Environment and Natural Resources Research; Vol. 5, No. 3; 2015
ISSN 1927-0488 E-ISSN 1927-0496
Published by Canadian Center of Science and Education

Wildlife Induced Damage to Crops and Livestock Loss and how they Affect Human Attitudes in the Kwakuchinja Wildlife Corridor in Northern Tanzania

Kwaslema Malle Hariohay[1,2] & Eivin Røskaft[2]

[1] Tanzania Wildlife Division, P.O Box 1994, Dar es Salaam, Tanzania

[2] Department of Biology, Norwegian University of Science and Technology, Realfagbygget, No-7491, Trondheim, Norway

Correspondence: Eivin Røskaft, Department of Biology, Norwegian University of Science and Technology, Realfagbygget, Trondheim NO-7491, Norway. Tel: 47-9065-2883. E-mail: roskaft@bio.ntnu.no

Received: July 31, 2015 Accepted: August 20, 2015 Online Published: August 21, 2015

doi:10.5539/enrr.v5n3p72 URL: http://dx.doi.org/10.5539/enrr.v5n3p72

Abstract

Human-wildlife conflict is a major issue for conservationists due to crop-damage and livestock depredation by wild animals, causing local farmer's economic loss resulting into deepening of poverty. This study assesses wildlife induced damage. A total of 250 households were randomly interviewed by the use of questionnaires in three villages (Kakoye, Minjingu and Olasiti) in the Kwakuchinja wildlife corridor, northern Tanzania. Annually loss of 383 kg of crops per household was reported in the study area, or US $ 154 per household annually. Most destruction was done by elephants. Depredations of livestock were estimated to on average 2.2 (US $ 106) livestock annually. This loss affects farmers economically as well as that they are spending time in guarding livestock from predators. Cattle were mostly attacked by lions and spotted hyenas while goats and sheep were attacked by spotted hyenas and leopards. These losses lead to retaliatory killing of carnivores. Wildlife induced damage to crops and livestock were worsened by people encroaching into the borders of protected areas and destroying wildlife habitats. Households close to the boundary of the Tarangire and Lake Manyara National Park incurred greater losses from crop and livestock depredation. There should be provision of conservation educations to communities bordering protected areas to practice sustainable agriculture and income generating projects that are conservation friendly.

Key words: human-wildlife conflict, crop raiding, livestock depredation and attitude

1. Introduction

Protected areas often occur in areas of high human population density (Kideghesho, Nyahongo, Hassan, Tarimo, & Mbije, 2006a; Msoffe et al., 2007; Mwalyosi, 1991). Communities bordering protected areas may suffer loss of economic opportunities, including exclusion from potential resources as well as damage and depredation to crops and livestock by wild animals (Emerton & Mfunda, 1999; Holmern, Nyahongo, & Røskaft, 2007). Historically, human–wildlife interactions have tended to result in human 'victory' over animal 'combatants' which were subsequently excluded from traditional areas or eliminated altogether (Noe, 2003; Shemweta & Kideghesho, 2000). Human-wildlife conflict and its negative impact on people in African countries including Tanzania, is a common phenomenon (Kideghesho, Nyahongo, Hassan, Tarimo, & Mbije, 2006b; Newmark, 1996; URT, 2009). Wildlife corridors and many protected areas in Tanzania are becoming isolated due to growing human populations adjacent to protected areas and expansions of cropland, infrastructure and settlement in areas that were previously unpopulated. Tarangire National Park is one of the most threatened national parks in Tanzania from human encroachment and expansions of cropland (Newmark, 2008; Noe, 2003). Local communities have encroached the margins of protected areas resulting into more conflicts because problem animals destroy cultivated crops and predators attack livestock (Holmern et al., 2007).

