Short Communication

Preparations for the reintroduction of Asiatic lion *Panthera leo persica* into Kuno Wildlife Sanctuary, Madhya Pradesh, India

A.J.T. Johnsingh, S.P. Goyal and Qamar Qureshi

Abstract Approximately 300 Asiatic lions *Panthera leo persica* are confined to the 1,883 km² Gir forests in Gujarat, western India. To establish a second home for the Asiatic lion in its former range, Kuno Wildlife Division (1,280 km², with a core 345 km² Sanctuary) has been identified in Madhya Pradesh. To assess whether the Sanctuary has sufficient wild ungulates to support a population of lions 17 transects totaling 461 km were surveyed over an area of 280 km² in early 2005. The density of potential ungulate prey was 13 animals km^{-2}. There are also *c.* 2,500 feral cattle, left behind by translocated villagers; the cattle are considered to be buffer prey in case droughts adversely affect the populations of wild ungulates. Control of poaching, moving of two villages, grassland management and building a rubble wall around the Division to keep out livestock would lead to a substantial rise in the population of ungulates (to *c.* 20 animals km^{-2}) by the end of 2007. This density would support the first group of five lions (three females and two males) due to be reintroduced in the beginning of 2008. Even if all the three females raise cubs there will be sufficient wild prey by the end of 2009 to support the males, females and cubs.

Keywords Asiatic lion, canine distemper, India, Kuno Wildlife Sanctuary, *Panthera leo persica*, reintroduction, ungulates.

The only free-ranging population of Asiatic lions *Panthera leo persica*, categorized as Critically Endangered on the IUCN Red List (IUCN, 2006), exists in Gir Wildlife Sanctuary (1,154 km²), Gir National Park (259 km²) and surrounding forests (470 km²), an area totalling 1,883 km² in Gujarat, western India (Singh, 1996; Johnsingh *et al.*, 1998). The total lion population is *c.* 300. Such small animal populations restricted to single sites face a variety of extinction threats from genetic and environmental factors (Gilpin & Soule, 1986). Catastrophes such as an epidemic, an unexpected decline in prey or reprisal killing by people could result in the extinction of a threatened species when it is restricted to a single site. The outbreak of canine distemper in the lions of the Serengeti National Park, Tanzania, in 1994 killed an estimated 30% of the population (Roelke-Parker *et al.*, 1996). The lion population in the 40,000 km² Serengeti-Mara ecosystem is large, with *c.* 2,500 lions (Bauer & Van der Merwe, 2004). If an epidemic of this scale were to affect the lions in Gir, it would be difficult to save them from extinction, given the much smaller area of the lion habitat and the considerably smaller population. The establishment of a second free-ranging population of Asiatic lions would help to guard against this.

An attempt to establish such a population in Chandrprabha Sanctuary, Uttar Pradesh in 1957 failed (Negi, 1965) because of a lack of monitoring and the small size of the Sanctuary (96 km²), and because lions moved outside the Sanctuary, leading to conflicts with people and poisoning and poaching of the lions (Divyabhanusinh, 2005). However, in a renewed attempt to establish a second population of lions, surveys of Sitamata and Darrah-Jawaharsagar Wildlife Sanctuaries (Rajasthan) and Kuno Wildlife Sanctuary (Madhya Pradesh) were made by the Wildlife Institute of India in 1993–94. The 345 km² Kuno Wildlife Sanctuary, 830 km north-east of Gir (Fig. 1), established in 1981, was identified as the most suitable site because it lies within a large forested area of 3,300 km² (Chellam *et al.*, 1995) that could support a growing population of introduced lions within former lion range (Pocock, 1930; Chellam, 1993). The Government of India and the State Government of Madhya Pradesh were receptive to the recommendations made by the Wildlife Institute of India and between 1996 and 2001, 24 villages (Fig.

A. J. T. Johnsingh (Corresponding author)*, **S. P. Goyal** and **Qamar Qureshi** Wildlife Institute of India, PO Box 18, Chandrabani, Dehra Dun 248 001, India. E-mail ajtjohnsingh@ncf-india.org

*Current address: Nature Conservation Foundation, 3076/5, IV Cross, Gokulam Park, Mysore 570 002, India.

