THE HIROLA CONSERVATION PROGRAMME (HCP) PROGRESS REPORT, OCTOBER, 2015

The Hirola Conservation Programme (HCP) is a non-governmental organization based in Garissa County in north-eastern Kenya. The HCP is primarily dedicated to promoting conservation of the endangered hirola antelope (*Beatragus hunteri*) in the region (Figure 1). Towards this, HCP commits itself to improving hirola's habitat in partnership with the local pastoralist groups. The main goal of HCP is to establish and sustain a conservation programme that will make a lasting contribution to the future of hirola antelope and also the livelihoods of the local communities living within hirola's geographical range.

Figure 1: Herd of hirola within Ishaqbini Conservancy.

One of the key concerns for conservation of hirola antelope is that, their population have declined from approximately 15,000 individuals in 1970 to between 300 and 500 individuals currently. That is why our programme focuses on *in situ* conservation within the species historic geographical range to ensure that we achieve our objective in partnership with local communities. Specifically, for long-term monitoring of this critically-endangered species, the programme intends to protect and increase the numbers and distribution of hirola through local participatory conservation, education, and international support in north-eastern Kenya.

Our core functions include:

A) Conservation

Our conservation efforts are threefold

1) The protection and restoration of habitat for the endangered hirola antelope
2) Anti-poaching programme for hirola, elephants and other wildlife and,
3) Capacity building and technical advice to both local government officials and local groups.

B) *Research*

Our research programme is a locally supported conservation research effort that aims at understanding the underlying factors influencing hirola declines and to explore the best management interventions to improve their population. In particular, our research work focuses on hirola range collapse, habitat use, and the effects of land-use change in north-eastern Kenya. In addition, we are conducting participatory research with local communities to better understand

social factors that are affecting the future conservation of hirola in the region. These are knowledge gaps that we have consistently identified and prioritized for hirola conservation. We employ GPS telemetry using Vectronic GPS PLUS collars, analysis of long-term satellite imagery, mark-resight and sight-resight analyses to gather information and understand the demographic drivers of hirola declines. GPS-telemetered individuals are enabling us to collect data on habitat selection and demographic dynamics of this unique antelope.

C) *Education*

The hirola conservation programme conducts an intensive outreach programme consisting of lectures, video shows, and public discussions on hirola conservation. We also conduct educational seminars, meetings and workshops in the villages within the range. We work with local elders in each village and the local leaders to facilitate the availability of meeting venues and also to bring people together. We on many occasions use local language to communicate with locals as this makes it easier to follow and understand the discussions. We also use graphics, drawings and other materials such as pictures or photographs to illustrate conservation issues.

D) *Network and partnership for hirola*

To strengthen our work, we recently partnered with a number of international organisations that provide direct support to hirola conservation programme. These include; People's Trust for Endangered Species (hereafter referred to as "PTES"), Rufford Foundation, Houston Zoo and the Garissa County Government, Kenya. We anticipate to approach more other organisations for new partnerships and to enable us achieve our long-term conservation goals.

A BACKGROUND OF HIROLA CONSERVATION AND RESEARCH

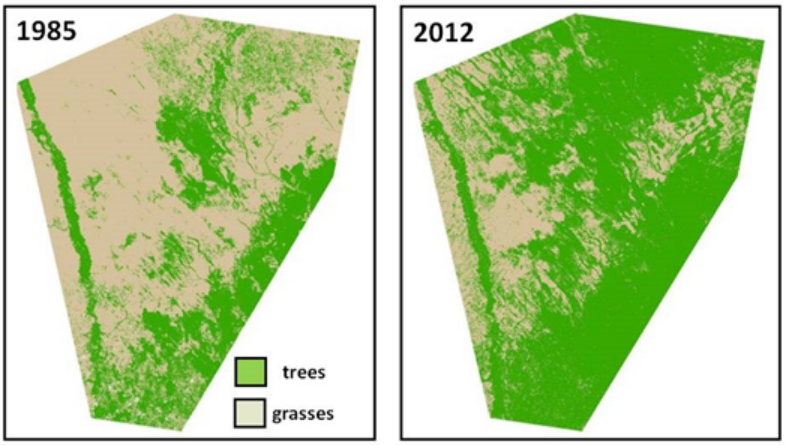

Figure 2: Changes in tree cover across the hirola's historic range from 1985 to 2012. Green represents tree cover and brown represents grasslands. The linear narrow band is the Tana River (the longest river in Kenya). Note the stark decrease in grassland between 1985 and 2012.

