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Managing success: Asiatic lion conservation, interface problems and peoples' perceptions in the Gir Protected Area

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ABSTRACT

The last population of free-ranging Asiatic lion (*Panthera leo persica*) has been steadily increasing in response to successful conservation initiatives spanning five decades. With the increasing population size, lions have expanded their range and move throughout the Greater Gir Landscape in Western India. Of concern to conservation and management is human-lion interaction outside the Gir Protected Area (GPA). The landscape surrounding the GPA includes agro-pastoral villages with large human communities and vast numbers of livestock. We assessed spatiotemporal patterns of lion depredation of livestock, via analysis of the Gujarat State Forest Department monetary compensation records, and human perceptions of forested habitat, lion conservation and wildlife damage mitigation, via interview surveys. We discovered that the number and severity of livestock depredations has increased over time despite a stable lion population in the GPA. Our spatial regression model identified that over a 10-year period, lion depredation tended to increase ($\beta = -0.10$, $P < .0001$) in villages near GPA, though the spatial configuration of depredations was patchy. We discuss that these hot spots of depredation are associated with movement paths of dispersing lions out of GPA. From the interview surveys we found that human livelihood dependency on forest was minimal, while economic losses associated with crop-raiding wild herbivores and livestock-depredation by lions were higher. Currently, the agro-pastoral economy, land-use and cultural tolerance appear conducive to lion survival in the GPA region. However, for lion conservation to continue to succeed in the Greater Gir Landscape, conflict mitigation and the continued promotion of positive public perceptions of lion is imperative.

1. Introduction

Large carnivores typically have extensive ranges, live at low densities often in isolated or fragmented populations and are sensitive to stochastic changes causing perturbation in demography and genetics (Macdonald and Sillero-Zubiri, 2002). Carnivore population viability is further threatened by agonistic interaction with humans in the borderlands surrounding protected areas (Loveridge et al., 2010; Woodroffe and Ginsberg, 1998). Concerns for human safety and livestock depredations render large carnivores vulnerable to retaliatory killing (Ogada et al., 2003; Sillero-Zubiri and Laurenson, 2001; Woodroffe and Frank, 2005). Thus, human-carnivore conflict along the borders of protected areas is a serious problem for both wildlife conservation and human livelihood (Woodroffe and Ginsberg, 1998; Macdonald et al., 2010). The magnitude of this threat depends on the availability of wild prey for carnivores, the land-use practices outside protected areas, human perception of carnivores and the extent of damage to human resource and safety (Chardonnet et al., 2010; Macdonald and Sillero-Zubiri, 2002). Resolving human-carnivore conflict is a global concern and is particularly relevant for endangered and isolated carnivore species (Shivik, 2006; Treves et al., 2006, 2009; Macdonald et al., 2013).

These problems afflict the only remaining population of free-ranging Asiatic lion (*Panthera leo persica*) inhabiting the Greater Gir Landscape (GGL) in the Gujarat State, India (Fig. 1). Conservation efforts spanning nearly five decades have resulted in a revival of this population (Meena, 2010; Singh, 1997) shifting the Asiatic lion's conservation status from Critically Endangered to Endangered (Breitenmoser et al., 2008). With this expanding lion population, there is an increased potential for human–lion interaction as lions disperse and use habitat in an agro-pastoral landscape matrix

