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THE EFFECT OF COMMUNITY WILDLIFE SANCTUARY ON CONSERVATION OF CRITICALLY ENDANGERED HIROLA ANTELOPE IN GARISSA COUNTY

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ABSTRACT

This study sought to establish the effect of community sanctuary at Garissa County that was constructed in 2012 with the sole purpose of providing favorable environment for Hirola breeding. Immediately after completion of the sanctuary in August, 2012, forty eight (48) individual Hirola were moved into the Sanctuary for breeding. The study employed a survey research design in data collection. The target population of this study was 63 individuals who were directly involved with operations of the sanctuary, this included board members, grazing committee members, rangers, fence maintenance team and management. The data collection instrument used was a structured questionnaire. The researcher used both qualitative and quantitative techniques in data analysis. Descriptive statistics was employed to communicate research findings. The study findings indicated that the wildlife monitoring system had significant effect on Hirola conservation & breeding in that it helped the Sanctuary management to understand various aspect of the wildlife like population, health condition, age, sex and wildlife conflict. The information from wildlife monitoring was also used for decision making and more so to provide history on success and failures on application of various conservation approaches. The predator proof fence had eliminated poaching, predation and competition for pasture between Livestock and wildlife which in turn led to increase in Hirola population. However, the fence had greatly interfered with the traditional grazing pattern of the adjacent pastoral communities and also the migratory route of other wildlife living outside the sanctuary. It was also established that controlled grazing within the Sanctuary has improved pasture regeneration, enhanced food security for Hirola in the Sanctuary but had negatively affected the traditional grazing pattern of the neighboring community. The study revealed that the establishment of the Hirola Sanctuary was indeed a right step towards enhancing Hirola conservation and breeding and suggested further research to be carried out on the behavioral differences between the Hirola living in the sanctuary and those living outside the Sanctuary and who were exposed to poaching, predation and competition for pasture with livestock.

Key terms: Captive breeding, Ex-situ conservation, In situ conservation, Hirola, IUCN Red list, Wildlife Sanctuary

INTRODUCTION

Conservation entails protection of animals and plant species and their habitat. The aim of wildlife conservation is to safeguard wildlife and wilderness so as to maintain ecological balance and for the future generation to enjoy.

According to (Ripple WJ, 2014) the major threats currently faced by the wildlife species in the world include habitat loss and degradation, persecution - often in relation to human - carnivore conflicts - over exploitation, and depletion of prey. International laws or rather legal instruments are not only a self-evident means towards protection of wildlife habitat and the regulation of their exploitation , but also a conspicuous ingredient of the toolbox of instruments suitable for the prevention and mitigation of human-wildlife conflicts (Linell, 2013; Trouwborst, 2015b). From a conservation perspective; it is obviously preferable to adjust relevant Law and policy to the biological unit of wildlife population - even where this population straddles the territories of various countries - instead of adjusting it to biological meaningless administrative boundaries like international frontiers (Linnel and Boitani 2012). To achieve such population level approach, intergovernmental cooperation and, by implication, international law and policy, have an important part to play. The need to adequately conserve and manage wildlife populations which overlap various national jurisdictions is, however, not the only reason why international cooperation is required in the present context. Another reason is the importance of wildlife from a global biodiversity conservation point of view, both as species to be conserved for their own sakes, and with a view to their influence on broader ecosystems. Yet a further reason is that certain activities which pose a threat to the conservation of particular wildlife species have a strong international dimension, and therefore need to be addressed at the international level. A prominent example is the international trade in specimens and derivatives, for instance bear bile (Lewis, 2012).

All this suggests a significant potential for international cooperation, including international law, to contribute to the conservation of wildlife. Many international legal instruments exist that have a bearing, whether directly or indirectly, on the conservation of wildlife species. Some of these are global in scope, namely the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat, the UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention), and the 1992 Convention on Biological Diversity (CBD). These global treaties are complemented by a diverse array of relevant regional instruments such us: the African Convention on the Conservation of Nature and Natural Resources, the Bern Convention on the Conservation of European Wildlife and Natural Habitats, and the European Union (EU) Directive 92/43 on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive). The World Conservation Strategy was developed by the "International Union for Conservation of Nature and Natural Resources" (IUCN) with advice, cooperation and financial assistance of the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF) and in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organization (Unesco)". The strategy aims to "provide an intellectual framework and practical guidance for conservation actions (IUCN-UNEP-WWF, 1980).

Many nations have government agencies dedicated to wildlife conservation, which help to implement policies designed to protect wildlife. Numerous independent non-profit organizations also promote various wildlife conservation causes.

In Kenya the Kenya Wildlife Service (KWS) conserves and manages Kenya's wildlife for the Kenyan people and the world. It is a state corporation established by an Act of Parliament Cap 376 with the mandate to conserve and manage wildlife in Kenya, and to enforce related laws and regulations. Though Kenya is renowned for its national Parks and the abundance and diversity of wildlife; however, Kenya's protected areas are too small, fragmented and not viable to maintain the current wildlife populations which rely on larger ecosystems than protected within the national parks (Watson, Fitzgerald and Gitahi, 2010). ("Wildlife conservation and management ACT", 2013) to great extent, emphasized on the importance of community empowerment on wildlife conservation.

The Ishaqbini-Hirola community conservancy located in Garissa County is one among the various community owned and managed Conservancies across the Republic of Kenya. The Conservancy was established in the year 2007 and is registered at present as a Community Conservancy Trust. The major economic occupation of Ishaqbini community is livestock rearing through pastoralism. This conservancy was born out of awareness of converting the problems of human/wildlife conflict into positive venture from which the communities could reap benefits in future. Besides, the conservancy was also formed to create refuge for its flagship animal *Beatragus Hunteri* (Hirola antelope) which was in the verge of extinction (The IUCN Red List of Threatened Species. Version 2014.3.). Generally, the environment of Ishaqbini has a rich complex eco-system of diverse natural resources ranging from Coastal tropical forest, Natural wetlands, Riverine forests and Open woodlands that also makes it one of the best habitats for a variety of wildlife species. This range from the flagship animal being *Beatragus Hunteri* (Hirola Antelope) and other rare Species such as Tana mamgabey and Tana Red colombus monkeys. Other common types include Topi, Zebras, Giraffes, Buffaloes, Lions, Hyenas, Baboons, Warthogs, Kudus, Dikdik, Wild dogs.

