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Seasonal herding practices influence predation on domestic stock by African lions along a protected area boundary

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ABSTRACT

Livestock depredation frequently results in retaliatory killing of carnivores by people. An understanding of the ecological and sociological factors that precipitate this conflict is essential to mitigation. We investigated the seasonality of lion (*Panthera leo*) depredation incidents in relation to cattle (*Bos primigenius*) herding patterns in Tsholotsho Communal Land and Ngamo Forest adjacent to Hwange National Park, Zimbabwe. Cattle from 14 villages along the protected area (PA) boundaries were fitted with GPS data loggers (2010–2012), and depredation incidents systematically recorded (2008–2012). More cattle were killed by lions during the wet season (October to May) than during the dry months (June to September). In the wetter months, corresponding to the growing season and the need to protect crops, cattle were herded further from their home enclosures, closer to PA boundaries and into more wooded habitats. By contrast, cattle remained closer to home, further from PAs and were left to graze in fallow fields close to villages in the dry months. Seasonal use of wooded areas distant to villages and close to PA boundaries during the growing season increases vulnerability of cattle to lion depredation. In the dry months, cattle grazing close to villages benefit from the close proximity of people, resulting in a lower incidence of depredation. Approaches to mitigate livestock depredation should focus on improving herd protection during the wet season when cattle graze far from villages. Strategies such as communal herding, more intensive livestock guarding and, where possible, avoidance of heavily wooded habitats close to PAs should be encouraged.

1. Introduction

Most large carnivore populations across the globe are declining (Inskip and Zimmermann, 2009). Habitat loss and fragmentation, conflict with humans and prey depletion are all major threats (Macdonald et al., 2010). As a result of contemporary human population growth, large carnivores are becoming increasingly threatened by these pressures (Cardillo et al., 2004). An understanding of each of these threats is therefore critical to the development of effective carnivore conservation strategies.

The extensive home ranges of large carnivores and their diet predisposes them to competition with humans (Treves and Karanth, 2003) and conflicts between people and wild carnivores are a global phenomenon and typically involve predators taking livestock as prey (Inskip and Zimmermann, 2009). In retaliation, livestock owners often persecute (e.g. shoot, poison, snare etc.) suspected problem animals (Woodroffe and Frank, 2005), such that conflict at protected area boundaries has been cited as a significant cause of mortality in large carnivore populations in protected areas (Woodroffe and Ginsberg, 1998). Human encroachment into wild predator habitat, the dispersal of predators into human-dominated habitat and a high ratio of domestic to wild ungulate species all serve to elevate the intensity of conflict. In areas where depredation is perceived to adversely affect human livelihoods, lethal retaliation has the potential to impact the viability of predator populations (Loveridge et al., 2010b).

The African lion *Panthera leo* now occupies 8% of its historic range and between 20,000 and 30,000 remain on the African continent, compared to an estimated 100,000 lions 40 years ago (IUCN-SSC, 2006; Bauer et al., 2015). Conflict with humans over livestock is widely perceived to have played a substantial role in this decline (Woodroffe and Ginsberg, 1998; Frank et al., 2006). Along the edge of Zimbabwe's Hwange National Park (HNP), the depredation of livestock by lions leads to frequent, lethal retaliation by livestock owners amounting to 22% of recorded mortalities (n = 181, 1999–2013). This, along with sport hunting, is the most significant source of mortality for this population (Loveridge et al., 2010a).

Reducing livestock losses to lions is likely to lead to increased tolerance of predators and reduced retaliatory killing of lions. Therefore, understanding the factors contributing to high rates of livestock depredation is crucial. Previous studies suggest that the availability of

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wild prey to lions and the accessibility of domestic stock are important factors in determining depredation rates (Woodroffe and Frank, 2005; Valeix et al., 2012). In this study we investigated how cattle herding patterns influence vulnerability to lion depredation in Tsholotsho Communal Land adjacent to HNP. We hypothesized that variation in landscape-scale cattle herding patterns over the year is likely to affect the accessibility of cattle to lions thereby contributing to variations in vulnerability and therefore the incidence of depredation.

2. Materials and methods

2.1. Study area

The study area spanned a 25 km buffer along the south-eastern border of HNP between the latitudes of 19°0′S and 19°30′S, constituting an area of 2930 km^2 (Fig. 1). This area, part of Tsholotsho Communal Land, encompasses 3940 rural homesteads across 87 villages (Fig. 1). An informal buffer zone, between 1.5 and 8.5 km wide, free of settlement, but used for grazing and resource extraction, is recognised along the HNP boundary. The region is characterized by low-fertility soils (Kalahari sands) and experiences low and erratic rainfall, with an annual average of 600 mm and an inter-annual CV of 25%. Rain falls primarily between November and March. Subsistence agro-pastoral farming practices predominate. Livestock husbandry in Zimbabwe forms an integral part of local culture and cattle are used for the production of milk and beef, and for ploughing and bartering (Hall, 1986). Seasonal crop growing (mainly maize *Zea mays*, but also sorghum *Sorghum bicolor*, millet *Pennisetum glaucum* and legumes Fabaceae) forms another essential component of subsistence livelihoods in the area. Traditionally, cattle graze during the day in designated grazing areas in the vicinity of villages and are brought back to the village in the evening. Cattle are not generally supervised or guarded whilst in grazing during the day (pers. obs.). Each village household usually has a protective enclosure (boma), constructed as a stockade of timber poles and brush wood, in which livestock are kept at night.