The hirola antelope is the world's most endangered antelope (IUCN, 2008), restricted to <5% of its original historic range on the Kenya-Somali border. Although they are have never been common, hirola population has reduced from ~13,000 individuals in the 1970's to < 500 individuals today (Probert et al. 2014). The current populations occur mainly on pastoral lands with no formal protection. However, the only single protected area that exists within the hirola's native range is the Arawale National Reserve but this also lacks adequate support from both the Kenyan government and the international conservation

community. Much of the hirola's historical range is in semi-arid grasslands, which for a long time were inhabited by nomadic people and other wildlife. Subsequently, recent colonial and post-colonial policies forced locals to shift to sedentary pastoralism which encouraged settlements around boreholes and other fixed infrastructures (Boone, 2005). A recent analysis of historical satellite imagery across the hirola's native range revealed that there was a nearly 300% increase in tree cover in the last 27 years (Fig.2). This might have been caused by elephant extirpation in the range which naturally would control tree encroachment.

The increase in tree cover poses one of the greatest threats to survival of hirola through food limitation and predation risk (Andanje 2002). For instance, our study (supported by PTES) shows that hirola perceive wooded areas as riskier than open spaces (Ali et al. under review (a)). This means that without any actions against tree encroachment, reversal of these, the recovery of hirola will be insurmountable. Moreover, increased tree cover negatively impacts local livelihoods which depend wholly on livestock. This situation calls for urgent actions to restore and conserve the hirola habitat. Restoration of degraded lands can lessen the threats posed to biodiversity by habitat loss and fragmentation (Benayas et al. 2009). Habitat restoration for endangered species like hirola can however, be costly in terms of money, time and expertise and would require careful evidence based conservation approach. Our project therefore aims to restore range for hirola in areas where hirola persist currently as well as future reintroduction sites by a combination of research based restoration actions. These restoration actions will not only help to improve habitat but will also have the knock-on benefit of improving local livelihoods.

In order to evaluate local's acceptance levels of potential restoration actions, we conducted a survey in which we administered questionnaires to the locals with several candidate restoration actions to choose from (Ali et al. in review (b)). Findings from the survey showed that the strongest local support was for bush clearing, grass reseeding, fertilization and community-based elephant conservation. In light of these, our programs and through the support of PTES aims at implementing these management interventions in the range. Increasing habitat ranks is one of the highest conservation priorities for hirola (IUCN, 2008) and has the potential to substantially and positively impact on the long-term recovery of hirola.

HISTORICAL AND CURRENT STATUS OF HIROLA CONSERVATION EFFORTS

The Hirola conservation programme is spearheading the restoration and re-establishment of Arawale National Reserve (ANR) which represents most optimal hirola habitat but enthusiasm for it is conservation waned in the 1980s due to financial constraints and lack of community engagement. The reserve which covers an area of 533 km^2 was established in 1973 to conserve the critically endangered hirola antelope and squarely falls under the Garissa County. The support for conservation of the reserve were short lived due to financial constraints, remoteness of the area, and the political turmoil that characterized the vast northern frontier of Kenya in the 1970s and 1980s. Subsequently both the Garissa County and the Kenya Wildlife Service (KWS) failed in the management of ANR by the late 1980s. Following this, the region (and the world) lost the only formally-protected area dedicated to the conservation of hirola. In the following years, the hirola antelope has experienced a 95% population decline and was listed as a Critically Endangered

species in 1996. Until recently, little attention was devoted to conservation efforts for hirola. In 2012, HCP initiated discussions on the restoration and re-establishment of Arawale with the local stakeholders and the Garissa County Government. This latest effort was motivated by the fact that Arawale lies within the center of the hirola geographic range, and therefore plays a pivotal role in the long-term conservation of this iconic species and doubles as a tourist attraction. The hirola conservation programme and Garissa County Government have partnered to reinstate the Arawale reserve and the full operations of the reserve are expected in the next five years.

