injured or killed by buffaloes and elephants, therefore wild ungulates tend to out-compete livestock wherever there is a feeding overlap between livestock and wildlife.

Moreover, the thorny vegetation fence around the eastern side of the park and intensive game control seemed to make wildlife-livestock interactions within the park a rare phenomena in eastern and southern parts of the park. However, in the northern part where there is a boundary conflict between the park and local community and western part occupied by a catchment forest, there are higher possibilities of W-L contacts. Table 2 shows the wildlife species that local people reported their appearance in village lands. Additionally, Ngurdoto Village inhabitants confirmed that buffaloes from the park do share the same watering point with livestock at Mzee Kiriba water spring which is located within the village land. However, there was no direct contact as buffalo and other wildlife species come at night while livestock use the water spring during the day time.

Livestock depredation: Hyena seemed to be a big threat to livestock in the study area. But a larger proportion of respondents reported cases happening to their neighbours and few cases related to them. Hyena and leopard were considered to be the leading predators causing loss to domestic ungulates (Table 3). Predation cases in the villages were few due to the practice of building livestock enclosures (bomas) that protect livestock from wild carnivores attack at night time. In addition, permanent attendance of livestock during grazing time and extermination of wild predators such as hyena by villagers once spotted in the village land, also reduced livestock depredation incidences.

Table 2: Wildlife species occurrence in villages adjacent to ANAPA

Common name	Latin name	Yes	No	(%)
Buffalo	*Syncerus caffer*	42	18	70
Elephant	*Loxodonta africana*	40	20	67
Warthog	*Phacochoerus africanus*	50	10	84
Dik dik	*Madoqua kirkii*	54	6	90
Bushbuck	*Kobus e. deffass*	20	40	34
Baboon	*Papio* spp.	45	15	75
Vervet monkey	*Chlorocebus pygerythrus*	37	23	62
Hyena	*Crocuta crocuta*	43	17	72
Leopard	*Panthera pardus*	28	32	47

Table 3: Wildlife to livestock predation incidences in the villages around ANAPA

Wildlife spp.	Number of complaints Yes	No	Sheep and Goat (%)	Cattle (%)
Hyena	31	29	50.12	1.67
Leopard	19	41	31.67	-

Diseases transmission: Wild ungulates were revealed to be carrier of most of the diseases that are fatal to livestock. According to the park reports no disease conditions that have been erupted or noticed in the park within the past 10 years. With exception of the massive death of flamingos that occurred in Lake Mommela in year 2004. The same catastrophe also occurred to flamingos of Lake Manyara National Park on the same year, the cause was believed to be toxin from cyanobacteria. The wildlife in ANAPA seemed to be free from diseases or do not indicate any clinical signs. This might be attributed to the fact that ANAPA wildlife are more or less sedentary, do not face much stress conditions because both water and food are adequately available and no flooding or extreme climatic conditions within the area.

However, when it comes to livestock in the outskirts of ANAPA the situation was contrary. W-L interactions were a major constraint to livestock production in the area. This was converse to Mlengeya and Lyaruu (2006) report that claims livestock to be the major carriers of diseases to the wild population. About 85% of the interviewed villagers pointed out disease as a major threat and problem to livestock industry in the area. This was affecting livestock keepers negatively through economic losses due livestock mortality, high vaccination and treatment costs. It also limits exportation of their animals and animal products due to strict international regulations

imposed on animal products from animal diseases prone areas.

Table 4: Diseases prevailing around ANAPA, 2010 (Source: Ngurdoto, Ngongongare and Engarenanyuki village offices)

Disease	Vernacular name	Frequency	(%)
East coast fever	Ndigana kali	623	68.01
Heart-water	Maji-moyo	182	19.87
Babesia	Mkojo mwekundu	71	7.75
Anaplasmosis	Ndigana baridi	27	2.95
Rabies	Kichaa cha mbwa	13	1.22

The respondents at Ngurdoto village claimed that cattle breeds apart from the native ones (short-horned zebu) hardly survive and reproduce effectively in this village due to diseases prevalence. The most threatening disease being ECF which killed over 30% of the cattle at Ngurdoto Village in the year 2009-10. Other diseases which are dominant in the study area include heart water disease, Babesia (red-urine disease), Anaplasmosis and Rabies (Table 4). All these diseases with exception of Rabies are tick-borne diseases.

The interviewed villagers claimed that, these tick-borne diseases become more severe during rain seasons. Likewise, worm infestations to livestock are coupled in the same season. Nematodes infection to cattle, sheep, pigs and goats were also reported; *Haemonchrus contortus* and *Taenia* spp. being the most problematic worm species.

Since the park is at relatively higher altitude than the surrounding villages, during the rainy season's worm eggs are believed to be carried to the village lands through surface water runoff. This is also caused by direct faecal droppings of wildlife such as buffaloes, bush pigs and warthogs to the livestock grazing areas and agricultural fields outside park boundaries.

Furthermore, in those villages where zero grazing is dominant, there is tendency of mowing grasses near the park boundaries or inside the park by villagers. This facilitates the carriage of ticks and worm eggs from wildlife to livestock at home. Generally, tick borne diseases were revealed as the major constraint to sustainability of livestock industry in the study area.

CONCLUSION AND RECOMMENDATIONS

The study revealed that wildlife-livestock interactions are amongst the key threats to livestock production. Tick-borne diseases transmission being the most critical problem in which they cause economic losses to livestock keepers, thus, adversely enhance the gap between wildlife conservation and livestock production sectors. Therefore it is important to control W-L interactions in order to harmonize and ensure sustainability of both wildlife and livestock sector.