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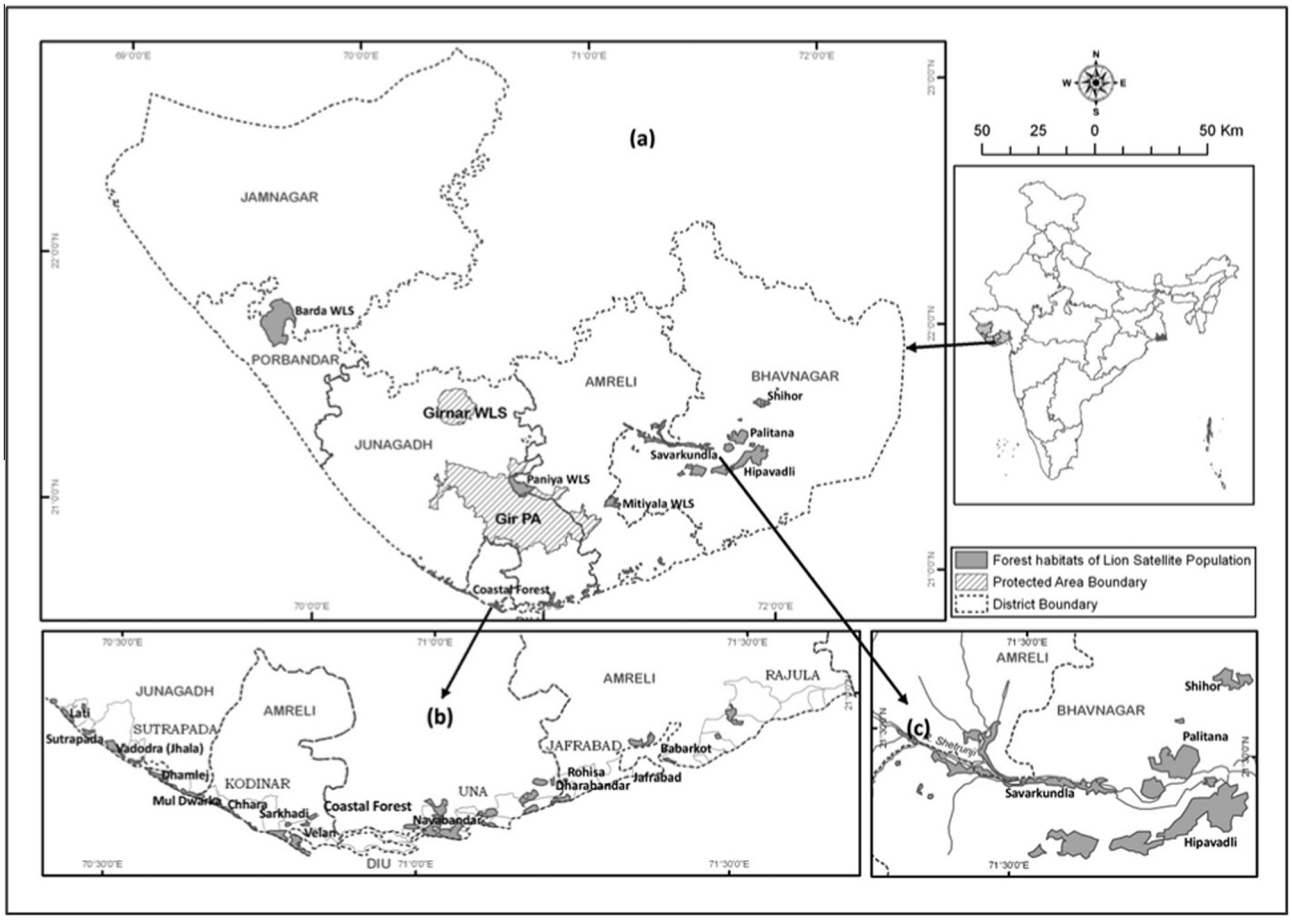

Fig. 1. Location of the Greater Gir Landscape in the Saurashtra peninsula, Gujarat, India. Panel (a) depicts the Gir Protected Area extending across Amreli and Junagadh districts, Panel (b) shows the Coastal Forests, and Panel (c) displays the eastern habitat in the Bhavanagar district.

(Meena, 2010; Singh, 1997). Habitats in which lions have recently expanded their range are interspersed amongst densely populated human villages (Meena, 2010). People living in these villages regularly encounter lions, magnifying concerns about human safety and economic loss via livestock depredations, both of which have grave implications for the survival of lions in this ecosystem (Meena, 2012).

Here we examine the spatial distribution of lion depredations of livestock in the region surrounding the Gir Protected Area (GPA) which has a high density of agro-pastoral villages. We used spatial pattern analysis to assess whether lion depredation of livestock was significantly clustered in environmental space. Further, we conducted interviews to evaluate local attitudes towards wildlife habitat, lion conservation, wildlife damage assessment and mitigation measures. This analysis is designed to depict the problems faced by people living alongside Asiatic lions, and their attitudes towards them so as to offer insights for mitigation and further conservation measures.

2. Methods

2.1. Study area

We conducted this study in 5 talukas (sub-districts) bordering the Gir Wildlife Sanctuary and National Park (referred to as the GPA hereafter). This system is characterized by semi-arid climate and tropical dry deciduous forests and is situated in the southern part of the Kathiawar or Saurashtra peninsula, in the state of Gujarat in western India (20° 57′ and 21° 20′ N latitude and 70° 27′ to 71° 13′ E longitude; Fig. 1a). The present range of the Asiatic lion includes 4 distinct lion sub-populations in GGL in vastly varying habitats: (i) the source lion population in GPA (Fig. 1a), (ii) the northern population in Girnar Wildlife Sanctuary (Fig. 1a) (iii) the coastal population occurring as disjunct populations along the Arabian Sea. The two discontinuous and distinct sub-populations in Kodinar and Rajula-Jafrabad taluka respectively were linked through different dispersal corridors with the source population (Fig. 1b) and *iv*) the eastern population extending into the Bhavanagar district (Fig. 1c). There is a total of 410 lions in the GGL with 71% (n = 290) inhabiting the GPA and 29% (n = 120) beyond (Fig. 1; Kumar and Meena, 2011). The management of these lions falls under the jurisdiction of five administrative units within the Gujarat Forest Department and the population dynamics of these lions are assessed at 5-year intervals. As part of preemptive human–lion conflict mitigation outside the boundary of the Gir Wildlife Sanctuary and National Park, lions that are injured or are a threat to human safety are trapped and either relocated to the closest natural habitat or retained in captivity. Approximately 60 lions are captured and relocated in this manner each year in the GGL (Kumar and Meena, 2011; Meena, 2008; Pathak et al., 2002).

The GPA extends across three highly populated districts (Amreli, Junagadh and Gir-Somnath) where farm-based agriculture and animal husbandry are mainstays of the economy. Additional economic activities include mineral-based cement industry, fish processing, agriculture-based industries such as sugar and edible oils.

Other large carnivores in the GPA are leopard (*Panthera pardus*) and striped hyaena (*Hyaena hyaena*). Wild prey of the lions in this