In 2015 through the support of PTES, the hirola conservation programme initiated a habitat restoration project to enhance the recovery of the hirola antelope. To the extent possible, we are most interested in curtailing the continued decline of hirola in ways that are compatible with livestock production. This is because locals depend solely on livestock production for their livelihoods. As such, this effort is employing manual removal to thin trees and seeding and fertilization to accelerate growth and quality of understory food plants. To start with, we are using four (4), one-ha experimental plots to study conditions necessary for range restoration from which we are demonstrating to Somali pastoralists firsthand success or failures of these efforts. Following these results, we will implement area wide restoration effort through a partnership with Somali pastoralists.

A successful result will constitute: 1) the physical cutting, uprooting or breaking of branches in attempt to restore grassland at scales of hundreds of hectares in prioritized areas within the hirola range, 2) the planting of native grass seeds alongside fertilizer (manure) at scales of hundreds of hectares, 3) community-based protection of elephants (in the form of anti-poaching squads and enhanced communication between villages) to encourage elephant herds to reside on community lands. Elephants are important in the control of tree cover. Our recent resource selection study (Ali et al. under review (a)), revealed that there was over 75% decline in habitat available for hirola; meaning that, this project will tackle degradation issues in an effort to curb population declines of hirola. Along with other conservation efforts, we specifically intend to protect and increase numbers of hirola and elephant through participatory conservation and education. As indicated earlier and following initial experimental plots (i.e., one-ha demonstration plots), we will replicate this effort at larger spatial scales (100s of hectares) through trained volunteer pastoralists. In addition to hirola, we believe that other wild ungulates will benefit from these attempts to improve range.

Figure 3: Local scouts patrolling and protecting hirola from poachers.

Our anti-poaching programme focuses on the conservation of elephants and hirola. Historically, about 5000 elephants and over 100 black rhinos maintained open grasslands for hirola in southeastern Kenya, between the Tana River and the Boni Forest regions. These "mega herbivores" were poached out in the late 1970s and early 1980s with a catastrophic transformation of grasslands to forests leading to massive declines in hirola population.

However, elephants have naturally recolonized this area in 2011 and now eastern Kenya represents one of the very few areas in which elephants currently are expanding to fill their historic range. We suspect that this is due to heightened poaching elsewhere in Kenya (Mose & Western 2015). The Abdallah and Abduwaq Somalis that reside in this region ascribe to hirola a mythical status and consider elephants to symbolize good luck. Consequently, poaching in southeastern Kenya is low relative to other parts of the country, although incursions from outsiders are on the rise. Local Abdallah and Abduwaq communities have expressed strong support for heightened elephant conservation, both to restore elephants themselves, and to restore grassland habitats on which hirola and livestock depend.

To address the poaching problem, we have employed a team of 8 scouts who are dedicated to the protection of elephants and hirola. Further, our scouts are working with other agencies to ensure that all security/poaching incidents in the entire range are monitored collectively between the government and the local groups. These joint effort, creates a collaborative approach to security incidents concerning human-livestock-wildlife interactions.

Figure 4: Our head scout showing various poaching snares recovered from hirola core areas.

Work completed so far:

We have organised 3 desnairing events in Kotile, Bura and Ishaqbini areas that also involved livestock herders in these areas.

The Hirola Conservation Programme has recruited 8 local scouts who in conjunction with the Kenya Wildlife Service (KWS) rangers who frequently patrol the hirola range and man the patrol base we

set up in Mansabubu area (This is the former headquarters of the Arawale National Reserve in the 1970s). We have trained all of our scouts with basic security drills, discipline, first aid and field survival techniques, and radio communications. We also produce a monthly report that we share with the local authorities and the Kenya Wildlife Service.

Remaining and ongoing Work:
In the remaining work, our objective is to recruit 12 local scouts i.e. 4 more scouts away from our initial target. We have already identified reliable and interested individuals who we hope to recruit within the the next few months. Looking forward and contigent on funding, we are hoping to equip our local scouts with 2-way radio transmitters (Motorola RDV 2020) with the dual intent of creating a collaborative approach for both conservation and security. Currently, the scouts rely on sporadic cell phone communication which at times can be frustrating because of the remoteness of this area (network reception is often very poor). Moreover, cell phones are costly in terms of usage.

