LEOPARDS IN HUMAN-DOMINATED AREAS: A SPILLOVER FROM SUSTAINED TRANSLOCATIONS INTO NEARBY FORESTS?[1]

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In the past decade, many Indian states have reported an increase in Leopard (*Panthera pardus fusca*) populations outside forests, in certain areas, accompanied by a large number of attacks on people. This high density was attributed to declining natural habitats and prey species, and the increased survival of Leopards in croplands where they preyed on tended, as well as feral domestic animals. That Leopard cubs were frequently found in agricultural fields was thought to also indicate rising Leopard populations. We use data from our human-leopard conflict study in Junnar, Maharashtra, along with information from three other conflict sites in India, to propose that the reason for this increase in Leopard population and conflict is related to the sustained translocation of 'problem' Leopards into nearby forests. That sustained releases could lead to population increases was never considered before, even though translocation is known to be a procedure for increasing populations of species at or close to the site of release. Although scientists do not recommend translocation as a management strategy for 'problem' carnivores, it is currently the legally recommended method of dealing with 'problem' large cats in India. Such faulty policies will only further hamper the conservation of this species, which is hunted in large numbers for illegal wildlife trade.

Keywords: translocation, *Panthera pardus fusca*, conflict, population increase, India

INTRODUCTION

India has a history of human-large cat conflict (Seidensticker and Lumpkin 1991), but increasingly it is the Leopard *Panthera pardus fusca*, which is most often implicated in attacks on people (Athreya *et al.* 2004). Leopards have always lived on the fringes of human habitation (Prater 1948; Gee 1964; Santiapillai *et al.* 1982; Tikader 1983; Johnsingh 1992; Daniel 1996; WWF-India 1997), especially in India where the interface between forests and rural habitations is a continuum. This is possibly because the Leopard is a highly adaptable species capable of eating a wide variety of prey, and is not dependent on free water like its larger cousin, the Tiger (Prater 1948; Bertram 1982; Daniel 1996; Edgaonkar and Ravi 1997; Stander *et al.* 1997; Mukherjee and Mishra 2001; Kulkarni *et al.* 2004).

In the event of a Leopard problem, which can vary from just a sighting near a village to livestock predation or an attack on a person, the most common management strategy followed throughout India is: setting up of baited traps, capture of an individual (not necessarily the problem-causing individual) and its subsequent translocation into the nearest 'suitable' natural habitat. This is also recommended by the Indian Wildlife Protection Act (Anon 1972), through an amendment made in 2002. However, this strategy is not recommended by scientists for managing 'problem' animals (Linnell *et al.* 1997; Fischer and Lindenmeyer 2000; Sullivan *et al.* 2004), because of the strong homing instincts exhibited by a wide range of carnivore families, and the possibility of the conflict moving with the individuals. A recent study of the conflict in Maharashtra by Athreya *et al.* (2004) has provided strong evidence of the same. Various Indian scientists and managers have also cautioned against this strategy for these reasons, as well as the potential disruption in the existing social setup of these highly territorial species by introduction of new individuals (Saberwal *et al.* 1994; Karanth and Sunquist 1995; WWF-India 1997; Edgaonkar and Ravi 1997; Karanth and Sunquist 2000).

The Indian states we will discuss in this paper, Maharashtra, northern West Bengal and Gujarat, have reported high human-leopard conflict levels for at least a decade (WWF-India 1997; Chauhan and Goyal 2000; Vijayan and Pati 2001; Athreya *et al.* 2004; Pati *et al.* 2004). These areas also report high densities of Leopards in human dominated areas and the principal reason put forward, essentially without evidence, is the decreasing natural habitat that compels the highly resilient leopard to move into human-modified habitats like tall crops, orchards (Gujarat), tea-gardens (northern West Bengal) and sugarcane fields (Junnar Forest Division, Maharashtra). Within these human-modified habitats, which provide good cover, it is thought that livestock and feral domestic animals provide an abundant supply of food in contrast to the depleting wild prey base (WWF-India 1997; Chauhan and Goyal 2000; Vijayan and Pati 2001; Field Director Buxa Tiger Reserve, pers comm).