Strategies to address the decline of Hirola have been translocation of a founder population to Tsavo East National Park in 1963 and 1996, to establish a second population outside the natural range, and active engagement of the community in Hirola conservation through the establishment of Ishaqbini Hirola Community Conservancy in 2007. Through Wildlife monitoring and Patrol of community rangers in Ishaqbini, there has been a significant reduction in the level of poaching in the conservancy and the poaching threat to Hirola within the immediate vicinity of the conservancy has been reduced drastically. A core conservation area was also agreed by the community in 2008 and livestock grazing restricted. The aim of the core area was to reduce disturbance and competition between Livestock and Hirola and allow recovery of grass within the area. A vegetation survey in February 2010 showed that controlled grazing of livestock has led to improved grass growth in the core area compared with outside (King, 2010). However, according to King (2010), despite improved range condition in the core conservation area, the Hirola population was not showing significant growth; high predation and low juvenile recruitment appear to be important factors limiting population growth in Ishaqbini and reports of animals outside this area in its range were becoming fewer.

Whilst these strategies have been partially successful and are likely to have prevented continued decline of the species in certain areas, particularly within Ishaqbini Conservancy, it is believed that they are not sufficient to enable rapid recovery which is urgently needed as declines will continue to occur especially in isolated, small populations. More intensive management, through the establishment of an in-situ predator-proof sanctuary with a small founder population, is seen as necessary to secure a breeding herd that is buffered from poaching, predation and livestock competition, King (2010). The erection of the fence of the Sanctuary was

completed by July, 2012. This was followed by the translocation of 48 individual Hirolas of both Sex into the Sanctuary by August 2012.

The study sought to establish the effects of Community Sanctuary on conservation of critically endangered Hirola antelope.

Objectives of the Study

- The effect of wildlife monitoring on Hirola conservation and breeding
- The effect of predator proof-fenced sanctuary on Hirola conservation and breeding.
- The effect of controlled grazing on Hirola conservation and breeding

RELATED LITERATURE

Theoretical Framework

The Theory of Coarse and Fine Filters

The theoretical constructs of Coarse and Fine Filters were originally put forth as a contrasting, yet complimentary approach to conserving biodiversity. The basic idea behind the Course filter approach to maintaining biodiversity is to establish a set of reserves containing respective examples of all the various types of communities in a given area. If this array is reasonably complete, it is assumed that it will protect viable population of most species from the remaining species - Those that fall through the pores of coarse filter - a series of fine filter are needed. Fine filter are individually tailored conservation plans for those species that require them (Malcolm L & Hunter, Jr. 1991). According to (Noss, 1987) Fine filter approach to conserving biodiversity is where conservation efforts is focused on conserving individual rare or specialized species, whose conservation needs were not met by the broader approach and are not necessarily protected in the reserves. In the study by (Mitchell, 2014) states that "Historically, the single species approach to conservation was successful as a recovery strategy for declining species and populations and was thus a logical starting point for biodiversity conservation. Recognition of the burgeoning problem of declining species was codified in the United States with passage of the Endangered Species Act (ESA) in 1973. While basically adhering to the single-species approach to conservation, the act reflects an awareness of the growing complexity of threats facing declining species. The ESA was a milestone in the history of conservation policy in that it recognized, and provided for, the protection of not only the organism in question, but more importantly its habitat.

The Ishaqbini community in this case has applied both approaches (fine filter and course filter) in its efforts to conserve Hirola and other wildlife species. First, the Ishaqbini community conservancy was established targeting a broader ecosystem for conservation, comprising of riverine forest, shrubs land, tropical forest and grass land with numerous wildlife species ranging from Zebra, Topi, Waterbuck, Hirola, Cheetah, Lion, Red Colobus, and Tana Mangabey among others. However, after the initial initiatives of wildlife monitoring, patrol and anti-poaching activities coupled by controlled and planned grazing could not yield a significant increase in the number Hirola (flagship animal). The community had to apply species specific approach to create favorable environment for Hirola breeding by erecting 25 km square predator-proof fence Hirola sanctuary. This sanctuary was developed to reduce predation on Hirola which happened to be the remaining threat faced by Hirola in Ishaqbini after poaching has been eliminated through the recruitment and training of community wildlife rangers. The sanctuary also hosts other species like Giraffe, Zebra, Dik Dik, Gerenuk, and Warthog among others.

Charles Darwin's theory

In this theory Darwin argues that species evolve over the generation through a process of natural selection. The theory purports that every species is fertile enough that if all offspring survived to reproduce the population would grow, despite

periodic fluctuations, populations remain roughly the same size, resources such as food are limited and are relatively stable over time, a struggle for survival ensues, individuals in a population vary significantly from one another, much of this variation is heritable, individuals less suited to the environment are less likely to survive and less likely to reproduce; individuals more suited to the environment are more likely to survive and more likely to reproduce and leave their heritable traits to future generations, which produces the process of natural selection and this slowly effected process results in populations changing to adapt to their environments, and ultimately, these variations accumulate over time to form new species. (Darwin, 1859)

The principle of natural selection enables the species to compete better in the wild. The Hirola antelope population has been on the decline as observed by International Union for Conservation of nature. Its population is globally estimated to be between 300-500 animals (Juliet King 2011). The genus Beatragus originated around 3.1 million years ago and was once widespread with fossils found in Ethiopia, Djibouti, Tanzania and South Africa but the species is currently only found on the Kenya - Somalia border. Female hirola give birth alone and may remain separate from the herd for up to two months, making them vulnerable to predation. Young hirola leave the nursery herd at around nine months of age and form various temporary associations (Probert 2011). These characteristics make them more susceptible to their predators and therefore not strong enough to compete in their wild habitat thus calling for deliberate effort to conserve the species. The hirola is now the only extant member of the genus and is ranked forty third on the Zoological Society of London's (ZSL) list of Evolutionary Distinct and Globally Endangered (EDGE) species.