HIROLA RESEARCH PROGRAMME:
The Hirola Conservation Programme invests and borrows its strength from evidence based conservation that is guided by strong research. Towards this, we carry out numerous analyses using data from the field and other information relevant to our conservation programme. These consist of the following:
#1. Analysis of the demographic drivers of hirola declines: Our work is based on three different populations of hirola exposed to varying levels of predation and range quality. These are:

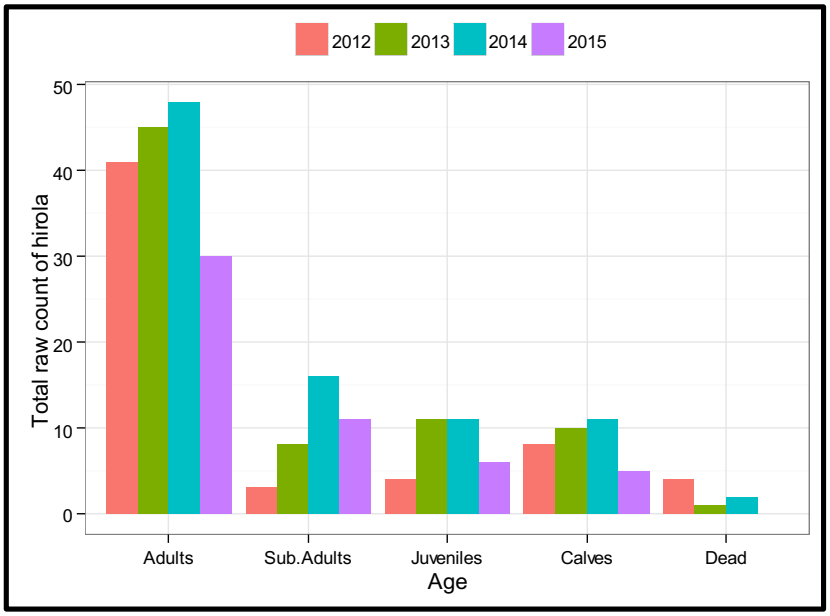

Figure 5: Total raw counts of hirola age groups within the hirola sanctuary.

The New Predator Proof Sanctuary (Scenario 1): This is characterized by low livestock grazing (equating to high range quality) + low predation. In 2012, the Kenya Wildlife Service translocated 48 hirolas from the outskirts of Boni Forest into the predator-proof sanctuary within Ishaqbini. We fixed uniquely-numbered ear tags to hirola individuals to aid in future identification. Animals within this sanctuary are protected from predators and are experiencing high-quality range stemming from the absence of cattle.

Ishaqbini Community Conservancy (Scenario 2):
This site is characterized by low livestock grazing (equating to high range quality range quality) + high predation. The activities involve the identification of individuals with unique marks and horn shapes. Since initiating our work in Ishaqbini, we have identified eight adult individuals that we use to track eight groups of hirola within Ishaqbini. These groups are faithful to particular areas and rarely stray outside the bounds of Ishaqbini, presumably because of high-quality range and heavy presence of livestock and humans in the surrounding buffer zones. Hirola within Ishaqbini but outside the sanctuary will experience the same high-quality range as animals in Scenario 1, but are exposed to lions and other predators.