The high human population growth in Tanzania endanger wildlife populations as wildlife habitats are diminishing (Kideghesho et al., 2006b). According to 2012 census the current human population of Tanzania is about 45 million people compared to that of 1961 during independence of Tanzania when it was only seven millions of people (URT, 2012). This goes with expansion of cropland in order to meet food requirements to feed this

population at the expense of wildlife habitats because an increasing food production is a priority. The expansion of cropland reduces natural ranges of many wild animals due to the loss of habitats and fragmentation which ultimately result into increased contact between wild animals and human beings (M. Goldman, 2009). With the fact that most of Tanzania's protected areas are not big enough to accommodate wild animals and some of them such as large carnivores have large home ranges, they end up into people's premises killing livestock and even human beings (Caro, Jones, & Davenport, 2009; Newmark, 2008; Packer, Ikanda, Kissui, & Kushnir, 2005). Human populations bordering these protected areas interact with wild animals. Most of the time these interactions are negative because wild animals are killed or humans lose their life and their properties are destroyed by wild animals. Whenever there is a conflict between wild animals and people the winner is in most cases the human being (C. Pittiglio, A. K. Skidmore, H. van Gils, & H. H. T. Prins, 2012; Shemweta & Kideghesho, 2000).

Establishment of human settlements in previously wildlife migratory areas increases the conflict between people and wild animals (Msoffe et al., 2007; Ogutu, Owen-Smith, Piepho, Kuloba, & Edebe, 2012). The main conflicts that are common in northern Tanzania include destructions of crops by wild animals especially African elephants (*Loxodanta africana*), warthogs (*Phacochoerus africanus*) and bush pigs (*Potamochoerus larvatus*) (Msoffe et al., 2007). Livestock depredation by carnivores such as lions (*Panthera leo*) and spotted hyenas (*Crocuta crocuta*) is another type of conflict between humans and wild animals. Human activities such as expansions of settlements, cultivation, overgrazing, bushfire and deforestation reduce wildlife habitats thus forcing wild animals such as elephants to enter the croplands causing trampling and destructions of crops in the farm (Galanti, Preatoni, Martinoti, Wauters, & Tosi, 2006; Røskaft, Larsen, Mojaphoko, Sarker, & Jackson, 2013).

In order to control human-wildlife conflict the first approach should be to understand the negative impacts of wild animals to humans (Kideghesho et al., 2006a). This study aimed to document these negative impacts in terms of crop destructions and livestock depredations in the Kwakuchinja wildlife corridor between Tarangire and Lake Manyara National Parks. Understanding negative impacts of wildlife to humans should assist in proposing short-term and long-term management strategies for the conflict management to responsible wildlife departments and different stakeholders on what should be done to halt the situation for the sustainable management of and conservation of wildlife in Tanzania. For the purpose of this study we tested three hypotheses; 1) there are increasing negative interactions between wild animals and human beings in the study area, 2) there is an increase in crop destruction and livestock depredations by wild animals closer to the National Park borders and, 3) negative interactions causes local communities to evolve negative attitudes to wild animals.

2. Methodology

2.1 Study Area

The Kwakuchinja wildlife corridor is an important area for the connection between Lake Manyara Biosphere Reserve and Tarangire National Park (TNP) and is recognized for its globally significant biodiversity (Figure 1).

It provides habitats for resident and migratory wildlife such as the African elephant, lion, hippopotamus (*Hippopotamus amphibius*), impala (*Aepyceros melampus*), giraffe (*Giraffa camelopardalis*), zebra (*Equus grevyi)*, wildebeest (*Connochaetes taurinus)*, bushbuck (*Tragelaphus scriptus*), leopard (*Panthera pardus*) and olive baboon (*Papio anubis*). It allows thousands of animals to migrate between these two national parks (Galanti et al., 2006). It is located between latitudes 03° 35′38″ and 03°48′02″S and longitudes 35°48′21″ and 35°59′25″E. The vegetation type is primarily savannah; *Microphyllous* savanna on riverine areas dominated by *Acacia tortilis* and broadleaf deciduous savanna on the ridges and upper slopes dominated by *Combretum* and *Commiphora* species (Marttila, 2011; C. Pittiglio, A. K. Skidmore, H. A. M. J. van Gils, & H. H. T. Prins, 2012). Black cotton soil prevails in the flood plains and dark red sandy clay loam elsewhere. The annual average rainfall is 450–650 mm; higher amounts in the west and lower in the east with bimodal characteristic whereby short rains from November to December and long rains from February to May (Marttila, 2011). March and April are the wettest months; July and August the driest (Caro et al., 2009).

