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Article in *European Journal of Wildlife Research* · January 2021

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Shrinking striped hyena (*Hyaena hyaena* Linnaeus, 1758) distribution in Nepal

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Received: 25 July 2019 / Revised: 1 November 2020 / Accepted: 5 November 2020
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Abstract

The striped hyena (*Hyaena hyaena*) is one of the largest carnivores within forest and grassland ecosystems across Africa and Asia and is currently threatened throughout its range. In this short report, we studied hyena presence between 1995 and 2018 in Nepal, via literature and field questionnaire surveys. Our results indicate that hyena distribution has significantly decreased in recent years, especially in areas outside National Parks, and is currently confined to the lowlands and hill areas of western and central Nepal. Although hyenas within National Parks have been least affected, the remaining population outside protected areas would be challenging for future conservation, without the implementation of a focused action plan incorporating community-based approaches.

Keywords Conservation · Distribution · Habitat · Hyena · Nepal

Introduction

The striped hyena (*Hyaena hyaena*) is a solitary and nocturnal large carnivore, playing a significant role in the forest and grassland ecosystems across Africa and Asia (Kruuk 1976; Rieger 1979; Hofer and Mills 1998a; Frembgen 1998). Currently, the species is found in northern and eastern Africa, the Arabian Peninsula, and western and southern Asia (Kruuk 1976; Hofer and Mills 1998a, b; Kasperek et al. 2004; Abi-Said and Abi-Said 2007; Khorozyan et al. 2011; Alam et al. 2015; Bhandari et al. 2015). In the Indian subcontinent, and more particularly in Nepal, hyenas are confined to

the tropical and subtropical zone, in the National Parks of Parsa, Chitwan, Banke, Bardia, and Suklaphanta, and adjacent areas (Hofer and Mills 1998a; Jnawali et al. 2011; Bhandari and Chalise 2016). Despite this relatively large area, Nepal hosts less than 100 individuals, as estimated by direct observations, sign surveys, and questionnaires (Hofer and Mills 1998b; Jnawali et al. 2011; Bhandari et al. 2020).

As in most carnivores, this restricted hyena population faces considerable habitat dwindling, mainly because of constant urban expansion. This results in increased use of human-dominated landscapes with some serious consequences regarding its conservation. As natural habitats are declining along with wild prey species, anthropogenic habitats may provide predictable resources and shelter, attracting such predators (Singh et al. 2010; Singh et al. 2014). Consequently, this increases human-carnivore conflict, resulting in direct threats to humans, livestock, and wildlife (Kasperek et al. 2004; Tourani et al. 2012; Srivastha et al. 2019; Bhandari et al. 2020). Increased use of human-dominated habitats by hyenas has been already recorded in Asia, and is directly or indirectly affecting their range and population numbers (Tourani et al. 2012; Singh et al. 2014; Alam et al. 2015). In this regard, poisoned baits, retaliatory killing for livestock depredation, collection of precious organs for local medicine, and vehicle collisions are main causes that account for the dwindling hyena populations across its range (Hofer and Mills 1998b; Kuhn 2005; Tourani et al. 2012).

This article is part of the Topical Collection on Road Ecology
Guest Editor: Marcello D'Amico

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These threats also affect hyena population and range in Nepal (Jnawali et al. 2011; Bhandari and Chalise 2016; Bhandari et al. 2020) but there is no existing information about the extent of range decline in the country. Considering this, the present study explores the current and past distribution of striped hyenas in Nepal via literature and interview-based surveys. Similar information, especially when combined with in situ ecological information, is a valuable tool for understanding the effects of human-hyena conflict in order to design and implement a focused and concrete action plan for the conservation of the species in Nepal.

Methods

For the purposes of the current study, we used a two fold approach: (a) analysis of published information and (b) field questionnaires. Firstly, we analyzed all available published information (journal articles, technical reports, books, and newspapers) between 1995 and 2018. All evidence regarding date, location, and context of hyena presence were meticulously documented resulting in a total of 78 relevant records. These data were combined with field questionnaires regarding the presence/absence of the species. Interviews were carried out between 2010 and 2018 in 34 districts of the lowland and mid-hill areas of Nepal, covering more than half of the country's area. The habitat of these surveyed lowland and mid-hill areas of Nepal consisted of sal (*Shorea robusta*) forest, tropical deciduous riverine forest (i.e., *Acacia catechu*, *Dalbergia sissoo*), and tropical evergreen forest (i.e., *Michelia champaca*, *Litsea polyantha*). The questionnaire survey was almost equally distributed into the three geographical regions (West, Central, and Eastern Nepal) and proportionately inside and outside National Parks. In the concerned areas, local interviewees were selected so as to (i) live in the proximity of forests and national parks and completely depend on forest products and livestock, (ii) be > 40 years old in order to cover data since 1995, and (iii) be separated by distances > 6 km, to guarantee increased spatial coverage and independence. Forest using people represented 5% of total households in the sampled areas. The interviewees were shown hyena photographs to ensure correct identification of the species and confirmation in their locality. We interviewed 65–81 people each year, resulting in a total of 650 people (western region: 220; central region: 225; eastern region: 205, and National Parks: 204; outside National Parks: 446) at the end of the survey. For our study, we considered two periods: 1995–2005 (past) and 2006–2018 (current). Presence and absence localities were considered independent observations to account for hyena distribution in Nepal. We also used the exponential growth model (McConnell and Abel 2013) to assess range change: $r = (1/t) \ln (N_t/N_0)$ where t is the time period, N_0 is the initial, and N_t is the final range of hyena.