We question this heuristic explanation and suggest that, ironically, far from being the panacea for managing conflict situations, the policy of translocation has resulted in increased Leopard populations colonizing the nearest suitable habitat, such as sugarcane fields and tea-gardens, thereby increasing

conflict potential. Finally, we suggest that increased Leopard populations reported from Sanjay Gandhi National Park, Mumbai, Maharashtra and affected areas in Uttarakhand, as well as Baria Forest Division, Gujarat are likely to have a very similar cause.

METHODS

The human-leopard conflict study in Junnar Forest Division first quantified the extent to which translocation has been used as a management strategy to handle problem felids in India (Athreya *et al.* 2004). In this paper, we use data from Junnar and other sites, which report a history of conflict and view it in the context of translocation of Leopards into or near these sites.

Data on Leopard densities and conflict were collated for Junnar Forest Division, Sanjay Gandhi National Park (Mumbai, Maharashtra); the Terai, western Duars and eastern Duars regions (northern West Bengal) and areas around Gir National Park (Gujarat). The sources of information were the Forest Department records of Maharashtra, northern West Bengal and Gujarat, Edgaonkar and Ravi (1997), WWF-India (1997), Vijayan and Pati (2001), Khan *et al.* (2003), Athreya *et al.* (2004) and Pati *et al.* (2004). Leopard densities for all sites, except northern West Bengal, have been estimated from actual number of animals trapped. In the case of northern West Bengal, the information was obtained from the Forest Department census figures. An idea of the numbers of Leopards living outside the forested areas is obtained from the number of cubs captured from tea-gardens and Leopards found dead. Information was also obtained from interviews with scientists and also past and present managers in these conflict areas (Field Director, Buxa Tiger Reserve; Deputy Chief Conservator of Forests, Junnar) to obtain a better understanding of the conflict patterns in various human-leopard conflict areas. Finally we corroborated our analysis with information from past scientific studies on translocated large cats.

RESULTS

Maharashtra

The two regions, which have reported high numbers of human casualties due to Leopard attacks in Maharashtra, are Junnar Forest Division, Pune district, and Sanjay Gandhi National Park (SGNP), Mumbai (Table 1).

Table 1: Leopard densities and numbers translocated into adjacent forests in four conflict sites in India

	Junnar[1]	Sanjay Gandhi National Park[2]	Northern West Bengal[3]	Gir[4]
Leopard densities	1 per 25 sq. km	1 per 3 sq. km	1 per 10 sq. km	1 per 7 sq. km
Habitat of conflict	Sugarcane fields	In and around protected area	Tea gardens	Sugarcane fields and mango orchards
No. of people attacked (period)	51 (2001-2003)	13 (June 2004)	121 (1990-1997)	27 (1990-1999)
Nearby sites of release (No. of Leopards released, period)	Malshej Ghats (25, 2001)	Bhootbangla Parisar (16, 2002-2003)	Gorumara National Park + Chapramari Wildlife Sanctuary (20, 1992-1997)	Gir National Park (38, 2001-2002)
			Buxa Tiger Reserve + Jaldapara Wildlife Sanctuary (7, 1992-1997)	
	Bhimashankar Wildlife Sanctuary (11, 2001)	Nagla Block (5, 2002-2003)	29 more were trapped but data on release is unavailable	
Distance of above site from site of conflict	< 60 km	< 20 km	< 20 km	< 50 km

[1]Data from Athreya *et al.* 2004
[2]Data from Forest Department Records
[3]Data from WWF-India 1997 and Field Director, Buxa Tiger reserve, pers. comm.
[4]Data from Vijayan and Pati 2001; Pati *et al.* 2004

The Maharashtra Forest Department Leopard census showed an increase from 20 animals in 1997 to 57 animals in 2001, in Junnar Forest Division. Livestock predation and attacks on people have been reported in this region since 1993, albeit at very low levels. It was only post-2001 that the conflict escalated sharply. The 4,360 sq. km of Junnar Forest Division is predominantly human-dominated and land cover analysis indicates no significant changes between 1992 and 2000. At the height of the conflict, approximately 1,600 sq. km of this area was affected (Athreya *et al.* 2004). Fifty-one people were attacked between 2001 and 2003, of whom 18 died (Junnar Forest Division records). Athreya *et al.* (2004) estimated a minimum population of 75 adult Leopards based on the number of individuals translocated, kept in captivity, and found dead, in this region between 2002 and 2003.