The area is home to several ethnic groups in at least five sub villages (Newmark, 2008). Their occupation includes livestock keeping, subsistence and or commercial agriculture and business. Moreover, fishermen from nearby villages as far as Babati town immigrated to the area and established temporary fishing villages when Lake Manyara was favourable as a fishery area (M Goldman, 2003).

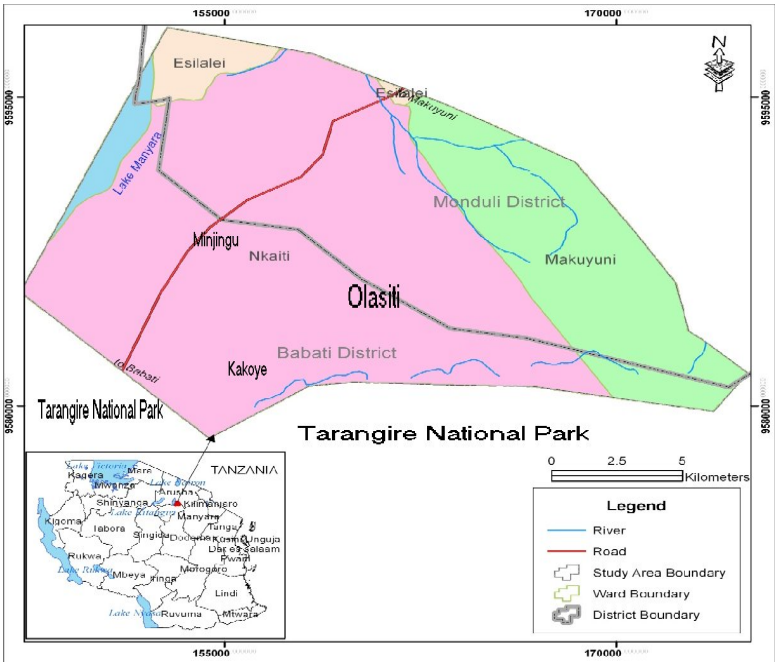

Figure 1. Kwakuchinja wildlife corridor between Lake Manyara National Park and Tarangire National Park showing three villages (Olasiti, Minjingu and Kakoye) in northern Tanzania

2.2 Methods

The study used primary data. These data were obtained by administering questionnaires to villagers, village leaders and different stakeholders including Tarangire National Park. Closed ended questionnaire questions were used. The first part focused on demographic variables such as gender, age, education level, occupation, income sources and immigration status of the respondent and number of people in the household. The second part focused on respondent's views about wildlife impacts on humans.

Questionnaire survey was conducted in all three villages located within the Kwakuchinja wildlife corridor and 250 households (HHs) were selected at random. Among those 250 HHs surveyed, 100 HHs were located in Olasiti village (5 km from the National Park), 100 HHs in Minjingu village (10 km from the National Park) and 50 HHs were in Kakoye village (0-5 km from the boundary). Selection of samples ensured representation of residents in the study area whereby number of HHs selected ensured 15 % of all households in every respective village. In most cases respondents were selected on the basis of their experience in the area, and only respondents above 18 years old were interviewed, gender balance was considered to insure representation of both males and females. The Maasai tribe is dominant in the study area accounting for about 50 % of all respondents; the other tribes (Iraq, Chaga, Barbaig, Pare and Meru) all together account less than 50 % of the interviewed respondents and are therefore combined in the further analyses. The occupation of the respondents were mainly livestock keeping, crop cultivations, small business charcoal selling and hunting bush meat for consumption and selling. Education level of respondents were categorised into informal and formal education (i.e. primary education, secondary and higher education).

In every household the head of the household was interviewed and when they were not able they allowed other representatives to provide the information on behalf of the household. Structured questionnaires were administered using face-to-face interview that provided the family member to answer. A research assistant was used in cases where the respondents could not understand Swahili language and translated into tribal language. We conducted meetings with the village leaders and Burunge Wildlife Management (WMA) leaders. Participants for household interview were selected with the assistance of village elders and village leaders and covering the entire corridor. Focus group discussion was composed of seven participants, comprising of village members who were aware on the history and patterns of settlement in the village.