Areas of initial and final range were estimated based on hyena's home range (i.e., 72 km² (Kruuk 1976)) and presence locations. Values of $r < 0$ indicate shrinking habitat and values of $r > 0$ indicate increasing habitat. All spatial data were input in QGIS (v. 3.0) to create a past and current distribution map of hyenas in Nepal.

Results

Based on our literature and interview survey, we identified 43 (literature: 7.6% (6/78); interviews: 5.6% (37/650)) past (1995–2005) and only 22 (literature: 10.2% (8/78); interviews: 2.1% (14/650)) current (2006–2018) locations of hyena presence, indicating a decline of 51.1% (Fig. 1). This decline was more severe outside National Parks (61.7% (21 current/34 past locations)), than inside National Parks (11.1% (1 current/9 past locations)) (Fig. 1). The exponential growth model showed a clear range reduction ($r = -1.5$), from a range area of approximately 5974 km² in 1995 to 4174 km² in 2018.

Past and present hyena distribution was significantly different ($\chi^2 = 7.82$, d.f. = 2, $p < 0.05$). Currently, hyenas are limited to few isolated pockets in the western (27.6–29.1° N; 80.0–83.1° E) and central regions (26.7–27.6° N; 83.5–85.9° E) of Nepal. We did not find any evidence of hyenas in the eastern region (26.7–27.0° N; 86.0–88.0° E) after 2005, although the species was found there before (1995–2005) (Fig. 1). These locations overlap with the ranges reported in previous studies (Hofer and Mills 1998a; Jnawali et al. 2011). In the western part of the country, hyenas are mainly restricted in National Parks (Suklaphanta, Bardia, and Banke), and a few adjacent areas. Similarly, Chitwan and Parsa National Parks and nearby areas also host most of hyena current presence locations in the central region (60% of presence locations; see also Jnawali et al. 2011). In fact, National Parks in Nepal host 40.9% (9/22) of current locations.

Discussion

Large carnivores, such as hyenas, play an important ecological role in tropical and subtropical forest and grassland environments (Rieger 1981; Frembgen 1998; Wagner 2006). However, anthropogenic pressure associated with declining suitable habitat and available prey species has led to human-hyena conflict, declining hyena numbers, and modification of hyena habitat use (Bhandari et al. 2019; Srivastha et al. 2019; Bhandari et al. 2020). The current study—the first of its kind in Nepal—suggests that hyena distribution in Nepal has dwindled to less than half between 1995 and 2018. Such drastic decline within a short period is certainly challenging for designing and implementing concrete conservation actions.