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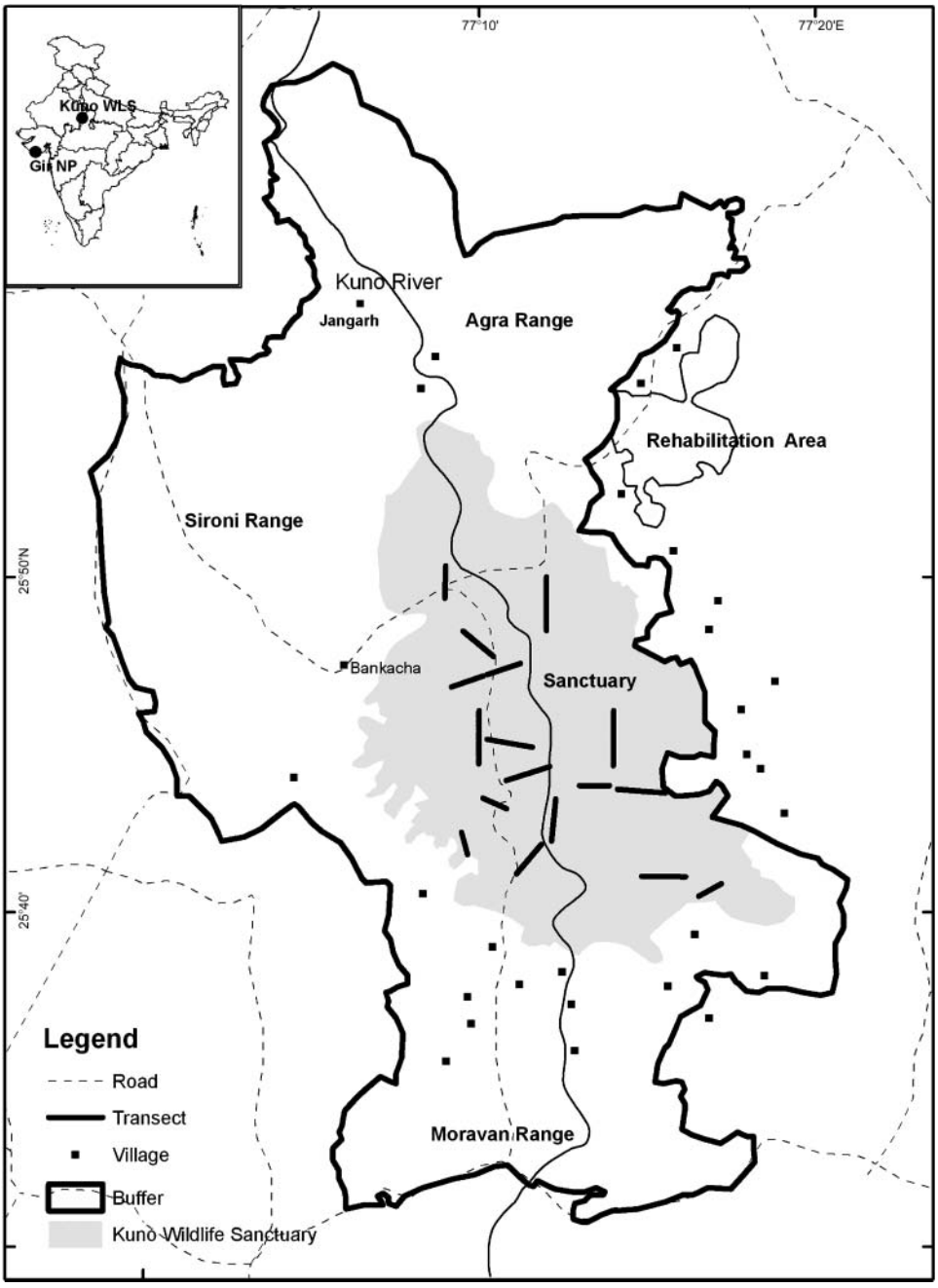

Fig. 1 Kuno Wildlife Sanctuary, showing the 17 transects (thick lines) walked for prey assessment, the surrounding forest divisions, and villages. The inset shows the locations of Gir National Park, Gujarat, and Kuno Wildlife Sanctuary, Madhya Pradesh, in India.

1) containing 1,547 families were translocated from the Sanctuary. The villagers were willing to move out as they were facing problems due to lack of a market, hospitals and all-weather road facilities, and harassment from dacoits. The Government provided them with an appropriate relocation package. A 1,280 km² Kuno Wildlife Division, encompassing the Sironi, Agra and Morawan forest ranges around the Sanctuary, was also demarcated. The Government has so far spent *c.* USD 3.4 million in programmes related to the Sanctuary.