Quantitative data were processed and analysed using Statistical Package of Social Science (SPSS) version 19.0. Descriptive statistic were used to generate mean, percentages which are important for comparison purposes, chi-square tests were used in understanding the significance differences of research results. Non-parametric statistics were mostly used when data were not normally distributed. Significance level was set at $P < 0.05$.

3. Results

3.1 Livestock Depredation

A total loss of 436 livestock was reported in 195 (78 %) households in three villages. Livestock depredation was reported to be at significant different levels between the three villages; most depredations were reported in Kakoye, which is closest to TNP (90.0 %, n = 50) followed by Minjingu, a little further away from TNP (78.0 %, n = 100) and Olasiti, which is furthest away from TNP (72.0 %, n = 100) villages (χ^2 = 7.8, df = 2, P = 0.02). However, there was no difference in reported livestock loss to predation in relation to respondent's gender (χ^2 = 0.6, P = 0.43), age-group (χ^2 = 6.0, P = 0.19) or tribe (χ^2 = 0.7, P = 0.39) (Table 1).

Table 1. Livestock depredations caused by wild carnivores as reported by respondents between villages, sex, age and tribes

Variable				χ^2	P	df
Village	Kakoye (90.0 %, N = 50)	Minjingu (78.0 %, N = 100)	Olasiti (72.0 %, N = 100)	7.83	0.02	2
Sex	Males (17.6 %, N = 153)	Females (21.6 %, N = 97)		0.61	0.43	1
Age	18-37 years (35.1 %, N = 179)	38-57 years (30.8 %, N = 55)	> 57 years (25.0 %, N = 16)	6.0	0.19	4
Tribe	Maasai (17.5 %, N = 154)	Other tribes (21.9 %, N = 96)		0.72	0.39	1

Livestock killed included goats (n= 192) followed by sheep (n = 158), cattle (n = 50), donkey (n = 17) and other domestic animals (n = 19). On average every household lost 2.2 livestock per year. This was valued at US $ 20 671 (or US $ 106 per household which reported loss). Highest value of loss were from cattle (US $ 9 375) followed by goat (US $ 6 000), sheep (US $ 3 950), donkey (US $ 1 275) and others (US $ 71). The most frequently reported predator responsible for livestock depredation was the spotted hyena (41.2, %, n = 195) followed by the lion (27.2 %, N = 195), leopard (8.8 %, n = 195) and other predators (0.8 %, n = 195).

3.2 Crop Damage

Respondents from Kakoye village (76.0 %) reported crop raiding to be important at a higher frequency than those in Minjingu (6.0 %) and Olasiti (37.0 %) villages (χ^2 = 25.0, df = 2, P < 0.001). However, there was no difference in reported crop loss in relation to respondent's gender (χ^2 = 0.01, P = 0.98), age-group (χ^2 = 3.3, P = 0.50) or tribe (χ^2 = 0.9, P =0.34) (Table 2).

Table 2. Crop damage caused by wild animal's as reported by respondents between villages, sex, age and tribes

Variable				χ^2	P	df
Village	Kakoye (76.0 %, N = 50)	Minjingu (6.0 %, N = 100)	Olasiti (37.0 %, N = 100)	25.3	0.0001	2
Sex	Males (44.4 %, N = 153)	Females (44.3 %, N = 97)		0.001	0.98	1
Age	18-37 years (5.3 %, N = 179)	38-57 years (7.6 %, N =55)	>57 years (62.5 %, N = 16)	3.3	0.50	4
Tribe	Maasai (46.8 %, N = 154)	Other tribes (40.6 %, N = 96)		0.9	0.34	1

More than half of all respondents (64 %, n = 250) were able to estimate the amount of crop loss caused by wild animals. Respondents reported an annually estimated total average loss of 383 kg equivalent to US $ 154 per household. Type of crops damaged includes maize 56.4 %, beans 5.3 %, millet 2.5 % and other crops 36.0 %. Generally most respondents (69.2 %, n = 240) reported that the amount of loss was ranging between 99 kg and 499 kg. Most crop damage were caused by elephants (71.2 %, n = 240) while other wild animals combined accounted for 24.8 % (n = 240) of crop damage.