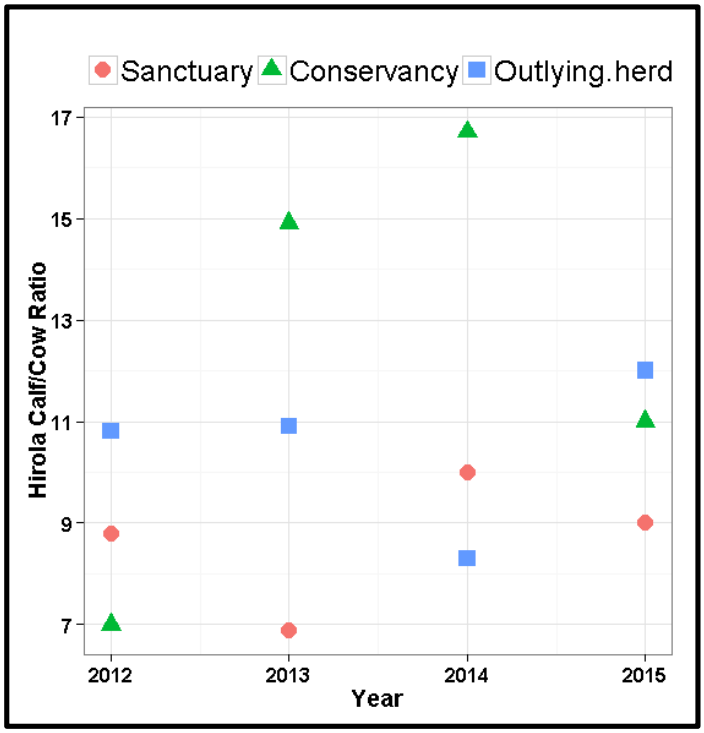

Figure 6: Hirola cow/calf ratios within the three different settings

Outlying areas **(Scenario 3)**:
These areas are characterized by high livestock grazing (equating to low range quality) + low predation; Here we captured hirola from the periphery of this species' geographic range (Arawale, Gababa, Burathagoin areas) and fixed GPS collars on 9 adult (>3 years old) females from 7 different herds to both estimate survival rates of collared individuals and relocate associated herds. We are employing mark-resight and site-resight methods to estimate survival of different age groups in each of the 3 scenarios (Table 1).
We are using these data sets to conduct population viability analyses of hirola herds under each of the three scenarios. Thus, PVA will permit us to quantify the relative impacts of predation and range degradation, allowing to make decisions to maximize the chances of long-term persistence. This report will be ready by the end of 2015

Table 1: Average hirola survival estimates for hirola pouplautions in two of the above settings: sanctuary and outlying herds

Stage class	Sanctuary	Outlying herds
	Average survival probability	**Average survival probability**
Adults	0.98 ± 0.07 SE	0.75 ± 0.06 SE
Sub-Adults	0.97.±0.0.3 SE	0.63 ±0.275 SE
Calves	0.93 ± 0.0.3 SE	0.52 ±0.164 SE

#.2 Analysis of range collapse and resource selection: the role of tree encroachment, elephant extirpation and overgrazing

Through a combination of GPS telemetry, analysis of long-term satellite imagery, and historical survey data, we assessed factors driving historic and contemporary declines of hirola. Our data suggest that hirola geographic range contracted largely due to increase in woody cover and habitat availability for hirola has declined by 75% between 1985 and 2012 (Figure 2). Using conditional logistic regression, we modeled a step selection function (SSF) for hirola (i.e., the probability of selecting a given step as a function of landscape variable). While hirola predator proof was built with the assumption of predation as the main driver of hirola declines, our data strongly suggest that woody cover is the ultimate driver of hirola habitat selection i.e., hirola avoid woody cover all seasons even more so than proximity to people.

Our RSF coefficients from the 6 predictors used in the regression analysis are shown in Figure 7. Hirola avoided woody cover in all the seasons and times (day and night) and this is indicated by the negative relationship with woody cover in all the seasons (Figure 7A). This shows that woody cover in the SSF predicts a higher probability of selection of open grounds (i.e., grasslands) compared to the selection of woody areas. In particular, we found that hirola resource selection was negatively related to distance from the river, road and woody cover during the wet season and also during the day time. In contrast and during the dry season, hirola exhibited the opposite behavior in the selection of areas near villages and livestock and incidentally near roads (Figure 7A). In other words, selection of features reflects risk avoidance at night, along rivers and also near woody cover which ensures more safety. During the day, this pattern of risk evasion could also be explained by avoidance of sunny conditions if the river had more trees. During the night, hirola resource selection conformed to negative coefficients and became apparent with most of the predictors in both the wet and dry seasons. This was evident from the large standard errors indicated in the coefficients relative to those indicated during the day time.