Community Based Natural Resource Management Strategy Model

The Community Based Natural Resource Management Strategy (CBNRMS) was developed to address environmental, economic and social justice goals. As a strategy in managing wildlife CBNRMS, integrates wildlife conservation and rural development objectives (Getz, 2002). CBNRMS recognizes that local communities could be motivated to have sustainable wildlife management practices. The strategy attempts to reverse resource degradation and thus at least begin to counteract the long history of impoverishment, political-economic subordination and disenfranchisement of traditional resource users (villagers). In other words, community based natural resource management emphasizes benefits to natural resource dependent communities and pursuers of subsistence livelihoods that are closely dependant on natural resource management (Getz, 2002). The strategy has been widely used in wildlife management. It purports that local communities are interested and willing to support implementation of wildlife conservation programs as long as they are legally entitled to any resultant ownership of resources and to associated benefits. In view of these benefits, CBNRMS emphasizes social fencing as a mechanism for conserving the natural resource in question and perpetuating the flow of benefits associated with it.

The Hirola Sanctuary employs this strategy with the view that the local community participate in the conservation of the Hirola Antelope and shares in the benefit that result from the activity. It is employed with recognition that if properly managed, targeting smaller mammals as a protein source at subsistence level is unlikely to cause depletion of wildlife stock. However, if left unmanaged subsistent hunting can have adverse impact on wildlife population (Jachmann 1998, Baland & Platteau 1996).

Conceptual Framework

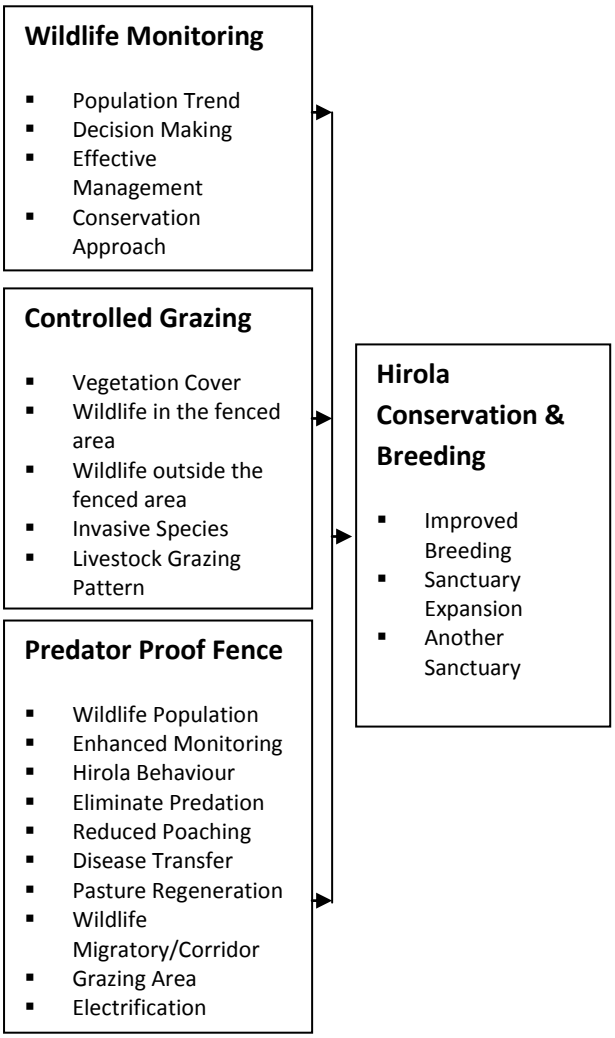

Figure 1: Conceptual Framework

Wildlife Monitoring and Conservation

USDA (2013) defines monitoring as "the collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a resource or management objective. A monitoring activity may include an information needs assessment; planning and scheduling; data collection, classification, mapping, data entry, storage, and maintenance; product development; evaluation; and reporting phases".

There are many reasons why natural resource managers need to monitor wildlife populations. However, the biologist assigned the task, should be aware of the many factors and difficulties that can hinder the successful outcome of a monitoring effort. Because the determination of wildlife population abundance or density can be very difficult and expensive, one should have a clear set of objectives and adequate resources available for the task. Additionally, one must carefully select one or more field methods to apply to the population of interest. Many considerations can influence the method(s) selected and the value and accuracy of the data that result. Finally, implementing the monitoring strategy can be fraught with difficulties, especially when applied in remote or restricted areas or in lesser-developed countries. (Witmer, 2005).

There are many diverse reasons why we need to monitor wildlife populations. Some of these reasons include first the population is a valued game species (e.g. deer, bear, grouse) that is being managed on a sustained-yield basis. Secondly the population may be an actual or potential pest species (e.g. rodents, flocking birds, invasive/non-native species) capable of causing agricultural, property, or natural resource damage or of posing a human or livestock disease or safety hazard. Thirdly, we may need to assess the status of an endangered or threatened species or the progress of a recovery program for that species. The forth reason is that we may need to determine the status of a purposeful introduction or reintroduction of a wildlife species to an area. We may also be trying to define the biological diversity or 'ecological health' of an area and to monitor changes over time. Lastly we may desire to know the effects of our management actions or land-use practices or alternative activities on one or more "featured or indicator" species (Caughley, 1977). Many species of mammals are difficult to monitor because of their small size, drab coloration, and secretive habits (Engeman & Witmer, 2000). Additionally, many are nocturnal, some are fossorial, and many occur at low densities such as rats (Quy, 1993).

Wildlife monitoring programs should form a core component of any conservation management

project. Wildlife monitoring if integrated fully into the project management cycle and decision-making process, monitoring can play three important roles: i) It can provide managers with information on the status of wildlife populations before deciding on the appropriate course of conservation action to take; ii) Monitoring programs can evaluate the effectiveness of management actions relative to stated objectives; and iii) In an adaptive management setting, monitoring programs can provide the important feedback loop for learning about which actions lead to the success or failure of a particular conservation approach, in order to specifically inform and improve upon management practice in the future (Nichols & Williams, 2006; Lyons et al, 2008).

