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Assessment of Human-Carnivore Conflict in the Communal Areas of the Karatu District, Tanzania, and Methods of Conflict Resolution

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Introduction

Tanzania, renowned for its cultural diversity, stunning landscapes, and rich biodiversity, is home to an impressive array of carnivore species. Iconic species such as the African lion (*Panthera leo*) commanding the vast savannas, to the colorful African wild dog (*Lycaon pictus*) transversing the dense forests, the carnivores of Tanzania play key roles in maintaining the health and balance of its ecosystems. These predators regulate populations, prevent overgrazing, control the spread of zoonotic disease, and contribute to the overall biodiversity of their habitats. The country's national parks and reserves, including Serengeti, Ngorongoro Crater, and Selous Game Reserve, are celebrated internationally for their carnivore populations and are crucial for overall wildlife conservation.

However, despite hosting such wonderful carnivore diversity, Tanzania faces significant challenges at preserving these species. Rapid human population growth, habitat encroachment, and agricultural expansion are leading to widespread habitat fragmentation and loss. This encroachment often brings humans and wildlife into close contact, increasing the likelihood of human-carnivore conflict. One of the most frequent forms of conflict is livestock predation. Many communities in Tanzania rely heavily on livestock for their livelihoods. Livestock predation by carnivores such as lions, leopards (*Panthera pardus*), wild dogs, spotted hyenas (*Crocuta Crocuta*), and jackals (*Canis spp.)* results in economic losses for local communities. These losses often cause a negative view of carnivores, particularly large predators, by local communities and often lead to retaliatory killing.

Additionally, the decline of natural prey due to habitat reduction, water resource depletion and overhunting for bushmeat or sport increases the pressure on carnivore populations, pushing them to seek food in human-dominated areas. Climate change adds further issue by altering habitats and availability of resources, forcing carnivores to adapt to a rapidly changing landscape. These threats are compounded by inadequate

enforcement of wildlife protection laws and lack of comprehensive policies that address the multifaceted nature of these challenges.

The loss of carnivore species in Tanzania would have detrimental ecological consequences, disrupting multiple trophic levels and severely weakening ecosystem resilience. Ecotourism is one of the primary economic industries for Tanzania. According to the Ministry of Tourism and Natural Resources ecotourism is responsible for employing more than 600,000 people directly and up to 2 million indirectly and contributes about 17% GDP for the country. This level of ecotourism relies heavily on charismatic, and widely available wildlife to attract visitors from a global audience. Efforts to conserve carnivores must therefore be holistic, incorporating habitat protections, conflict mitigation, community and cultural involvement, and strong policy frameworks.

Understanding and addressing factors in carnivore diversity loss, and human-carnivore conflict in Tanzania is essential for not only preserving these magnificent creatures. It is also imperative for maintaining the ecological integrity and sustainability of one Africa's most biodiverse nations.

Study Area

The Karatu district is in the Arusha region of Tanzania. The district is located south of the equator, with most northern latitude and longitude being -3.032766E, 35.947884N, and the most southern latitude and longitude being -3.941777E, 34.769840N. The district has an estimated area of 3,300 square kilometers, with Lake Eyasi occupying 10.6 square kilometers. There are 4 administrative divisions, 14 wards, and 58 registered villages within the district. The largest ethnic population is the Iraqw people, followed by the Datooga, as well as the Hadza [1]

Agriculture and livestock husbandry contribute to 85% of the district's economic activity. Coffee, onion, wheat, barley, pigeon peas, and sunflowers are grown as primary income crops. Maize, and beans are grown as important food crops. Karatu district hosts 1,025.75 square kilometers for farming. According to the 2016 Karatu Investment Guide the district cultivated 48,197.1 ha of food crops, and 27,782.5 ha of cash crops. Livestock husbandry is also a large percentage of economic activity in the area. An estimation done by the Karatu District Council in 2016 showed approximately 811,360 animals in the district, with 271,885 being cattle, and 373,588 being comprised of goats and sheep [1].

The climate throughout the district is variable, differing from one local to the next. Annual rainfall varies incredibly depending on location. The annual rainfall in the Eyasi basin averages between 300mm to 400mm, while the annual rainfall in Karatu town is more than double with an average of between 900mm to 1000mm. Wet and dry seasons are divided throughout the year, rainy seasons extend from November to December, hot and dry seasons appear from January to March, and mid-May, while the longest seasonal period is the cold, windy season that runs from June to October [1].

There are three distinct ecological zones within the Karatu district, the Highland that borders Ngorongoro, Midland bordering the Marang Forest, and the Lowlands that run along the Lake Eyasi Basin.