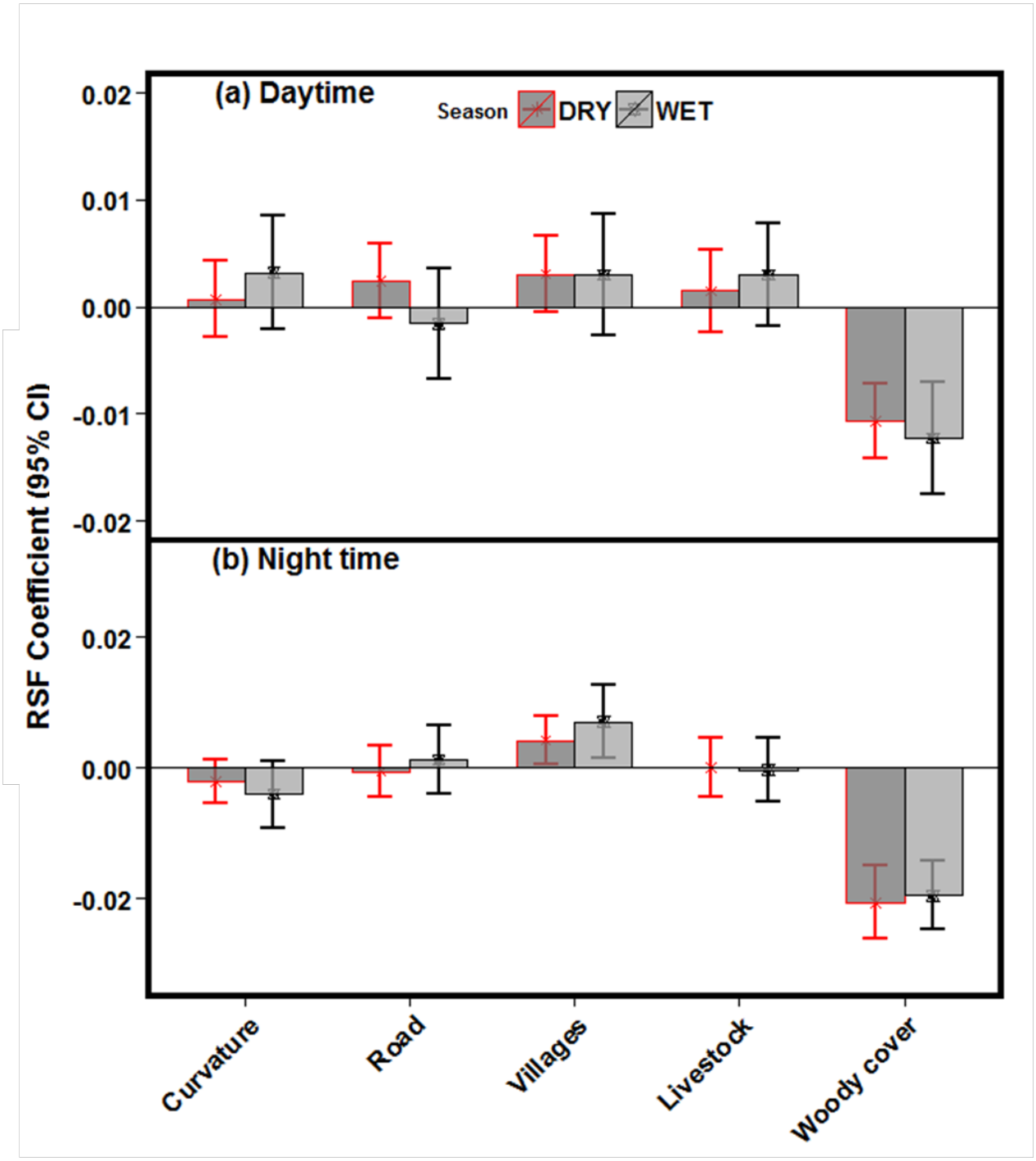

Figure 7: Hirola SSF coefficients for the strength of avoidance of range features in (a) day time (top panel) and (b) night time (bottom panel) from the selection of land cover types for hirola during the dry and wet seasons. Error bars that do not overlap 0 - line represent a statistically significant response.

Table 2 presents summary statistics of the 7 collared hirola females. Two of the individuals had the longest monitoring periods (total of 966 days each) and hence number of relocations (22579 and 22759 relocations respectively). The shortest number of relocations (9246) occurred over a period of 393 days. The average home range size for all the seven individuals combined was higher in the dry seasons (74.4 km^2) than in the wet seasons (40.1 km^2) and was significantly different ($p = 0.003$). The highest home range size was 235.6 km^2 and the smallest was 14 km^2 (Table 2). We found that most of the individual home ranges showed a distinct north-south orientation and were on average 4.2 km wide and 12.1 km long (Table 2).