Wildlife Enforcement Monitoring System (WEMS) Initiative, brainchild of environment policy researcher Remi Chandran, is an environmental governance project developed for assisting in monitoring the effectiveness of enforcement and compliance of wildlife law at a national level. WEMS was developed by United Nations University in partnership with Asian Conservation Alliance to address the issue of information collection and analysis of wildlife crime. WEMS was envisioned as a means to address the concerns raised by the international community during the Convention on International Trade in Endangered Species Conference of Parties meeting held in Bangkok in 2004 which identified the need for and benefit of greater and more timely sharing of information between enforcement communities and the respective Convention on International Trade in Endangered Species (CITES) management authorities. Information Communication Technology (ICT) provides an avenue for enhancing the effectiveness of the Convention on International Trade in Endangered Species of Wild Flora and Fauna. ICT can successfully contribute to CITES through the timely national, regional and global collection and analysis of data on illegal trade of endangered species. Such data and analysis will help to inform local, national and international enforcement efforts and enhance CITES policy analysis and decision making. The purpose of WEMS initiative is to monitor trafficking and illegal wildlife crime through a joint effort carried out by United Nations bodies, national governments, private industries, civil society and research institutions, by building a common data collection and reporting mechanism at a national level. The project plans to bring together various national institutions to common information sharing platform and thereby building the capacity of the states to manage knowledge on wildlife crime trends and threat assessments. The compiled data will be then analyzed and selected non nominal information will be made available online through the WEMS website. WEMS will also help in providing analyzed information electronically to all the national enforcement agencies and international policy makers including Interpol and CITES Secretariat. Selected information will be shared with the public for bringing awareness about wildlife Crime. The WEMS initiative works by bringing together Customs, Police, and Forest (all these agencies belong to different ministries) to a common information sharing mechanism within the national government and this will improve inter agency cooperation in tackling environmental crime holistically. Research and analysis of the crime data will be carried out through a designated national research Institute which will also carry out policy analysis identifying the trends and reasons for non compliance. It will also attempt to analyse the legal decisions on wildlife crimes from data obtained from local courts and will be able to identify weakness in legislation if any. Apart from this, the carriers (example Shipping or Airline Company) involved in the illegal trade will also be recorded (Nguyen, 2011)

In Kenya this system was adapted, launched and enforced under the auspice of the former President Mwai Kibaki. During its launch the president indicated that the Wildlife Enforcement Monitoring System will provide the platform for

our enforcement agencies to collect and share information on the trends and patterns of wildlife crime. Moreover, the cross-border nature of wild life crime underscores the need to enhance cooperation among our governments and to pool financial and human resources. He expressed his confidence, that these measures will go a long way in enhancing our capacity to protect our wildlife resources (KWS, 2011). The primary objective of threatened species conservation is to reduce the risk of population extinction. If a population is declining in numbers, and no action is taken to reverse the trend, then extinction is imminent (Ballou, 1989). The role of monitoring and patrols is therefore to establish the Hirola population trend. Ishaqbini conservancy was created as a result of massive Hirola population declines, with the estimated population decreasing from roughly 14,000 in 1976 (Bunderson, 1976), to 2,500 in 1989 (Grunblatt, 1989), to an estimated 300 in 1995 (Ottichilo, 1995) and the most recent count conducted within the natural range in Kenya found there to be 245 individuals (NRT, 2011). This combined with the estimated population within Tsavo East National park of 67 (KWS, 2011) brings the total numbers remaining in Kenya to be estimated as approximately 300 individuals. There is need for monitoring to be undertaken to assess broad scale patterns in local/regional abundance of hirolas and investigate any potential increase or decrease in population density.

Controlled grazing and conservation

Controlled grazing can be an economical way to provide forage to grazing animals. Utilizing pasture as a major portion of the forage plan can significantly reduce feed costs during the grazing season. However, optimizing a controlled grazing system requires careful planning and good management of a fencing system. Controlled grazing works by allowing livestock to intensively graze a portion of pasture followed by rotation to a "rested" paddock. This permits plant regrowth on the grazed pasture while letting animals forage on the highly nutritious plants in the rested paddock. An effective controlled grazing system requires an adequate fencing system that provides the manager control of the grazing animals. Permanent boundary fences are used to hold grazing animals in the pasture area (Susan, 2009).

Controlled grazing was introduced as an effort to increase efficiency, lower costs, and gain more profit from existing resources and ecologically maintain those resources. Since its introduction to North America in the 1970's it has been proven to be a sound management practice. Controlled grazing is the management of forage with grazing animals. It limits access to grazing by subdividing pastures with permanent and temporary fences. When compared to traditional grazing methods it has proven to be efficient in terms of energy, production, and operation. It results to increased amounts of forage harvested by animals; improved forage quality; extended grazing seasons; reduced fertilizer and herbicide applications; reduced labor and feed costs; fewer weeds; and environmentally responsible grazing areas. With controlled grazing, plants have an opportunity to rest and recover between pasture rotations. This leads to increased forage production. Because plants are less stressed under controlled grazing conditions, they have a greater persistence and vigor of desirable species. More uniform defoliation of pastures under controlled grazing means less wasted forage, especially in the spring and better control of residual height, thus less overgrazing. Higher forage quality results because plants are kept in a vegetative or growing stage. We find reduced weed encroachment because the desirable species of plants are better able to compete with weeds. And, manure and urine are better distributed through the pasture system because the animals spend less time congregating in the same location each day (Penn state Extension, 2015)

Controlled grazing results to increased stocking rate to about 30 to 50 percent. Gain per acre can

also be increased by ensuring that high-quality, fresh, and unsoiled vegetative growth is available throughout the grazing system. Vigor of the pasture is improved. Handling and checking grazing animals is easier. It further leads to more accurate estimates of the amount of forage available, greater uniformity in grazing of pastures, and the flexibility of harvesting and storing forage not needed for grazing. Extending the length of the grazing season while providing a more uniform quality and quantity of forage throughout the season are also important benefits (Penn state Extension, 2015)

With increased pasture regeneration and quality, it is expected that the Hirola would not have a challenge of food and therefore the risk of dying from hunger is reduced. This in return is expected to increase the population of the Hirola.