An assessment of the prey base for any lions reintroduced to Kuno Wildlife Sanctuary was carried out in January-February 2005. Seventeen transects of 1.8–3.2 km, over an area of *c.* 280 km², were walked 17 times each. The total distance covered was 461 km. The transects were walked in the mornings and evenings, and for each sighting of ungulates sighting

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distance and angle were recorded. Analysis of transect data was based on the *Distance* model (Laake *et al.*, 1994). No tiger pugmarks were seen during the survey, although tigers have been reported from the Sanctuary area in the past (Chellam *et al.*, 1995). The density of potential wild prey (spotted deer *Axis axis*, sambar *Cervus unicolor*, nilgai *Boselaphus tragocamelus* and wild pig *Sus scrofa*) for lions was 13 animals km^{-2}, giving a total of *c.* 3,600 animals available in the Sanctuary (Johnsingh *et al.*, 2005). Estimation of the number of cattle, left behind by the translocated villagers, by the line transect method is not necessarily reliable as the cattle occur in large groups confined to specific locations. Therefore we used a population estimate based on counting the cattle at yarding sites, which gave a minimum of 2,500 in 2004 (Khudsar & Chundawat, 2004). Including cattle, the estimated total potential prey was *c.* 6,100 animals. We consider other large mammals in the Sanctuary, the arboreal langur *Semnopithecus entellus*, *chowsingha* or four-horned antelope *Tetracerus quadricornis* and the fleet-footed chinkara *Gazella bennettii*, as prey rarely available to lions.

The energy or prey requirements of a carnivore can be determined using body weight (Carbone & Gittleman, 2002). Therefore, to estimate the prey requirements of lion we used the data available for tiger, which is almost equivalent to lion in body weight. A female tiger kills 40–45 ungulates per year, consuming *c.* 2,000 kg of meat (*c.* 3,000 kg of live prey) for maintenance, and when raising three cubs needs *c.* 60–75 prey animals per year; males require *c.* 4,000 kg of live prey per year (Sunquist *et al.*, 1999). Assuming that 50 wild ungulates can support one lion for 1 year, on average, then five lions (three females and two males) will require a total of *c.* 250 wild ungulates per year. Medium to large predators in various ecosystems remove 9–10% of estimated prey biomass per year (Schaller, 1972; Karanth *et al.*, 2004). Therefore we estimate that in 2007, 5–8 lions could be supported by the then estimated 19 animals km^{-2} in Kuno. Johnsingh *et al.* (2005) recommended, however, that the lions (three females and two males) should be introduced into Kuno in the beginning of 2008 to ensure that the prey base is greater than required. Based on the available information on the growth rate of ungulate populations for habitats similar to Kuno (0.23–0.41; Chellam *et al.* 1995), and using the logistic growth model, the prey base of wild ungulates for lions by the end of 2007 will be 5,400 animals, and 7,460 at the end of 2009. This prey base will therefore be sufficient to support the reintroduced lions even if all three females raise three cubs each (requiring 700 animals per year) by the end of 2009.

Reported average genetic heterozygosity and polymorphism in Asiatic lions is 0.087 and 0.19, respectively. This is low compared to African lions, which have values of 0.567 and 1.0, respectively (Uphyrina & O'Brien, 2003). This makes it imperative to eventually replace old males in Kuno Wildlife Sanctuary with young males from Gir (Chellam *et al.*, 1995). This should be done preferably when the females have grown-up cubs, as new males could kill the young sired by other males (Schaller, 1972). It may also be necessary to introduce females from Gir periodically to enhance genetic vigour. Other recommendations (Johnsingh *et al.*, 2005) will also need to be implemented in advance of any reintroduction: the villages of Bankcha and Jangarh (Fig. 1) should be relocated from Sironi forest range (to add a further 300 km^2 of human-free habitat to the Sanctuary), grassland management is required to improve forage availability, and a rubble wall needs to be built around the Kuno Wildlife Division to keep out livestock. In addition, there will need to be recruitment and training of staff, control of poaching, and launching of a public awareness and conservation education campaign about coexistence with a large and potentially dangerous carnivore (Kellert *et al.*, 1996). The Government of India and Madhya Pradesh and Gujarat Forest Departments are working on the implementation of the lion translocation, and the Forest Department of Madhya Pradesh has initiated the habitat improvement programme.

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Biographical sketches

A.J.T. Johnsingh has studied species ranging from fishes to elephants, including mammalian carnivores, and he studied dholes *Cuon alpinus* in Bandipur Tiger Reserve, south India, in the late 1970s. After retirement from the Wildlife Institute of India in October 2005 he has worked for WWF-India and the Nature Conservation Foundation, Mysore.

S.P. Goyal specializes in the ecology of large herbivores, including elephants, and large carnivores, focusing in particular on leopard-human conflict in the Himalayas. He has also developed a forensic facility at the Wildlife Institute of India.

Qamar Qureshi is a specialist in geographical information systems, remote sensing, landscape ecology and large mammal conservation. He presently assists the Government of India to assess tiger populations.

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