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Short communication

A conservation success story in the otherwise dire megafauna extinction crisis: The Asiatic lion (*Panthera leo persica*) of Gir forest

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ABSTRACT

Carnivores in Asia and throughout the world face high risk of extinction due to factors such as continued habitat loss and hunting. However, the Asiatic lion of Gir forest, India presents a conservation success story whose history may help to guide the recovery and conservation of other imperiled predators. Protection of core and satellite habitats and the relocation of pastoral communities and their livestock triggered forest recovery and coincident increases in native prey populations. Wild ungulate populations increased by 10-fold between 1970 and 2010, supporting an increase in the lion population from 180 animals in 1974 to 411 animals in 2010. Coincident with this increase, lions shifted their predation preferences from a diet composed of 75% livestock to one composed of just 25% livestock. This example demonstrates the value of native prey populations to sustain imperiled carnivore species, and the use of protected areas and livestock exclusion to maintain healthy prey populations.

1. Introduction

Biodiversity conservation in Asia faces major challenges. Continued threats from habitat conversion and hunting place tropical Asia at the top of the world's most threatened regions (Sodhi et al., 2010). Within these imperiled habitats, large carnivores and other megafauna face high risk of extinction (Morrison et al., 2007), and these threatened species require immediate conservation intervention to ensure their continued survival. What rare conservation success stories exist must serve as examples to study and follow in order to protect other imperiled species facing similar threats.

The Asiatic lion (*Panthera leo persica*) persists as one remaining population in and around Gir forest in the southwest part of Saurashtra region in the state of Gujarat, India. Although classified as endangered (Breitenmoser et al., 2008), the Asiatic lion has displayed a remarkable recovery in the past century, coming from the brink of extinction with an estimated population of just a few dozen individuals at the beginning of the 20th century to a population of over 400 individuals today (Singh, 2007). The management history of this species may reveal valuable lessons to guide conservation efforts for other carnivores in tropical Asia and worldwide.

In this paper, we examined population changes of Asiatic lions in relation to availability of native prey and domestic livestock and to the management of lion habitat in the Gir forest. We predicted that lion population size would be positively related to the abundance of native prey species and consequently to the protection of lion habitat in the Gir forest. This study reveals the importance of managing healthy prey populations in order to sustain threatened top predators.

2. Materials and methods

2.1. Study region

Asiatic lions occupy remnant forest habitats in the state of Gurajat, India. Two hill systems in this region, Gir and Girnar, comprise Gurajat's largest tracts of dry deciduous forest, thorny forest, and savanna, which provide valuable habitat for a diverse flora and fauna that includes several endangered species (Fig. 1; Singh and Kamboj, 1996). These habitats also support the highest concentration of top carnivores in India, with over 600 lions and leopards (*Panthera pardus*; Singh, 2007; Anon., 2010). Native ungulates include the chital or spotted deer (*Axis axis*), sambar (*Cervus unicolor*), blue bull (*Boselaphus tragocanelos*), chinkara (*Gazella gazelle*), four-horned antelope (*Tetracerus quadricornis*), blackbuck (*Antelope cervicarpa*), and wild boar (*Sus scrofa*). Of these, the chital, sambar, blue bull, and wild boar comprise the main wild prey items for lions in Gir (Joslin, 1973). Additionally, lions frequently hunt