In controlling for crop destructions and livestock depredation methods used includes guarding/scaring was the most common one (42.8 %, n = 247), the other methods used included reporting to district wildlife officers (22 %, n = 247), fencing farms and houses (11.6 %, n = 247), shooting (12.8 %, n = 247) and poisoning and other methods (9.6 %, n = 247). There was a significant difference between the methods applied in different villages; respondents from Olasiti village mostly used guarding/scaring (63.6 %, n = 100) while respondents from Kakoye reported to wildlife officers (42 %, n = 50) and respondents from Minjingu village were mostly guarding and scaring (31.6 %, n = 100) ($\chi^2 = 46.23$, df = 10, P = 0.001).

3.3 People's Attitude toward Wild Animals

We asked the respondents to indicate to what extent they "liked" or "disliked" the wild animals (predators and ungulates) found in the Kwakuchinja wildlife corridor. Generally most respondents (66.4 %, n = 176) liked wild animals with few (28.8 %, n = 74) expressing their fears or dislike over predators such as hyena and lion that mostly depredated their livestock. Among villages respondents from Kakoye disliked most (84 %, n = 42) were as only (15 %, n = 15) and (17 %, n = 17) from Olasiti and Minjingu respectively disliked wild animals in the corridor ($\chi^2 = 1.195$, df = 10, P = 0.0001).

The other questions posed to the respondents focused on the role of wild animals whether they should be protected? Over (63.2 %, n = 158) of respondents agreed with the statement that wild animals should be protected and (35.6 %, n = 89) disliked while only (1.2 %, n = 3) had no opinion. Respondents attitude toward protecting wild animals in the corridor differ significantly where by only few respondents (30 %, n = 15) from Kakoye agreed to protect wild animals, 70 % from Olasiti and 73 % of respondents from Minjingu villages are willing to protect wild animals in the corridor ($\chi^2 = 64.59$, df = 10, P = 0.0001).

Majority of respondents (85.6 %, n = 214) indicated their willingness to abide by the regulations of TNP while less than 40 % felt that National Park was actually benefiting the local population. Nevertheless they appeared to be quite pragmatic with less than 34.4 % (n = 86) of respondents supporting the notion that only solution to depredations would be to trap or kill all predators that depredate on their livestock from the corridor.

4. Discussion

In Tanzania, pastoralist societies like Maasai sources of income to households are mainly livestock keeping and crop cultivations. Rodriguez, Henson, Herrero, Nkedianye, and Reid (2012) reported that the Maasai tribe are pure pastoralists in East Africa however; this is not the current case in Kwakuchinja as they have become involved in cultivation of crops. Most of interviewed Maasai depended mainly on livestock keeping and crop cultivation. This is maybe a strategy to meet food demands in the area or due to lack of grazing pasture (Muyungi, 2007). Other activities such as charcoal making and hunting were found at low rates. Still such activities can have a wide negative impact such as deforestation and loss of habitat or even local extinction of wild animals. This is because such activities directly involve cutting of trees and burning which can destroy large forests and lead to desertification (Muyungi, 2007).

In most cases males are the one who respond to the visitor in their household thus making women shy or sometime afraid to come out to speak to the scientist (M Goldman, 2003; Noe, 2003). This was also the case in our study area as most of the interviewed people were males. Low level of formal education was due to tradition of pastoralist societies like Maasai who don't encourage their children to attend schools instead many of them remain home taking care of livestock. Only those who are looked upon as troublemakers and were not taking care of livestock properly were allowed to go to school. Therefore spending most of their life time taking care of livestock was for those who were not looked upon as trouble makers.