Table 2: Summary of hirola home range (sizes) and other discriptive statistics

Individual ID	Start date	End date	No. of fixes	No. of days	Home range size (KM^2)	Home range size (KM^2)
					(wet season)	(dry season)
A	20-08-2012	6/4/15	22414	959	16.6 ± 1.6SE	14.0 ±1.57SE
B	20-12-2012	5/4/15	19877	836	26.1 ±2.7SE	27.8 ±2.75SE
C	20-12-2012	6/4/15	19923	837	39.3 ±2.1SE	31.0 ±1.8SE
D	20-08-2012	6/4/15	22592	959	40.0 ±2.7SE	40.4 ±2.7SE
E	20-08-2012	11/9/13	9106	387	65.0 ±2.8SE	38.8 ±2.6SE
F	20-12-2012	6/4/15	19543	837	43.3 ±1.6SE	133.5 ±2.4SE
G	20-12-2012	28/2/15	18302	800	51.0 ±2.75SE	235.6 ±5.4SE

#3: Analysis of acceptance levels of pastoral Somalis towards range restoration:

Tree encroachment is partly responsible for habitat loss and the decline of contemporary hirola populations. Through interviews in local communities across the hirola's current range, we identified socially-acceptable actions for habitat restoration and hirola recovery. We used classification trees, regression trees, conditional inference trees, and generalized linear models to identify social-demographic predictors of support for range-restoration strategies. Locals supported efforts to conserve elephants, seed and fertilizing of grass, and removal of trees, but were opposed to livestock reduction. Locals were ambivalent toward controlled burns and soil ripping. Livestock ownership and years of residency were key predictors of locals' perceptions toward range-restoration practices. Locals owning few livestock were more supportive of elephant conservation and seeding and fertilization of grass, while longer-term residents were more supportive of livestock reduction but were less supportive of elephant conservation. Ultimately, wildlife conservation outside protected areas requires long-term, community-based efforts that are compatible with human livelihoods. We recommend elephant conservation, grass seeding, manual tree removal, and resting range from livestock both to enhance the potential for hirola recovery and to build positive rapport with local communities in the geographic range of this critically-endangered species.

Table 3. Response frequencies to questions on range restoration actions for improving hirola habitat in Ijara and Fafi districts.

	Frequency (%) of responses to restoration questions						
	n = 131						
Response variable	**Livestock reduction**	**Soil ripping**	**Controlled burning**	**Core area resting**	**Seeding and fertilization**	**Manual removal of trees**	**Elephant reintroduction**
1.Strongly disagree	44.3	30.5	43.5	22.1	16.8	2.3	4.6
2. Disagree	16.8	17.6	4.6	13	7.6	5.3	5.3
3. Neutral	1.5	12.9	8.4	8.1	3.1	6.9	3.8
4. Agree	33.6	27.5	30.5	46.6	7.6	68.7	69.5
5.Strongly agree	3.8	11.5	13	10.2	64.9	16.8	16.8
In agreement	37.4	39.0	43.5	56.8	72.5	85.5	86.3
In disagreement	61.1	48.1	48.1	35.1	24.4	7.6	9.9
Neutral	1.5	12.9	8.4	8.1	3.1	6.9	3.8

COMMUNITY EDUCATION AND OUTREACH

Figure 8: Herd of hirola with the hirola sanctuary, Ijara, Kenya.

The HCP works in Ishaqbini Conservancy, Hirola sanctuary and in Arawale National reserve and with the local communities to save hirola. This cannot be achieved without intensive environmental education. As mentioned previously we promote an intensive outreach programme entailing lectures, video shows, and public discussions on hirola conservation. These are supported through educational seminars, village meetings and workshops in the villages within the range.

Accomplishment towards promoting hirola conservation:

Figure 9: Local youths marking the first ever World's hirola Day through football.