Predator-proof fencing and conservation

Predator proof fences have been developed in various forms and for various reasons in the world. Barriers developed for protection from human predators include, among others, The Great Wall of China, moats surrounding medieval European castles, and the stockades which surrounded early forts in North America. Some examples are the barbed concertina and other fences routinely used by modern armies to repel invaders (Wade, 1982). The predator proof fence uses technology that has been used with great success in New Zealand in both coastal and forested areas. Trial predator-proof fences were constructed on the slopes of Mauna Loa on Hawai`i, demonstrating their effectiveness in excluding rats, cats, and mongoose and allowing the development of methods to exclude mice on ‘a‘ā substrate. Ka`ena Point was the first project-level fence of its type constructed in Hawai`i and the U.S. In Hawai`i, the use of predator-proof fencing is especially promising in that it can provide areas within which the entire ecosystem, including native vegetation, can recover and where birds and snails can breed and forage free from the threats of introduced terrestrial vertebrate predators (MacGibbon, 2002).

The biological diversity of ecosystems is very important to maintain the level of services which they provide. Much is unknown about the number of species and the extent of biodiversity. However, there is no debate within the scientific community on the importance of biodiversity for human life (Callan, 2007). One of the more prominent instruments to respond to the decline in biodiversity has been predator-proof fence projects (Chug, 2011). Sanctuaries have been praised as a cost-effective way to avoid catastrophe and disaster (Clapperton, 2001). The use of the predator-proof fencing greatly increases the effectiveness of existing animal control efforts, shifting the focus from reducing predator numbers to eradication (Long and Robley, 2004). Moreover the predator proof fence lead to improvement in ecosystem function, increase in the number and density of native invertebrates and an increase in the diversity of plant vegetation. Thus this study will seek to establish the effects of predator proof fence on the breeding of the Hirola Antelope.

METHODOLOGY

The study used the descriptive survey research design. Descriptive survey research design is an attempt to collect data from members of a population in order to determine the current status of that population with respect to one or more variables (Mugenda and Mugenda 2003). A sample of 86% (i.e. 54/63) using stratified random sampling based on the membership category was selected for the study thus giving a total fifty four (54) respondents. To obtain the numbers to represent the total population, the (Yamane, 1967) formula that was used was

$$n = \frac{N}{1 + N(e)^2}$$

Where n = number of samples, N = number of total population (63), e= error designated to be at 95% significant level (0.05). The table below shows the target population and the sample size.

The studyused a multiple regression model of the following nature:

$Y= \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\varepsilon$

Where: Y= Hirola conservation and breeding

β_0= Constant (Value of the dependent variable when all the independent variables are zero)

X_1= Wildlife monitoring

X_2= Predator proof fence

X_3 = Controlled grazing

β_1... β_3=Regression Coefficients

ε=Stochastic or Random term

RESEARCH FINDINGS

Effect of wildlife monitoring on Hirola conservation and Breeding

The study sought to find out how wildlife monitoring had affected the Hirola conservation. The research sought to find out for how long the respondents had been involved in the Sanctuary and the following were the responses.

Table 1: Distribution of responses on length of involvement with the Sanctuary

Length of involvement	Frequency	Percent
1 to 2 years	4	7.4
3 to 4 years	20	37.0
5 to 6 years	4	7.4
7 and above	26	48.1
Total	**54**	**100.0**

Most of the respondents had been involved with the sanctuary for more than four years. This means they had vast knowledge about the sanctuary and the Hirola conservation. Further the study sought to find out when Hirola monitoring started, the responses were presented in the table below.

Table 2: Distribution of responses on when Hirola Monitoring started

When Monitoring started	Frequency	Percent
2 years ago	4	7.4
3 years ago	6	11.1
4 years ago	24	44.4
5 years and above	20	37.0
Total	**54**	**100.0**

81% of the respondents indicated that Hirola monitoring started more than four years ago. This was long enough for the Sanctuary team to understand the trend of Hirola population within the sanctuary. To clearly understand wildlife monitoring the study asked questions on the aspect of wildlife considered during monitoring exercise and the responses are shown below. Majority of the respondent admitted that wildlife data was collected on all aspects of wildlife questioned which included sighting, death and birth, sex, age and wildlife conflict. This information could make the management figure out whether there were any improvements or not.

The study used a likert scale to establish to what degree the respondents agreed with the statements and the responses were shown in the following tables.

Table 3: Distribution of responses on whether Hirola monitoring system can help to establish population trend

Monitoring helps	Frequency	Percent
Do not know	6	11.1
Agree	6	11.1
Strongly agree	42	77.8
Total	**54**	**100.0**

The table above clearly showed that most of the respondents strongly agreed to the fact that Hirola monitoring help in establishing Hirola population trend.

Table 4: Distribution of responses on Hirola Monitoring provides information for decision making

Monitoring informs decision	Frequency	Percent
Do not know	6	11.1
Agree	12	22.2
Strongly agree	36	66.7
Total	**54**	**100.0**

The respondents felt that Hirola monitoring gave information that was useful in decision making and coming up with new conservation approaches. 88.9% of the respondents agreed with the statement.

Table 5: Distribution of responses on Hirola Monitoring provides feedback.

Monitoring provides feedback	Frequency	Percent
Do not know	6	11.1
Agree	16	29.6
Strongly agree	32	59.3
Total	**54**	**100.0**

The respondent felt that Wildlife monitoring provided important feedback on success and failures of a particular conservation approach. 88.9% of the respondents agreed with the statement.

Table 6: Distribution of responses on Hirola monitoring provides information on wildlife disease

Information on wildlife disease	Frequency	Percent
Disagree	2	3.7
Do not know	6	11.1
Agree	20	37.0
Strongly agree	26	48.1
Total	**54**	**100.0**

The table above clearly indicated that Hirola monitoring helped the concerned to unearth wildlife diseases, this fact was alluded to by 85.1% of the respondents.

Having noted that a predator proof fence was introduced in the Hirola Sanctuary, the study sought to find out its effect on the Hirola conservation.