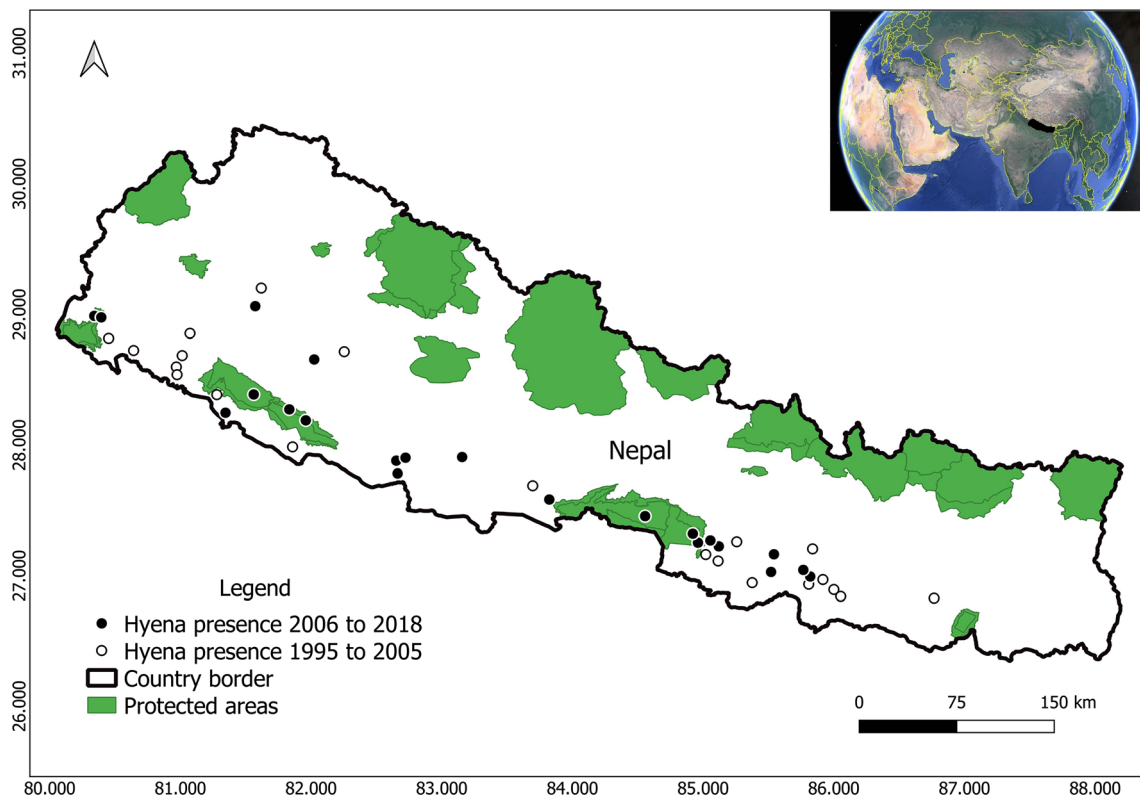


Fig. 1 Past (1995–2005) and current (2006–2018) distribution of striped hyenas in Nepal

Hyenas are indicators of healthy tropical and subtropical forest and grassland environments (Hofer and Mills 1998a, b; Wagner 2006). Unfortunately, most tropical habitats in Nepal are facing multiple anthropogenic threats such as deforestation, construction of developmental infrastructures, and expansion of farming and livestock activities. These threats contribute to habitat reduction, degradation and fragmentation, and decrease in available prey populations, resulting in declining hyena numbers. In this way, hyenas tend to be confined to protected and hilly areas, characterized by open semi-arid, arid habitats, and dry forests (Wagner 2006; Alam et al. 2015). Current presence localities appear to corroborate this, as most positive observations are found in the mid-hill area (Churia forests; altitude around 300 m). This type of habitat is considered very favorable for many ungulates and small mammals which compose the main prey species for hyena (Qarqaz et al. 2004; Kuhn 2005). Furthermore, similar rugged habitats are also suitable for shelter, enabling hyenas to select for larger caves and dens (Rieger 1979; Leakey et al. 1999) and can therefore sustain higher hyena densities.

Another significant finding of our survey is the drastic reduction of hyena distribution outside National Parks, whereas presence inside the parks changed only slightly. In Nepal, the species is protected under the National Park and Wildlife Conservation Act of 1973. Although this act may be efficient within National Parks, hyena conservation outside these protected areas remains a challenge, as most of these habitats are characterized by increased human activities. This is even

more crucial when considering that the majority of hyena presence (~60%) is found outside National Parks. Increased use of human-dominated environments may result in higher carnivore-human conflict (Srivastha et al. 2019; Bhandari et al. 2020). In the case of hyenas, this may have severe impact on its populations: poisoned baits, retaliatory killings for livestock depredation, collection of precious organs for local medicine, and vehicle collisions are among the major threats that account for the dwindling hyena populations across its range (Singh et al. 2010; Tourani et al. 2012; Singh et al. 2014; Alam et al. 2015). However, their persistence in such human-dominated habitats may be a positive indication, perhaps suggesting they may be more tolerant to anthropogenic pressures than other species. Nevertheless, caution is required as direct action is needed for the maintenance of this remaining population. In this direction, a better compensatory system for livestock loss to local households and strengthening of the community forest management program (in direct collaboration with local people) could be crucial for hyena conservation. Considering this, concrete conservation and management plans by the government body and non-profit organization should take this into account in order to implement viable and focused targets, involving community-based approaches.

Acknowledgments We thank B. Gautam, B. Thapa, and S. Bishwakarma for the field assistance. We are grateful to the anonymous reviewers for their constructive comments that largely improved this short communication.

Funding This study received funding from Rufford Foundation, Idea Wild, and KACF.

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