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Original Investigation

Local spotted hyena abundance and community tolerance of depredation in human-dominated landscapes in Northern Ethiopia

Gidey Yirga[a,*], Ekwal Imam[a], Hans H. De Iongh[b,c], Herwig Leirs[c,d], Solomon Kiros[a], Tesfamichael G. Yohannes[e], Mekonen Teferi[a], Hans Bauer[f]

[a] Department of Biology, Mekelle University, PO Box 231, Mekelle, Ethiopia
[b] Institute of Environmental Sciences, Leiden University, PO Box 9518, Leiden, The Netherlands
[c] Evolutionary Ecology Group, University of Antwerp, Groenenborgerlaan 171, 2020 Antwerp, Belgium
[d] Aarhus University, Department of Agro-ecology, Denmark
[e] Department of Earth Sciences, Mekelle University, PO Box 231, Mekelle, Ethiopia
[f] Wildlife Conservation Research Unit, Zoology, Recanati-Kaplan Centre, University of Oxford, Tubney House, Tubney OX13 5QL, UK

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ABSTRACT

The generally accepted wisdom that large carnivores cannot survive in human dominated landscapes does not hold true in Ethiopia. The present work reports on spotted hyena abundance and distribution in and around three National Forest Priority Areas in Tigray, northern Ethiopia. Calling stations were used to assess spotted hyena abundance and distribution in and outside the protected areas. We assessed human tolerance towards predators and factors responsible for livestock loss. The response outside the forest was significantly higher. Predators, disease and theft were the factors responsible for livestock loss. The presence of a guard, the construction of an enclosure and the presence of dogs were used to mitigate livestock depredation. The majority of the respondents had a positive attitude towards predator conservation. Our data suggest that spotted hyenas in our study area are more abundant and widely distributed in human-dominated landscapes than in natural forest areas, probably because of better scavenging opportunities from human waste and livestock.

Introduction

Large carnivores including spotted hyena (*Crocuta crocuta* hereafter called hyena) are declining worldwide as a result of habitat loss and retaliatory killing (Kolowski, 2007). Habitat fragmentation (Woodroffe and Ginsberg, 2000), large home range and conflict with local communities make carnivores highly vulnerable to extinction (Sunquist and Sunquist, 2001). Large carnivores survive with difficulty in human-altered habitats (Kolowski, 2007) and coexistence between large carnivores like lion (*Panthera leo*), cheetah (*Acinonyx jubatus*), hyena and painted dog (*Lycaon pictus*) and local communities are problematic (Woodroffe and Ginsberg, 2000). This is because carnivores need extensive areas usually with few people and sufficient prey (Lindsey et al., 2013). The general accepted wisdom that large carnivores may not survive in human dominated landscapes does not hold in Ethiopia, as was suggested by Yirga et al. (2013).

Hyenas remarkably coexist with people in northern Ethiopia; the cost to people is marginal and tolerable (Yirga et al., 2013). Their catholic diet has allowed them to maintain a secure status too (Hayward and Kerley, 2008). Hyenas are opportunistic predators (Hayward, 2006) and do not have clear dietary preferences (Cooper, 1990; Gasaway et al., 1991; Hayward, 2006). They are able to change between scavenging and hunting as the opportunity arises (Cooper et al., 1999; Yirga et al., 2012a).

Predation on livestock by large carnivores have been found to affect perceptions of local people (Zimmermann et al., 2005; Baral and Henien, 2007; Dar et al., 2009) or not (Conforti and De Azevedo, 2003). People who experienced attacks on livestock are less positive towards carnivores (Røskaft et al., 2007) and are against the increase of carnivore populations (Kissui, 2008; Hazzah et al., 2009). Predation on livestock creates a negative attitude and leads to retaliatory killing of carnivores (Kolowski and Holekamp, 2006; Holmern et al., 2007). As level of stock loss increases tolerance by local people decreases and this intensifies human–carnivore conflict (Dickman, 2008; Sogbohossou et al., 2011).

Hyenas in northern Ethiopia survive partly through livestock depredation but much more importantly through scavenging on human organic waste (Abay et al., 2011; Yirga et al., 2013).

* Corresponding author. Tel.: +251 914750373; fax: +251 0344410969.
E-mail address: gidey.yirga@yahoo.com (G. Yirga).

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Therefore, anthropogenic food sources are of major nutritive importance for hyenas in Ethiopia; natural prey biomass is highly depleted. We hypothesize that hyenas are more abundant and widely distributed in human-dominated landscapes than natural forest areas, because of better scavenging opportunities from human waste and livestock. Our previous work focused on rural degraded landscapes about 150 km away from the present study areas (Abay et al., 2011; Yirga et al., 2012a,b, 2013); here we contrast that with the only available forest area with some degree of protection. This paper aims to investigate hyena abundance and distribution in and around three National Forest Priority Areas (NFPA) of Tigray, in northern Ethiopia and on human tolerance towards predators and the factors responsible for livestock loss in the areas.

Study area

The study was conducted in and around three National Forest Priority Areas of Tigray regional state of Ethiopia (Fig. 1).