Effect of Predator proof fencing on Wildlife conservation and breeding, Livestock production and Grazing pattern

Table 7: Distribution of responses on whether predator proof fence led to increased Hirola population

Increase population	Frequency	Percent
Strongly disagree	2	3.7
Agree	2	3.7
Strongly agree	50	92.6
Total	**54**	**100.0**

Table 7 above showed that 96.3% of the respondent agreed to the statement that the predator proof fence led to increase in Hirola population.

Table 8: Distribution of responses on whether predator proof fence enhance monitoring

Enhance monitoring	Frequency	Percent
Do not know	2	3.7
Agree	20	37.0
Strongly agree	32	59.3
Total	**54**	**100.0**

The respondents felt that the predator proof fence has enhance effective wildlife monitoring, this fact was alluded to by 96.3% of the respondents.

Table 9: Distribution of responses on predator proof fence help understand Hirola behavior

Understand behavior	Frequency	Percent
Do not know	2	3.7
Agree	14	25.9
Strongly agree	38	70.4
Total	**54**	**100.0**

As show in table 9 above, 96.3 % of the respondent agreed that the fence sanctuary has enhance understanding of Hirola behavior by the concerned team.

Table 10: Distribution of respondents on predator proof fence eliminate predation

Eliminate predation	Frequency	Percent
Strongly disagree	2	3.7
Agree	8	14.8
Strongly agree	44	81.5
Total	**54**	**100.0**

Almost all the respondent agreed to the statement that the predator proof fence eliminated predation in the sanctuary, this was alluded by 96.3% of the respondent.

Table 11: Distribution of respondents on predator fence reduced poaching

Reduced Poaching	Frequency	Percent
Strongly disagree	2	3.7
Agree	6	11.1
Strongly agree	46	85.2
Total	**54**	**100.0**

As shown in the table 11 above , 96.3% of the respondent agreed to the statement that the predator proof fence reduced poaching.

Table 12: Distribution of respondents on disease transfer from Sanctuary to outside

Disease Transfer Outside	Frequency	Percent
Strongly disagree	2	3.7
Disagree	2	3.7
Do not know	2	3.7
Agree	16	29.6
Strongly agree	32	59.3
Total	**54**	**100.0**

The respondent felt that predator proof fence reduced the risk of disease transfer from wildlife in the Sanctuary to those living outside the Sanctuary.

Table 13 Distribution of respondents on disease transfer within the Sanctuary

Disease Transfer within	Frequency	Percent
Disagree	2	3.7
Do not know	2	3.7
Agree	16	29.6
Strongly agree	34	63.0
Total	**54**	**100.0**

The respondent felt that the risk of disease transfer within the fenced Sanctuary is very high in case of disease outbreak. This was agreed by 89.9% of the respondent.

Beside Hirola, the study also sought to find out the effect of predator proof fence to other wildlife species living inside the Sanctuary area.

Table 14: Distribution of respondent on population trend of other wildlife species

Poaching	Frequency	Percent
Disagree	2	3.7
Agree	8	14.8
Strongly agree	44	81.5
Total	**54**	**100.0**

As shown in the Table 14 above shows 96.3% of the respondent have agreed to the statement that the population of other wildlife in the Sanctuary has increased.

Table 15: Distribution of respondent on poaching of other wildlife species

Poaching	Frequency	Percent
Disagree	2	3.7
Agree	8	14.8
Strongly agree	44	81.5
Total	**54**	**100.0**

Above 80% of the respondent strongly agreed to the statement that poaching of other wildlife species in the Sanctuary have reduced.

Table 16: Distribution of respondent on food security for wildlife in the Sanctuary

Food Security	Frequency	Percent
Disagree	4	7.4
Agree	14	25.9
Strongly agree	36	66.7
Total	**54**	**100.0**

As shown in the table 16 above, 92.6% of the respondent had agreed that the food security for wildlife in the sanctuary have increased. This is because there is no competition for pasture between the livestock and wildlife in the fenced area as opposed to those outside the fenced area.

Table 17: Distribution of respondent on interference with the wildlife migratory behaviors

Wildlife Migration	Frequency	Percent
Disagree	6	11.1
Agree	30	55.6
Strongly agree	18	33.3
Total	**54**	**100.0**

The respondent felt that the fence has interfered with the migratory behavior of the wildlife living inside the Sanctuary since it has confined them in a specific area. This was agreed by 88.9% of the respondent.

The study further sought to find out the effect of predator proof fence to other wildlife species living outside the Sanctuary area.

Table 18: Distribution of respondent interference with wildlife corridors living outside

Wildlife Migration	Frequency	Percent
Strongly disagree	14	7.4
Disagree	20	18.5
Do not know	6	11.1
Agree	10	37.0
Strongly agree	4	25.9
Total	**54**	**100.0**

Table 18 above shows that the respondent agree to the statement that the fence has interfered with the wildlife corridors by blocking the those wildlife living outside the fence to access some of their corridors.

Table 19: Distribution of respondent on wildlife migration

Wildlife Migration	Frequency	Percent
Strongly disagree	14	25.9
Disagree	20	37.0
Do not know	6	11.1
Agree	10	18.5
Strongly agree	4	7.4
Total	**54**	**100.0**

As shown in the table 19 above, 62.9% had disagreed to the statement that construction of fenced Sanctuary has led to the migration wildlife from the conservancy area. However, 18.5% agreed to the statement. This showed that there were no or little migration.

Table 20: Distribution of respondent on limitation of grazing area for wildlife

Grazing Area	Frequency	Percent
Strongly disagree	2	3.7
Disagree	14	25.9
Do not know	2	3.7
Agree	32	59.3
Strongly agree	4	7.4
Total	**54**	**100.0**

From Table 20 above, 59.3 % agree to the statement that the fence has limited the grazing area of other wildlife species living outside the Sanctuary. However, 25.9 % felt that the fence has not limited the grazing area.

Table 21: Distribution of respondent on wildlife death as a result of electrification

Electrification	Frequency	Percent
Strongly disagree	4	7.4
Disagree	6	11.1
Agree	34	63.0
Strongly agree	10	18.5
Total	**54**	**100.0**

From the table 21 above, 81.5% agree to the statement that the electrified fence has led to the death of wildlife through electrocution . The study also sought to understand the effect of the fenced predator proof Sanctuary to the Livestock of the neighboring community.