Specifically this study recommends the following:

- The farmers' practice of growing Guatemala (*Tripsacum* spp.) and Napier (*Pennisetum purpureum*) grasses along their farm boundaries and the use of maize and beans' straws for feeding livestock during dry season, should be further promoted. Also, planting of legume pasture species in communal grazing areas grass and should be facilitated. This can be best achieved through collaboration with extension officers.
- Better land use planning systems that set aside land for wildlife conservation, settlements, cultivation and grazing should be put in practice, these land use types must be demarcated, well known and respected by all land users in the area. This will help to prevent encroachment problems and resolve the existing land use conflicts. This can be best achieved through a collaboration that involves village governments and all relevant sectors being led by the ministry of land planning and human settlements.
- The dipping/spraying, de-worming and vaccination services should be provided to the livestock and other domestic animals. This will indirectly control ticks and tick-borne diseases to wildlife as well. This can be best achieved through working with veterinarians and incorporating it to the park outreach programmes.
- Wildlife habitat manipulations, this involves prescribed burning to provide palatable feed to wildlife herbivores and introduction of watering points inside the park whenever ecologically and economically feasible. This will reduce the tendency of wildlife to look for these life necessities outside the park boundaries.
- Education to raise public awareness on the problems associated with wildlife-livestock interactions, together with education on proper mitigation measures. In addition, law enforcement and park ranger patrol programs to prevent livestock grazing inside the park should complement this.

REFERENCES

Andrewatha, H.G. and L.C. Birch, 1954. The distribution and Abundance of Animals. University of Chicago Press, Chicago, IL. Sited In: Patton, D.R., 2010. Forest Wildlife and Habitat Management. CRC Press, Taylor and Francis Group, Boca Raton, U.S.

Beier, P. And R.F. Noss, 1998. Do habitat corridor provide connection? Conservat. Biol., 12: 241-252.

Bourn, D. and R. Blench, 1999. Can Livestock and Wildlife Co-exist? An Interdisciplinary Review; Environmental Research Group Oxford Ltd., Oxford, UK, Retrieved from: http:// ergodd.zoo.ox.ac. uk/livewildsum.htm, (Accessed on: June 20, 2010).

Boyd, C., R. Blench, D. Bourn, L. Drake and P. Stevenson, 1999. Reconciling interests among wildlife, livestock and people in Eastern Africa: A

sustainable livelihoods approach. Natural Resources Perspectives, 45.

Daszak, P., A.A. Cunningham and A.D. Hyatt, 2001. Anthropogenic environmental change and the emergence of infectious diseases in wildlife. Acta Tropica, 78: 103-116.

Homewood, K., W.A. Rodgers and K. Arhem, 1987. Ecology of pastoralism in Ngorongoro Conservation Area, Tanzania. J. Agric. Sci., 108: 47-72.

Kinyanjui, P., 2011. Hifadhi ya Bonde la Ngorongoro Na Miaka 50 ya Uhuru Yenye Mafanikio. Raia mwema, Dec. 2011. Retrieved from: http:// www. raiamwema. co.tz/hifadhi-ya-bonde-la-ngorongoro-na-miaka-50-ya-uhuru-yenye-mafanikio, (Accessed on: December 28, 2011)

Kruuk, H., 1980. The effects of large carnivores on livestock and animal husbandry in Marsabit District, Kenya. IPAL Technical Report E-4. UNEP-MAB-Integrated Project in Lands.

Lindsey, P.A., J.T. Toit and M.G.L. Mills, 2005. Attitudes of ranchers towards African wild dogs (*Lycaon pictus*): Conservation implications on private land. Biolog. Conservat., 125: 113-121.

Plowright, W., 1964. Studies on malignant catarrhal fever of cattle. D.V.SC. Thesis, University of Pretoria. South Africa.

Mbisse, S., 2010. Discussion on incidences for livestock grazing inside Meru Catchment Reserve [Cell Phone] (Personal communication, 5 June 2010).

Mlengeya, T. and V. Lyaruu, 2006 Experiences with and Challenges of Wildlife Health Management in the Management in the National Parks of Tanzania, pp: 51-53. Retrieved from: <http//www.wcs-ahead.org/ book/ chapter07.pdf> (Accessed on September 09, 2010).

Rasmussen, G.S.A., 1999. Livestock predation by the painted hunting dog *Lycaon pictus* in a cattle ranching region of Zimbabwe: A case study. Biological Conservat., 88: 133-139.

Sinclair, A.R.E., 1974. The natural regulation of buffalo populations in East Africa: The food supply as a regulating factor and competition. Afri. J. Ecol., 12(4): 291-311.

Olff, H. and J. Grant, 2008. The Resource Basis of Human-Wildlife Interaction. In Serengeti III: Sinclair, A.R.E., C. Packer, S.A.R. Mduma and J.M. Fryxell (Eds.), Human Impacts on Ecosystem Dynamics. Chicago University Press, USA, pp: 95-133.

Thompson, R.C.A., A.J. Lymbery and A. Smith, 2010. Parasites, emerging disease and wildlife conservation. Int. J. Parasitol., 40: 1163-1170.

Young, A.S., G.D. Brown, M.J. Burridge, J.G. Grootenhuis, G.K. Kanhai, R.E. Purnell and D.A. Stagg, 1978. The incidences of thelerial parasites in East African buffalo (*Syncerus caffer)*. Tropen. Parasitol., 29: 281-288.