Hugumburda and Grat-Kahsu forest priority areas

Hugumburda and Grat-Kahsu are two contiguous forests located between 39°34.00′ East 12°32.00′ North and the elevation ranges between 1600 and 2600 m a.s.l. (Bird Life International, 2013). It consists of about 40,000 ha and represents the only significant expanse of dry coniferous forest in the region (Bird Life International, 2013). In this dry coniferous forest, *Juniperus procera*, *Olea europaea*, *Podocarpus falcatus*, *Millettia ferruginea*, *Croton macrostachyus*, *Celtis africana*, *Ekebergia capensis*, *Prunus africana*, *Cordia africana* and *Ficus* spp. are common (Bird Life International, 2013).

Desa'a forest priority area

This is located in a semiarid environment (13°36′–13°56′ N and 39°48′–39°51′ E) and altitude ranges between 1400 and 2720 m a.s.l. (Aynekulu et al., 2011). The mean annual rainfall is 532 mm (Abegaz, 2005) and consists of about 20,000 ha (Bird Life International, 2013). This is dry single-dominant Afromontane forest within the forest classification of northeast tropical Africa (Friis, 1992). The dominant species *Juniperus procera* and *Olea europaea* are drought-tolerant species (Cuneo and Leishman, 2006; Breshears et al., 2009). Desa'a forest is an important bird area (Ermias et al., 2012) and an important habitat for *Dracaena ombet* which is listed as Endangered by the IUCN (1998).

Desa'a, Hugumburda and Grat-Kahsu are under anthropogenic pressure from degradation of habitat due to a variety of impacts and deforestation for fire wood, charcoal, construction material and others. Local people make extensive use of any easily accessible areas of forest to satisfy their needs. Hyenas, leopard, and jackal exist in these forest areas. No study of prey species composition has been carried out and hence data on prey are not available.

Methods

Hyena abundance and distribution

Calling stations were used to assess hyena abundance and distribution in July–August 2012, following Mills et al. (2001). Hyena sounds and gnu (*Connochaetes gnou*)-hyena distress were played at full volume on an MP3 player connected to a megaphone (Monacor 45) mounted onto the roof of a vehicle. Each callup consisted of two cycles of 20 min broadcast and 10 min silence and the speaker was rotated 90° after 5 min broadcast. A call-up survey is inexpensive and an effective technique for counting hyenas and lions (Ogutu and Dublin, 1998; Mills et al., 2001; Bauer, 2007) and jackal (Maddox, 2003; Giannatos et al., 2005). Calling stations were located along the roads and GPS coordinates of locations were recorded. Responding hyenas were counted in the dark, based on sounds and eye reflections from torches. Calling stations were at least 6 km apart in order to avoid double counting of hyenas.

Collection of conflict data and human perception of predators

Interviews are widely used to investigate conflict and perception of people to predators (Marino, 2003; Sogbohossou et al., 2011). In September 2012 we trained six extension workers, two from each of the study sites, to complete a structured survey with a six page questionnaire. The time of day of each attack, the carnivore species involved, mitigation techniques used, the species and number of all livestock killed, location, season, human attack and time of livestock depredation over a period September 2007 to September 2012 were recorded. A total of 387 household heads who were living in and nearby Grat-Kahsu ($n = 121$), Hugumburda ($n = 126$) and Desa'a ($n = 140$) were interviewed. Community perceptions were also collected and questions were measured using the Likert scale on a 5-point scale ranging from "strongly disagree" to "strongly agree" (St John et al., 2011).

Data analyses

All statistical tests were performed using JMP-5 statistical package. We used non-parametric Van der Waerden test to test the observed frequency of hyena distribution and abundance inside and outside NFPAS (Van der Waerden, 1952). We used non-parametric Wilcoxon test to compare depredation between wet season (June–September) versus dry season (October–May). Spearman's correlation was used to examine the relationship between depredation versus the stock number. Chi-square test was used to test proportions of livestock kills by hyena, leopard and jackal over the years and livestock depredation between wet and dry season.

Results

Hyena abundance and distribution

A total of 49 hyenas responded to 17 playbacks. Twelve playbacks were performed in the natural sites and 3 hyenas encountered. A total of 5 playbacks were performed in the human dominated site, 46 hyenas responded. This was 15 times higher than in the natural sites, a statistically significant difference ($\chi^2 = 16$, d.f. = 1, $P < 0.001$, $n = 17$). The mean number of hyenas responding per station outside was approximately 10.

Livestock loss caused by predators, disease and theft

About 42% of local people interviewed experienced livestock depredation at least once. No attacks on humans by carnivores were recorded or reported. Approximately 2% and 17% of the local people experienced livestock loss attributed to theft and disease, respectively. Compared with disease, the impact of depredation was approximately two times higher for cattle, goats and sheep (Fig. 2).

A total of 518 attack events were reported on cattle, goats, sheep, donkeys, poultry, dogs, horses, camels and cats over a period September 2007 to September 2012 by hyena (63.3%, $n = 328$), leopard (24.3%, $n = 126$) and jackal (12.4%, $n = 64$) (Table 1). Leopard and hyena were the main predators on domestic dogs. There was a non-significant relationship between depredation versus the stock number across species ($r = 0.5$, $n = 9$).