Table 22: Distribution of respondent on livestock production

Livestock production	Frequency	Percent
Strongly disagree	2	7.4
Disagree	14	25.9
Agree	28	51.9
Strongly agree	8	14.8
Total	**54**	**100.0**

The respondent felt that the predator proof fence has reduced livestock production of the neighboring community. This was alluded by 66.7% of the respondent.

Table 23: Distribution of respondent on grazing area

Grazing area	Frequency	Percent
Strongly disagree	2	3.7
Disagree	6	11.1
Agree	36	66.7
Strongly agree	10	18.5
Total	**54**	**100.0**

From Table 23 above, 85.2% of the respondent agree to the fact that the fenced Sanctuary has reduce the grazing area for the neighboring , particularly for Gundhi and Alijarire village.

Table 24: Distribution of respondent on trekking distance of livestock

Trekking Distance	Frequency	Percent
Strongly disagree	2	3.7
Do not know	2	3.7
Agree	38	70.4
Strongly agree	12	22.2
Total	**54**	**100.0**

From Table 24 above , 82.6% of the respondent agree to the fact that the fenced Sanctuary has increase the trekking distance of livestock to access pasture, particularly those from the adjacent community of Gundhi and Alijarire.

Table 25 Distribution of respondent on families living apart in search of pasture

Families	Frequency	Percent
Strongly disagree	6	11.1
Disagree	12	22.2
Agree	28	51.9
Strongly agree	8	14.8
Total	**54**	**100.0**

From the Table 25 above, 66.7% agree to the statement that the fence has led to families living far apart from each other due to search for pasture while 33.3% disagree to the statement.

The study also sought to understand the effect of controlled grazing to the Wildlife, Livestock and pasture regeneration.`

Effect of Control Grazing to Wildlife, Livestock and Pasture regeneration

Table 26: Distribution of respondent on pasture regeneration in the Sanctuary

Pasture Regeneration	Frequency	Percent
Strongly disagree	2	3.7
Agree	16	29.6
Strongly agree	36	66.7
Total	54	100.0

From Table 26 above, 96.3% have agreed to the statement pasture regeneration has improved in the Sanctuary. This is due to the fact that there is no competition for pasture between wildlife and livestock in the fenced area.

Table 27: Distribution of respondent on food security for wildlife in the Sanctuary

Food Security	Frequency	Percent
Agree	16	29.6
Strongly agree	36	70.4
Total	**54**	**100.0**

The respondent felt that there is food security for wildlife in the Sanctuary compared to those living outside the Sanctuary. This was alluded by 100% of the respondent.

Table 28: Distribution of respondent on presence of invasive species in the Sanctuary

Invasive Species	Frequency	Percent
Strongly disagree	2	3.7
Disagree	6	11.1
Do not know	2	3.7
Agree	26	48.1
Strongly agree	18	33.3
Total	54	100.0

From Table 4.29 above, 82.4% have agreed to the statement that controlled grazing has suppressed presence of invasive species. This is due to pasture and undisturbed soil.

Table 29: Distribution of respondent on the negative effect of controlled grazing.

Grazing pattern	Frequency	Percent
Disagree	2	3.7
Do not know	4	7.4
Agree	42	77.8
Strongly agree	6	11.1
Total	**54**	**100.0**

From Table 29 above, 88.9% of the respondent agreed to the statement that controlled grazing within the Sanctuary has negatively affected the traditional grazing pattern of the neighboring community. This is due to the fence that blocked the livestock to get into the sanctuary.

The effect of the Sanctuary on Hirola Breeding and Conservation

The study sought find out whether the establishment of the predator proof fenced Sanctuary has created a favorable environment for Hirola breeding which was indeed the sole purpose behind its construction.

Table 30: Distribution of respondent on the exact population of Hirola in the Sanctuary

Hirola Population	Frequency	Percent
103	4	7.4
105	2	3.7
108	12	22.2
109	2	3.7
110	2	3.7
113	24	44.4
115	4	7.4
180	2	3.7
118	2	3.7
Total	**54**	**100.0**

From Table 30 above, 100% of the respondent have agreed that the current Hirola population in the Sanctuary is more than 100 individuals. This is an indication that the population of Hirola in the Sanctuary has increased by more than 100% within a span of 4 years i.e up from a founder population of 48 individuals by August 2012.

Table 31: Distribution of respondent on whether the sanctuary improved Hirola breeding

Improved Hirola breeding	Frequency	Percent
Strongly disagree	2	3.7
Agree	6	11.1
Strongly agree	46	85.2
Total	**54**	**100.0**

From Table 31 above, 96% of the respondent agreed to the statement that the establishment of Hirola sanctuary improved Hirola breeding. This indicated that the expectation of the founders had been met.

Table 32: Distribution of respondent on expansion of the existing Hirola Sanctuary

Expansion of current Hirola sanctuary	Frequency	Percent
Strongly disagree	2	7.4
Agree	6	11.1
Strongly agree	46	81.5
Total	**54**	**100.0**

As shown in Table 32 above, 92.6% of the respondent have recommended for the expansion of the existing Hirola Sanctuary.

Table 33: Distribution of respondent on the establishment of another Hirola Sanctuary

Expansion of current Hirola sanctuary	Frequency	Percent
Strongly disagree	2	40.7
Agree	6	11.1
Strongly agree	46	48.2
Total	**54**	**100.0**

From Table 33 above, 59.3% of the respondent agreed to the establishment of another Hirola Sanctuary outside Ishaqbini area while 40.7% disagreed to the statement.

Correlation Analysis

To establish the relationship between independent variables (wildlife monitoring, controlled grazing and predator proof fence) and dependent variable (Hirola conservation and breeding), Pearson Bivariate Correlation was used.