The Highlands encompass Lositete, Upper Kitete, Slahhamo, Kambi ya Simba, Kilimatembo, Rhotia Kati, Kainam Rhotia, Ayalabe, Tloma, Oldeani, Getamock, Buger, Ayalalio, Endonyawe and Makhoromba. The elevation is between 1400m to 2000m above sea level, with an average annual rainfall of 600mm to 800mm. The soil type is predominately clay loam, and allows for the cultivation of wheat, barely, coffee, maize, beans and chickpeas.

The Midlands hold Chemchem, Kilimamoja, Gyekrum Lambo, Gyekrum Arusha, Gongali, Bashay Qurus, Endashangwet, Changarawe, Bassodawish, Endamarariek, Khusmayi, Endallah, Qaru, Endabash, Kambi ya Faru, Laja and Ngaibara. The elevation is between 900m to 1400m above sea level, with an average annual rainfall of more than 600mm. The soil is comprised of clay loam sand, which supports crops such as maize, beans, peas, millet, sunflower, and cassava.

The Lowlands include Matala, Dumbechand, Jobaj, Mbuga Nyekundu, Qangdend, Endamaghan, Maleckchand, Mang'ola Barazani and Laghangarer. This ecological zone has the lowest annual rainfall of the three distinct zones, with an annual average of slightly more than 300mm. The soil type is characterized by sand silt loam, which allows crops such as onions, paddy rice, maize, sweet potato, spinach and other greens to grow well [1].

The Karatu district borders two conservation areas, hosts most of the Marang Forest Reserve, as well as a network of important wildlife corridors. The Ngorongoro National Park is located to the northeast, with a piece of the Ngorongoro Conservation Area (NCA) residing in the Karatu district. The eastern border of the district also follows along Lake Manyara National Park. The upper Kitete/Selela corridor falls directly within the Karatu district and is an important feature along the Great Rift Valley. The Kitete corridor follows the movement of wildlife from the Northern Highland Forest to the lowlands before the extreme change in elevation from the Great Rift Valley. The Selela corridor extends from the lowlands of the Selela groundwater forest to Lake Manyara National Park. Together these corridors form a key pathway that is 2km wide and 10km long [2].

Another important wildlife corridor that does not fall directly in the Karatu district but runs along much of the eastern border is the Manyara Ranch-Lake Natron corridor. This corridor starts at the northern tip of Tanangire National Park and extends north between NCA and the northwest base of Lolsimongori Mountain, until it reaches the southern edge of Lake Natron [2].

Though Lake Eyasi only comprises a small part of the Karatu district, it is worth describing due to the economic activity of fishing as well as being a stopover site for many wetland birds. It is a shallow, seasonal, salt lake that is has no outflow. It rests on

the floor of the Great Rift Valley, at the base of the Ngorongoro Crater Highlands. Its primary inflow source is the Sibiti River, which in years of increased rain will flow year around. The lake fluctuates dramatically with the changes in rain throughout the wet and dry seasons. The lake is known to dry up almost entirely during dry season [3]. Spotted hyena are known to frequently scavenge the fishing villages that occur along the edge of the lake, as well as the less common striped hyena.

Purpose

The purpose of this research is twofold. First is to create a long-term project monitoring carnivore presence, and carnivore-human conflict in the Karatu district of Tanzania. Second is to establish methods to mitigate the carnivore-human conflict in the project area, thus providing people relief of suffering and promoting carnivore conservation.

Objectives

1) Assess carnivore-human conflict within the Karatu District, Tanzania.
2) Assess the attitudes of local communities towards carnivores within the Karatu District, Tanzania.
3) Propose solutions within the local communities to minimize conflict between carnivores and humans.
4) Assist to mitigate the effects of carnivore conflict on local communities.
5) Collect necessary data to support the publication of a scientific articles and reports.
6) Participate in conservatory activities of carnivore species and habitat.

Methodology

1) Assessment of carnivore conflict will be done using several questionnaires to measure conflict across multiple spectrums. Livestock loss and attacks on humans, community attitudes towards different carnivores (spotted hyena, leopards, lions, etc.), and known retaliatory actions. Questionnaires will be collected with the mobile app Epicollect.
    - Livestock loss will be encapsulated in a survey developed and contributed by University of Glasgow graduate student Oliva Carter, and collected from participants who own livestock at their home. The questionnaire collects the date the survey was recorded, the unique location, the home name (using a numbering system), how many of each livestock they own (cows, goats, sheep, donkeys, dogs, and poultry), if they have ever had an attack on their livestock, the details of said attack (month or time of year such as wet/dry season, which predators species were involved, which livestock species and how many were affected, if the household lost any livestock, whether the attack occurred in the grazing grounds or in the livestock enclosure, and anything else of note in the form of free answer.