It has to be stressed that all the natural forests in Junnar Forest Division are confined to a narrow strip on the western edge along the ridge of the Western Ghats, while the rest of the division is totally devoid of natural cover. The hotspot of conflict was the irrigated valley of Narayangaon lying close to the eastern edge of the division and farthest from the forested Ghats. The rise in conflict was attributed to the ideal cover provided by sugarcane fields leading to increased Leopard populations. Forty-two Leopards were removed from the 390 sq. km of the Narayangaon range, either due to death, permanent captivity or far-off translocations (Athreya *et al.* 2004).

SGNP is a forested island inside the booming metropolis of Mumbai, and is the only site in India, which reports sustained human-leopard conflict from within the boundary of a protected area (Maharashtra Forest Department Records (MFDR), Edgaonkar and Ravi 1997). The Leopard population in SGNP increased from a handful of individuals in the early 1970s (J.C. Daniel, pers comm) to 35 in 1988 and 40 in 1996 (MFDR). Attacks on people have been reported since 1986, albeit in very low numbers (MFDR, Edgaonkar and Ravi 1997). Between March 2002 and March 2004, 24 attacks were reported, of which six occurred within the boundary of the Park (MFDR). In 2004, the number increased, with 13 attacks reported only in June 2004, of whom 10 people died (MFDR). After this, more than 30 leopards were trapped, indicating a minimum density of one Leopard per 3 sq. km and probably more. Clearly, any explanation for this extraordinary spurt in attacks has to involve a sudden trigger and not gradual processes like encroachments and reduction of wild prey base. The most common strategy of dealing with the Leopard 'problem' in SGNP has been their capture in baited traps and subsequent translocation into certain areas of the Park and adjacent forests (such as Tansa WLS which is about 150 km north-east; see Edgaonkar and Ravi 1997). Between July 2002 and December 2003, 26 leopards were trapped, most of them outside the forest, of which 21 were translocated back inside the forest. The data available from Edgaonkar and Ravi (1997) indicates that this strategy has been in use for close to a decade now.

Northern West Bengal

One hundred and twenty-one people were attacked in this region between 1990 and 1997 (WWF-India 1997), of whom 10 died (Table 1). Forest Department records until 2002 report the death of 18 people in leopard-related incidents. Of the three regions in Jalpaiguri district (Terai, eastern Duars and western Duars), the western Duars has experienced maximum conflict. Forest Department data reports that 13 people have died in the western Duars between 1990 and 2002, and 0 and 5 in the Terai and E. Duars respectively. Based on leopard attacks on people and livestock, as well as the number of cubs found, the WWF-India report (1997) identified 24 conflict hotspots in the region. Fifteen of these lie in the western Duars and within 15 km of Gorumara National Park and Chapramari Wildlife Sanctuary. The remaining nine occur in the eastern Duars at the fringes of Jaldapara Wildlife Sanctuary and Buxa Tiger Reserve. The census figures for 1999 report 159 leopards in the forest areas with a density of one per 10.85 sq. km (http://www.wb.nic.in/dist/jalpai.html). There are reports of a large number of Leopard deaths due to conflict related incidents in this region; five in the Terai region between 1993 and1996, 20 in western Duars between 1990 and 1997, and 14 in the eastern Duars between 1990 and 1996 (WWF-India 1997). Of these 39 deaths, 25 were caused by people (either mob related or poisoning or shot at).

Gir National Park, Gujarat

The Gir National Park is a forested island, home to the Asiatic Lion and the Leopard. However, both these large cats are increasingly reported in conflict incidents on the periphery of the Park (Vijayan and Pati 2001). Gir National Park reports very high densities of both, the Asiatic Lion (one per 5-7 sq. km) and the Leopard (one per 7 sq. km) (Vijayan and Pati 2001, Table 1). A study carried out in one of the areas affected by human-leopard conflict (Talala sub-district/taluka) adjacent to the Park reported 27 leopard attacks on people between 1990 and 1999, of which four were fatal (Vijayan and Pati 2001). However, the common management strategy in dealing with Leopards and Lions that are found outside of the Park is their capture and release within the National Park (Saberwal *et al.* 1994; Vijayan and Pati 2001; Khan *et al.* 2003). An average of 50 Leopards are translocated into the National Park each year (Vijayan and Pati 2001; Khan *et al.* 2003). Thirty-two leopards

were rescued and 12 found dead between 1990 and 1998 from the Talala subdistrict alone. Eleven lions were rescued and eleven found dead due to poisoning or falling into wells (Vijayan and Pati 2001), during the same period.