Table 34: Correlation Matrix

		WM	CG	PPF	HCB
WM	Pearson Correlation	1	.682**	.522**	.784**

	Sig. (2-tailed)		.000	.000	.000
	N	137	137	137	137
CG	Pearson Correlation	.682**	1	.622**	.668**
	Sig. (2-tailed)	.000		.001	.000
	N	137	137	137	137
PPF	Pearson Correlation	.522**	.622**	1	.722**
	Sig. (2-tailed)	.002	.000		.000
	N	137	137	137	137
HCB	Pearson Correlation	. 784**	.668**	.722**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	137	137	137	137

Table 34 showed a varied degree of interrelationships among wildlife monitoring and Hirola conservation and breeding. There was a significant positive correlation (r=0.784) between wildlife monitoring and Hirola conservation and breeding. wildlife monitoring had a strong influence on the Hirola conservation and breeding, with a significant p-value of 0.000. This therefore implied that if the community wildlife sanctuary in Garissa could effectively carryout wildlife monitoring they were likely to improve the Hirola conservation and breeding. These results were in agreement with the study by (Nichols & Williams, 2006; Lyons et al, 2008) which revealed that proper wildlife monitoring has an impact on wildlife breeding.

There was also a significant positive relationship (r=0.668, p-value=0.000) between controlled grazing and Hirola conservation and breeding. This therefore implied that if grazing was not controlled, it would influence the Hirola breeding in the Ishaqbin sanctuary. This was in support of the findings by (Penn state Extension, 2015) who agreed that controlled grazing has a positive influence on Hirola conservation and breeding.

Predator proof fence was also found to have a positive correlation with Hirola breeding giving a coefficient correlation of 0.722 And a significant p- value of 0.000. This was in support of study findings by (Long and Robley, 2004) who established that the use of the predator-proof fencing greatly increases the effectiveness of existing animal control efforts

Multiple Regression Analysis

Multiple regression analysis was performed to assess the relationship between the independent variables (wildlife monitoring, controlled grazing and predator proof fence) and the dependent variable (Hirola conservation and breeding). The results for multiple regression analysis are shown in table 35.

Table 35: Multiple Regression Model Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	.781	.263		2.970	.104
WM	.104	.026	.032	.545	.000
CG	.237	.080	.246	2.970	.000
PPF	.429	.076	.454	5.619	.000

a. Dependent Variable: Hirola conservation and breeding

Key: **WM=**Wildlife Monitoring; **CG**=Controlled Grazing; **PPF**=Predator Proof Fencing; **HCB=**Hirola Conservation and Breeding.

The individual conservation factors were regressed against the aggregate mean score of Hirola conservation and breeding. The multiple linear regression model coefficients highlighted in table 35 Showed that wildlife monitoring, controlled grazing and predator proof fence had a significant effect with p-values <0.05. The response from the Ishaqbin sanctuary managers indicated that there were other factors which influence Hirola conservation and breeding but had not been factored in the study, majorly Improved breeding, Sanctuary expansion, and establishment of another Sanctuary

Predator proof fence had the highest significance on Hirola conservation and breeding (β=0.429) while the results show that wildlife monitoring had the least significance (β=0.104). From the results in table 4.36 a multiple linear regression equation that can be used estimate the Hirola conservation and breeding in Ishaqbin sanctuary given the different wildlife conservation variables was given as follows:

HCB=0.781 + 0.104**WM** + 0.118**CG** + 0.237**CG** + 0.429**PPF**

Where:

HCB= Hirola conservation and breeding in Ishaqbini Sanctuary

0.781=βo (Constant term)

0.014, 0.118, 0.237, 0.429= an estimate of the expected increase in Hirola breeding corresponding to increased adoption of conservation methods.

WM= Wildlife Monitoring

CG = Controlled Grazing

PPF= Predator Proof Fence

The regression results indicated that a unit change in wildlife monitoring resulted in 10.4% change in Hirola conservation and breeding (β=0.108) while a unit change in controlled grazing resulted in 23.7% increase in Hirola conservation and breeding (β=0.237). A unit change in predator proof fence caused a 42.9% change in Hirola conservation and breeding (β=0.108).

To obtain the overall goodness of fit, all the independent variables were regressed against the dependent variable and results shown in table 36.

Table 36: Model Summary-Regression of Community Conservation initiatives and Hirola conservation and breeding

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.741[a]	.549	.535	.25566

a. Predictors: (Constant), wildlife monitoring ,controlled grazing and predator proof fence

Table 36 presented the coefficient of determination (R-squared) results for the effect of community conservation initiatives on Hirola conservation and breeding. The results indicated that 54.9% of change in Hirola conservation and breeding was explained by the conceptualized community initiatives variables (R^2=0.549) while the remaining percentage could have been explained by other un-conceptualized variables. The high coefficient of determination implied that sanctuaries that more effectively embraced such initiatives recorded better and improved wildlife conservation and breeding.

CONCLUSIONS

Based on the findings of this study, the following conclusions were drawn. The result revealed that Hirola monitoring, predator proof fence and controlled grazing have significant effect on Hirola conservation and breeding. This was evident by more than 100% increase in Hirola population in a span of four years. Further the study revealed that most of the initiatives were biased towards Hirola conservation and breeding with little regards to the lifestyle of the neighboring communities and other wildlife species living within the same geographical area. This was evident by how the predator proof fence and controlled grazing have greatly interfered with the traditional grazing pattern of the adjacent pastoral communities which led for families to live a part in search of pasture and the fence interference with the migratory route of other wildlife species.

Recommendations

The use of wildlife monitoring system is essential in the performance management of Community wildlife sanctuaries. The information from wildlife monitoring system is very critical in decision making processes and can be used as a tool to measure the success and failure of various conservation approaches.

Predator proof fence is a good option in creating a favorable breeding area for critically endangered wildlife species that are facing predation threat. Communities wildlife sanctuaries should adopt planned and controlled grazing for pasture regeneration whilst very much considerate of pasture need of their neighboring communities.

Going by the growth of Hirola population in a span of four years immediately after the establishment of the Hirola community sanctuary informs on how communities can contribute to the conservation of wildlife in Kenya. If communities are empowered and educated on how they can reap benefits from their wildlife resource, they will develop sense of ownership and supplement the work of conservation organizations. Conservation stakeholders can also apply the findings of this study to formulate policies that will enhance conservation of critically endangered wildlife species.

Suggestion for Further Study

Further research to be carried out on the behavioral differences between the Hirola living in the sanctuary and those living outside the Sanctuary who are exposed to poaching,

predation and competition for pasture with livestock.

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