2) Attitudes towards carnivores will be assessed with a scale-based survey. Emphasis will be placed on leopard, spotted hyena, black-backed jackal, bat-eared foxes, and genet cats, to gain knowledge of community attitudes for multiple species of carnivore. Questionnaires will be given either at participant homes where livestock is owned or in community meetings. Questions will be scaled from 1 (strongly disagree), 2 (disagree), 3 (no opinion), 4 (agree), 5 (strongly agree). The questions will be asked in verbal or written format and then recorded in a form on the survey app Epicollect. A picture of each animal will accompany their category to ensure that the correct animal is being discussed. Per carnivore species each question will be as follows:
    - On a scale of 1(strongly disagree) through 5 (strongly agree) “carnivore species” cause me to lose money.
    - On a scale of 1(strongly disagree) through 5 (strongly agree) I am afraid of “carnivore species”.
    - On a scale of 1(strongly disagree) through 5 (strongly agree) I would like to have fewer “carnivore species” in this area.
    - On a scale of 1(strongly disagree) through 5 (strongly agree) “carnivore species” should be in a fenced area away from humans and livestock.
    - On a scale of 1(strongly disagree) through 5 (strongly agree) lethal means is the only way to protect my livestock from “carnivore species”
    - On a scale of 1(strongly disagree) through 5 (strongly agree) I am interested in other non-lethal means to protect my livestock.
3) Proposal of solutions need to mirror the complexity of the communities and their relationship with carnivore species. Based on the questions from the previous objectives’ solutions should be proposed with respect to the economic, cultural, ecological factors of the area.
4) Mitigation of conflict comes through pursuit of action based on community trust, and involvement. Mitigation of conflict will be done over time, Mitigative actions will include:
    - Assist in building/rebuilding livestock enclosures to better protect livestock at peoples’ homes.
    - Provide community education on the ecological importance of carnivores for the environment.
    - Increase wildlife habitat beyond the national park boundaries, thus allowing space for prey populations and carnivores.
    - Collaborate with researchers, students, conservation managers, and volunteers to collect data on carnivore movement, behavior, and population in a human dominated landscape.
5) Data will be collected utilizing efforts from biological technicians, community members and trained volunteers. All members collecting data will be trained to utilize proper survey methods and techniques. This includes transect surveys for carnivore sign, trail camera surveys, callback surveys, and spotlighting. Data will be collected with the goal of publishing reports for the Tanzanian Wildlife

Institute, as well as supporting students with their graduate theses, and scientific articles about the relationships between carnivores and humans in a communal space.

6) Conserving and rehabilitating habitat is one of the first lines of defense against loss of biodiversity. A large focus of this conservation will be in the areas between the national parks and the local communities, as wildlife are known to travel between the two areas. Agricultural expansion and overgrazing have caused severe depletion of this space. Using students, volunteers, and organization members native trees and grasses will be planted along these edge habitats. Protective enclosures will be used to guards the seedlings and growing grass until they can become established in their environment.

Conservation and Livelihood Implication

Implications from this research project are alleviation of community tension with carnivores, leading to greater quality of life for both humans and carnivore species.

Expected Outcomes

Potential results include…

- Decreases in livestock predation at human homes due to reinforcement of enclosure walls.
- Decrease in retaliatory actions against carnivores related to livestock loss.
- Increased understanding of livestock predation through surveys, including species involved, frequency and economic loss.
- Increased understanding of community attitudes towards carnivores and how that affects community actions.
- Education programs that can be taught in the schools as well as at community events.
- A successful out planting program that focuses on rehabilitation of habitat within buffer zones. Such increase of habitat will have a positive outcome on wild prey populations and reduce the need for carnivores to associate with human communities for food.

Potential Impact on Wildlife

Impacts from this research may be direct or indirect. Direct contact with wildlife is potentially dangerous for both the animal as well as the researcher. Survey methods for capturing wildlife will be non-invasive to minimize this risk. Transect surveys and camera trapping will be conducted as primary methods for assessing wildlife activity in the study area. When monitoring wildlife activity directly researchers will either be in a closed vehicle or a safe distance away (beyond 30 meters). Researchers will limit time spent in contact with wildlife to maintain the “wild” aspect of the animals, as well as limit stress, particularly if the wildlife has offspring.

Potential positive impacts will be a decrease in direct conflict with people, including a decrease in carnivore culling and retaliatory actions. Increased ecological diversity, which is important for ecosystem stability. A more secure future for the country of Tanzania, where humans and wildlife can live in peaceful coexistence.

Citations

1) Karatu District Office. (D. Executive, Ed.), *Karatu District Council Investment Profile* (2016). Karatu, Arusha; United Republic of Tanzania.

2) Jones, T., Caro, T and Davenport, T.R.B. (Eds.). 2009. *Wildlife Corridors in Tanzania*. Unpublished report. Tanzania Wildlife Research Institute (TAWIRI), Arusha. 60pp.

3) Foster, A. and C. Ebinger and E. Mbede and D. Rex (1997). *Tectonic development of the northern Tanzanian sector of the East African Rift System*. Journal of the Geological Society. **154** (4): 689–700. doi:10.1144/gsjgs.154.4.0689.