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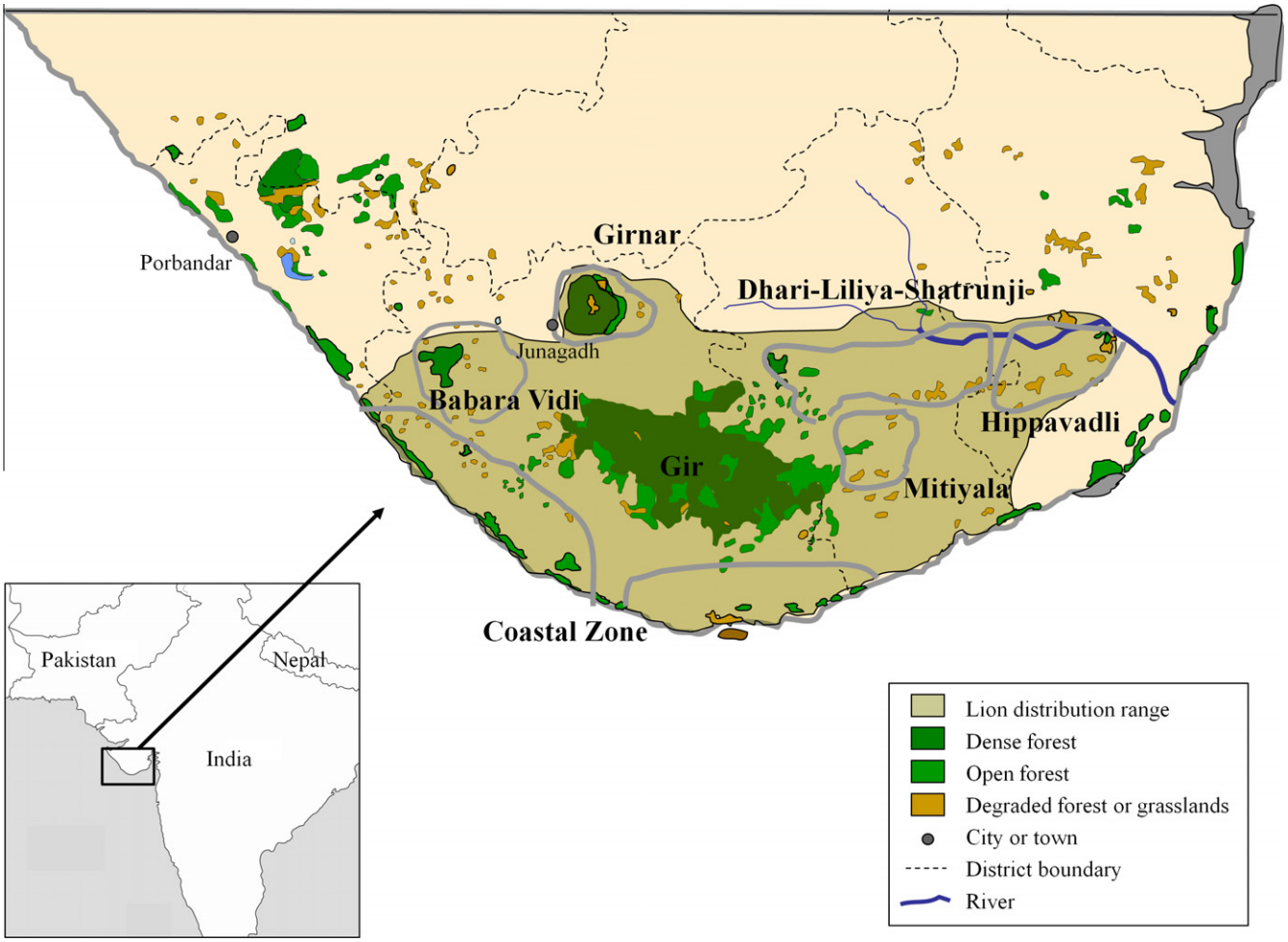

Fig. 1. Location of lion populations in the core Gir forest and surrounding satellite habitats including Babara Vidi, Girnar, Dhari-Liliya-Shatrunji, Hippavadli, Mitiyala, and Coastal Zone.

livestock, primarily buffaloes and cows, in the forest and surrounding settlements (Anon., 1975).

In the second half of the 20th century, as the Asiatic lion was on the verge of extinction, several conservation actions were taken to protect lion habitat. The Gir Wildlife Sanctuary became the first protected area in Gujarat in 1965. The Sanctuary was subsequently expanded to cover peripheral forests, and the core area was declared the Gir National Park in 1975 with enhanced protection levels. Adjoining lion habitat in the Amreli district was declared the Pania Sanctuary in 1989, and surrounding community lands were declared protected forests to serve as a buffer zone to the Gir forest. Following these initial actions, lion numbers steadily increased and animals started dispersing into satellite forest patches in the districts of Junagadh, Amreli, and Bhavnagar (Fig. 1; Singh and Kamboj, 1996). Management followed the dispersal of lions to protect reclaimed habitats surrounding Gir, and additional sanctuaries were created in Mitiyala in 2002 and in Girnar in 2007. Thus, five protected areas currently exist to protect the Asiatic lion: Gir Sanctuary, Gir National Park, Pania Sanctuary, Mitiyala Sanctuary, and Girnar Sanctuary. The first three protected areas form the Gir Conservation Area (20°57′–21°20′N, 70°27′–71°13′E), a 1452 km^2 forest block that represents the core habitat of the Asiatic lion (Singh, 2007). The other two sanctuaries, Mitiyala and Girnar, protect satellite areas within dispersal distance of the Gir Conservation Area. An additional sanctuary is currently being established in the nearby Barda forest to serve as an alternative home for Gir lions.

Following designation of protected areas, resident indigenous pastoral communities, "Maldharis", were relocated outside the Gir forest. Prior to this resettlement, the Gir forest was heavily degraded and used by livestock, which competed with and restricted the population sizes of native ungulates (Berwick, 1974; Anon., 1975). During the Gir Lion Sanctuary Project, which started in 1972, over two thirds of the Maldhari families and their livestock were relocated outside the Gir forest (Anon., 1975; Singh and Kamboj, 1996). Various studies reveal tremendous habitat recovery and increases in wild ungulate populations following the Maldhari resettlement during the last four decades (Singh and Kamboj, 1996). A full history of the management of the Gir Conservation Area and surrounding habitats is provided in Singh and Kamboj (1996).

2.2. Methods and data

Published scientific studies and official monitoring data from Gujarat Forest Department provided past and current population estimates of lions and prey species analyzed in this paper. Since 1968, the Forest Department has conducted wildlife censuses every 5 years in the Gir forest, most recently in April 2010 (Anon., 2010). Visual surveys were used to identify the minimum number of lions in Gir forest and surrounding habitats. Live bait stations were used to attract lions during visual surveys through 1995, but subsequent surveys were conducted without the use of bait. All visual surveys were conducted in the different lion populations