DISCUSSION

The Leopard occurs throughout India and has always been reported from areas bordering human habitation (Prater 1948; Daniel 1996; Seidensticker and Lumpkin 1991), but severe conflict is reported only from pockets across the country. Leopards occur in tea-gardens of Assam and southern India, but no conflict comparable to that in northern West Bengal has been reported. Sugarcane occurs in many parts of Maharashtra with far more extensive tracts in the southern areas of Kolhapur and Karad, situated at the same distance from the Western Ghats as in Junnar, but without comparable conflict levels (Athreya *et al.* 2004). Even in those forest divisions that report human-leopard conflict, the problem is confined to a small sub-region. For example, in Junnar, the conflict that started in 2001 was concentrated in the Narayangaon valley; the hotspots of the conflict in SGNP in 2004 were close to the Ghodbandar and Film City areas; in Gir it is the subdistricts/talukas of Visavadar, Malia and Talala (Saberwal *et al.* 1994); in northern West Bengal most of the hotspots identified by WWF-India (1997) were in the western Duars, a few in the eastern Duars, while none in the Terai region.

The theories commonly put forth to explain human-leopard conflict are loss of natural habitat and wild prey and the subsequent movement of leopards to 'ideal' irrigated areas and the associated domestic animals. An important aspect that was not considered was the sustained translocation of Leopards for at least a decade into or close to these sites. The Junnar study by Athreya *et al.* (2004) looked into the patterns of conflict on a landscape level and they found that the conflict was not present close to the sites of release, but commenced about 15 km away, with the hotspot of conflict ranging 40-60 km away from the site of release (Athreya *et al.* 2004). A translocation exercise in Kenya in the late 1970s provides an insight into why this might be. Radio telemetric studies showed that eight Leopards translocated more than 200 km into a National Park, in response to livestock predation, immediately moved a distance of 25 km away from the release site (Cobb 1981). It is likely that a hard release into an alien area makes these highly territorial animals leave the area in the direction of home, a phenomena seen across carnivore species (Linnell *et al.* 1997). In all the conflict sites discussed in this paper, except SGNP, the areas with highest vegetation density immediately outside forested release sites are human-modified croplands. A sustained release of Leopards into a few release sites over many years is likely to have led to the high Leopard numbers seen in irrigated fields, tea-gardens and even in the single protected area of SGNP.

Moreover, natural leopard populations are already present at these release sites. For example, census figures for the Bhimashankar Wildlife Sanctuary (MFDR, Kulkarni *et al.* 2004) reported 10 leopards. In 2001, 11 leopards trapped in the Junnar Forest Division were released close to the Wildlife Sanctuary. In the absence of leopard-free forests in the surrounding area and in their attempt to leave the site they would naturally move down the river valleys that contain irrigated fields with high vegetation density. High levels of conflict were reported for the first time in five years in these areas following the translocations (Athreya *et al.* 2004).

Translocation is the most common management strategy used in our country in response to any problem associated with the large cats (lions, tigers and leopards), and is recommended by law. Translocation as the preferred method of dealing with 'problem' Schedule I species was introduced as late as 2002 as an amendment to the Wildlife Protection Act (Anon 1972). However, translocation is also the preferred method to establish or increase the presence of a species near the site of release (IUCN 1987) and has rightly been recommended for founding a second home the Asiatic Lions outside Gujarat (Chellam *et al.* 1994). The Florida panther study shows how large cat populations increase following translocation (Ellis *et al.* 1999). In 1995, the 8 female Florida panthers that were released had increased to 21 individuals by 1999 due to new births. Furthermore, translocation is not recommended for problem carnivores for reasons rooted in their biology (such as very strong territoriality and consequent post-release movements, movement of the conflict with the individual, social disruption of existing leopard populations at site of capture, as well as release, introduction of pathogens to the new sites of release, see Rabinowitz and Nottingham 1986; Linnell *et al.* 1996; 1997; Khan *et al.* 2003; Treves and Karanth 2003; Athreya *et al.* 2004). Furthermore, our data shows that population increases can also occur close to the release site and that in the absence of forested areas devoid of conspecifics, the animals will colonize adjoining human-modified habitats such as crop fields and tea-gardens.