4.1 Livestock Depredation

Loss of livestock to predators was highest in Kakoye village. This is due to the fact that Kakoye village is bordering the Tarangire National Park. Therefore this village experienced a probability of coming in contact with predators such as lions, spotted hyenas, leopards and others which search for prey outside the park due to edge effects (Woodroffe, 2000; Woodroffe & Ginsberg, 1998). Every household in the study area who reported depredations of livestock lost on average 2.2 livestock annually. This loss affect farmers economically and they are

also spending more time in guarding livestock from predators which sometimes even result in human injury from predators. Holmern et al. (2007) reported an average loss of US $ 97.7 due to livestock depredation in western Serengeti, very similar to our findings.

Cattle were mostly attacked by lions and spotted hyenas while spotted hyenas and leopards most frequently attacked goats and sheep. In the Tarangire - Manyara ecosystem the spotted hyena is the large predator with highest density followed by lions. This was reflected in the depredation cases as they were mostly caused by spotted hyenas followed by lions and leopards. This loss of livestock to predators lead to retaliatory killing of carnivores as the livestock owners become angry toward predators (Holmern et al., 2007; Røskaft, Händel, Bjerke, & Kaltenborn, 2007; Røskaft et al., 2013) .

4.2 Crop Damage

As most livestock predation and most cases of crop damage by wild animals occurred in Kakoye village the results were supporting the hypothesis that most damage should occur closest to TNP. More than 75 % of the cases of all crop losses in the study area were reported here. Because Kakoye village is bordering Tarangire National Park also other scientists reported that farms that are close to the boundaries of protected areas are more probably attacked by wild animals (Emerton & Mfunda, 1999; Kideghesho, 2010; Noe, 2003). Those living closer to the boundary of the National Park are experiencing more contact with wild animals such as elephants (Woodroffe & Ginsberg, 1998). This was the case in Kwakuchinja wildlife corridor as those farms close to TNP were most frequently attacked. A annually loss of 383 kg of crops per household is a big loss when taking into account that most people in the study area depend on farm produced food as they are not able to buy food from the market or shop. The loss averaged 154 $ per household per year which is far less than that estimated by Kideghesho (2010) who reported an average loss of US $ 516 per household in western Serengeti corridor. However Emerton and Mfunda (1999) reported a loss close to US $ 155 per household that suffered crop damage in western Serengeti. With a difficult bureaucratic system to get compensations of their crop loss these households end up by just complaining and filling the paper forms but they never get compensated for the loss by the wildlife department. Most destruction was in the form of trampling when elephants were moving around foraging.

4.3 Effect on Attitudes of Local Communities

Local communities performed negative attitudes toward wild animals due to severe losses they incur in terms of livestock depredations and crop damage. Those communities that incurred most loss were more negative toward wild animals this is evident as respondents in Kakoye village expressed their dislike than those from Olasiti and Minjingu village. Røskaft et al. (2013) expressed the fact that more communities that performed negative attitudes to wild animals were those who had been affected negatively by wild animals as was the case in our findings. Similar findings that most of the households which their livestock are killed by predators perform retaliatory behaviour on predators and therefore disliked the predators have also been found in other studies (Holmern et al., 2007; Kideghesho, 2010). Those households that were furthest away from the National Park performed relatively more positive attitudes toward wild animals which revealed that distance was the factor to how communities felt toward wild animals.

5. Conclusion

Wildlife induced damage to crops and livestock is jeopardising people's life near the borders of protected areas while human encroaches boundaries of Tarangire National Park. All the three hypotheses are supported by the findings that there were negative interactions between wildlife and local communities, there was increased livestock depredations and crop damage and the wildlife induced-damage was greater in the border of TNP. This was the case in this study as those households close to the boundary of the National Park incurred greater losses from crop and livestock depredation. The negative interactions between wild animals and the losses they incur from depredations and crop damage interviewed respondents had negative attitude toward wild animals. Developing ways of enabling farmers to benefit from the existence of protected areas could be a possible way forward but in the case of the TNP, benefits from outreach activities are currently inadequate to offset costs associated with wildlife, and poor track record of revenues from tourist reaching local farmers. Experience from community-based conservation projects show that distribution of benefits can be problematic and does not necessarily improve conservation. Thus, there should be provision of conservation educations to communities bordering protected areas to practice sustainable agriculture and income generating projects that are conservation friendly such as apiary and village owned forest.

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