Establishment and celebration of the world hirola day: In collaboration with local and international partners, we initiated the world's first Hirola Day to be marked on the 12th of August every year. This date coincides with the world's elephant's day in an effort to connect the two species. HCP has agreed to sponsor this event annually in collaboration with local conservation groups such as Ishaqbini conservancy.

As a starting point of this long-term event, we focused this year on awareness creation, with meetings between local youths culminating in a football match between local clubs hosted by Ishaqbini conservancy (Figure 9). In the coming years we will continue to support this local groups to mark this important event.

The project has recently produced a video which could be accessed through our website. We also produced awareness materials that can also be downloaded directly from our website. We have also uploded few in our PTES Upload link (see category other). Because the entire hirola conservation effort hinges on strong local support and governance, we need to hold several meetings to ensure communities understand their roles so that they can be able to sustain it in the long term. In addition, we use these meetings to disseminate our research findings to local groups and encourage individuals to minimize overstocking triggered by improved range.

Ongoing and remaining Work:
We have been developing a public awareness curriculum. It is currently in initial stages and will be finalized and ready within the next 6 months. This document will provide guidelines that will enable the project to effectively and sytematically inform and create capacity in conservation of hirola in the range region.

OVERALL PROJECT APPRAISAL
The project is on course and well within its schedule. Most of the planned activities have been completed or are ongoing. We frequently share our progress through monthly newsletters which one can subscribe to through our website (www.hirolaconservation.org). Our work still continues to be the major backbone of hirola conservation and research in Kenya.
Most of our work has been featured in numerous international outlets including The Belfast, Telegraph, The Christian Science Monitor, The Express, The Metro, The Sun, and The Wildlife Extra. Our work has also generated similar enthusiasm locally with coverage from the dailies in Kenya including The Nation and The Standard Newspapers (see our website for these articles).
Despite our success so far, insecurity within the North Eastern region of Kenya continues to be our biggest challenge. While this has the potential to interrupt our work, we are closely working with the security officials in the region as a contingency measures.

LONGTERM CONSERVATION EFFORT FOR HIROLA
While past hirola conservation efforts have failed due to limited local involvement and financial constraints, we are determined to change these historical failures into a successful conservation model. We concede that this situation was exacerbated by lack of biological knowledge about the species and the political turmoil along the Kenya-Somalia border. Our programme is unique in the sense that it is promoting evidence based conservation combining both science and grassroots approach to save hirola.

Over the years the hirola range has endured poor land use practices and the intensification of human activities resulting in severe range degradation. Our Program is demystifying these issues through a spirited educational campaign. If not addressed, human activities have a ripple effect to the future of wildlife, locals and their livestock, characteristically through tragedy of the commons. In effort to avert further situational complexity, our project aims to advance management and livelihood practices that foster ecological, cultural and economic sustainability. Thus, with the continued support from PTES and other partners, it is possible (and indeed likely) that we will make real headway toward the conservation of this unique animal. This work addresses major IUCN conservation action plan for the hirola including habitat improvement and adequate protection which are important priorities that need urgent actions. Importantly, and unlike many critically endangered species, we suspect that a modest amount of funding can actually make a substantive impact with respect to hirola populations. This is mainly for two reasons: First, the primary factor responsible for hirola declines—range degradation—is reversible, given local support and financial investment. This is because the fate of hirola is linked to the long-term sustainability of livestock production in this region, which hinges on the fact that both hirola and cattle require open grasslands and also appropriate densities. Because Somali elders have witnessed range degradation through time, they are now eager to implement improvement measures. Second, the Somali clans in this region typically ascribe to hirola a near-mythical status and elephants as a sign of good luck. Thus, locals in this area have both economic and cultural incentives to protect hirola and elephants, providing a legitimate chance against extinction of this unique species. It is our goal that the uniqueness of hirola will continue to be recognized by the community leaders and members in the region, thus strengthening long-term conservation efforts. Integrated long-term and continued hirola conservation effort is necessary because 1) habitat is the ultimate driver of hirola declines, 2) a very small proportion (less than 1%) of the hirola's native range is protected, and 3) the project is a win-win situation for both hirola and locals. Thus our programme, is building capacity for wildlife conservation in this ecologically important but also highly threatened region of Africa.

Figure 10: Hirola and gerenuk within Arawale National Reserve.

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