The state of Uttaranchal has had a history of human-leopard conflict; around 140 people succumbing to Leopard attacks between 1988 and 2000, while 93 leopards were killed in the same period (UA Forest Department records in Chauhan and Goyal 2000). Rajaji and Corbett National Parks are reported to be sites of release for Leopards trapped elsewhere in the state. An analysis of the capture and release

sites and dates, overlaid on maps of vegetation density and river systems could test our hypothesis that sustained translocations into the nearby forested areas have created the hyper-dense Leopard populations of 3-4 per 10 sq. km reported in the Pauri region (Chauhan and Goyal unpublished report of the Wildlife Institute of India, Dehradun.). That Pauri is not in the immediate vicinity of the forested sites (about 40 km away), may not be an issue. Even in Junnar, the conflict area - Narayangaon, and the release site - Malshej, are 40 km apart, with few attacks reported in the intervening area. In the complete absence of post-release monitoring of large numbers of translocated leopards, we do not have any information on how these animals use the new areas of release and their movements across the landscape in their attempt to head back home. A leopardess trapped in Junnar was marked with a transponder chip and released in the forests at the Madhya Pradesh-Maharashtra border. She moved 90 kms in the direction of Junnar and in the process, resulted in 6 human fatalities and a similar number of injuries (Belsare and Athreya 2004 http://carnivoreportal1.free.fr/archives2004_3.htm). In keeping with the known biology of the species, her route was along the river valleys in human dominated areas, just as we inferred for the Malshej-Narayangaon leopards (Athreya *et al.* 2004).

Felid biology explains why problems even at the site of capture do not decline following large removals of leopards. Sub-adult felids are known to incur high mortality rates due to poor hunting success and due to killings by resident males (Cramer and Portier 2001). The removal of 12 mountain lions (similar in size to leopards) in Utah, USA, following livestock depredations did not change conflict levels because 17 different, and younger individuals moved in to occupy the vacant territories (Linnell *et al.* 1996). If landscape features do not allow translocated individuals to home all the way back to their territories, their vacant territories will be filled up by younger individuals while the survival of the translocated mature individual close to the new site will indeed increase the overall leopard population over a period of time. Furthermore, landscape features just outside of the release sites are likely to determine the extent to which the newly released animals can use them. Availability of prey is not an issue for leopards living in human dominated areas due to the abundance of feral dogs and domestic livestock. It is well known that domestic dogs are commonly taken by leopards (Mukherjee and Mishra 2001; Edgaonkar and Ravi 1997). Most leopards trapped in India are from outside natural habitats. Following their release into forested sites it is likely that they will move towards human settlements thereby perpetuating conflict. This has indeed been shown to be true (Khan *et al.* 2003; Athreya 2006).

In conclusion, the consistent pattern of high Leopard density seen in various areas reporting human-leopard conflict (many parts of Maharashtra, northern West Bengal, Gujarat, Uttarakhand) is likely due to their proximity to 'preferred' release sites of Leopards, effectively re-stocking the area with Leopards. Habitats such as tea-gardens in northern West Bengal, sugarcane in Junnar, orchards around Gir will provide the next best habitat for colonisation for the released animals and their progeny. Therefore, when analysing human-carnivore conflict patterns, it is also important to take into account the numbers of animals that are trapped and released and the proximity of release sites to the conflict sites. For instance, Himachal Pradesh reported 70 Leopard trappings between 1997 and 2003 (Athreya *et al.* 2004), and also reported conflict, but we could not access data on the fate of these captured animals. The Baria Forest Division in Gujarat reported 121 attacks on people by Leopards in 2000 (Gujarat Forest Department records in Athreya *et al* 2004). Releases of Leopards are also reported close to Baria Division, but we lack factual data to discuss the issue. Translocation of problem Leopards was also carried out in Meru National Park, Kenya, where 108 Leopards were released over 11 years until 1979 (Cobb 1981). It would be interesting to know if the areas outside of the release site reported increased Leopard numbers in those years.

Following Linnell *et al.* (1997), we also recommend that translocation of problem carnivores should not be carried out. With our faulty methods of dealing with Leopards – a species capable of living close to human settlements – we have only perpetuated conflict and increased it to alarming levels in recent years. It is of serious concern that the amendment to Section 11 of the Wildlife Protection Act was made a full five years after a scientific review (Linnell *et al.* 1997), which advised against such a management strategy. It is imperative that past studies and the biology of species as well as experiences of managers be considered when changing or making policy decisions.

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