Ecological and agro-pastoral seasons were defined as follows and used to interpret results. (1) Ecological seasons: the wet season (November to April), and the dry season (May to October). (2) Agro-pastoral seasons: the early growing season (October to January), the late growing season (February to May) and the post-harvest season (June to September). In practice, the crop growing season (early and late growing and harvest seasons) largely coincides with the wet season.

Large predators present in the system included lions, spotted hyenas (*Crocuta crocuta*), cheetahs (*Acinonyx jubatus*) and leopards (*Panthera pardus*). Lion, hyena and leopard occurred in the protected area immediately adjacent to the study area at densities of 4.5/100 km^2, 9.0/100 km^2 and 1.46/100 km^2 respectively, (Periquet, 2014, Loveridge unpublished data). Cheetahs are rare in the ecosystem (pers. obs.). Predator populations were resident within the protected area with no evidence for resident populations in surrounding communal land (pers. obs.).

2.2. Collaring of cattle

Of 56 focal villages regularly surveyed for human–wildlife conflict incidents, 15 were randomly selected for the deployment of GPS datalogger collars (African Wildlife Tracking, Rietondale, Pretoria, South Africa). In each village, a herd of cattle was selected and a single adult female was fitted with a logger. Loggers were checked periodically to ensure they were functioning and there were no adverse effects on the study animal. Herd owners were paid a nominal fee of US$50 for participating in the study. Each collared cow represented the movements of a herd of 25.9 ± 15.9 (mean ± SD) cattle. One logger failed to collect data. Loggers were programmed to take a GPS fix every hour and were fitted to cattle for periods ranging from 15 to 20 months between April 2010 and January 2012 (516 ± 112 days fitted, mean ± SD).

2.3. Lion depredation incidents

Between 2008 and 2012, comprehensive monitoring of livestock losses to large carnivores was carried out in Tsholotsho. Field research

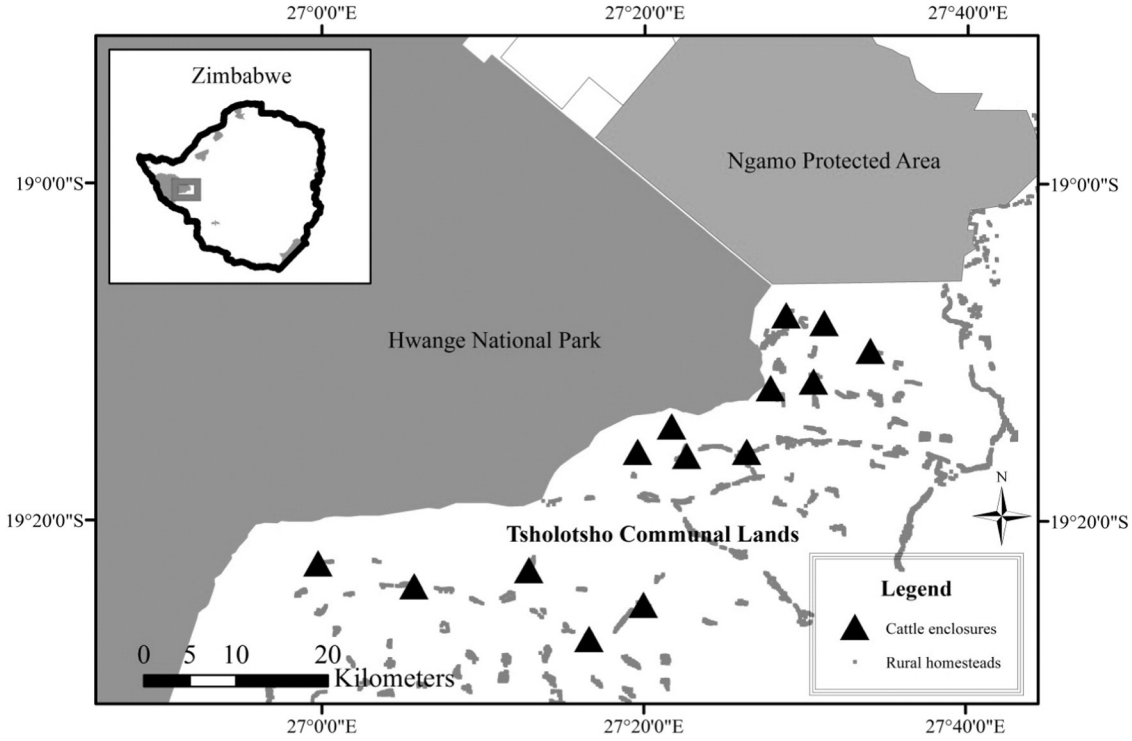

Fig. 1. The Tsholotsho study area, showing the positions of cattle enclosures in the villages at which cattle GPS collars were deployed (one collared cow per village). Rural homesteads mapped from satellite imagery are also shown (Google Earth 2013).