Human - wildlife conflict is of growing concern because it threatens the survival of many wildlife species. This is especially true in the case of large felids, most of which are threatened primarily due to anthropogenic causes, with conflict accounting for the highest mortality (Loveridge et al. 2010a). The creation of protected areas aims to separate the use of space by large cats and humans thereby reducing the potential for conflict (Sanderson et al. 2002). However, all large cats are wide ranging, are obligate carnivores and human-use areas are usually resource rich because of the high density of domestic animals. Thus in many situations, large cats, especially around the edges of protected areas venture into human settlements to prey on livestock and sometimes attack humans (Inskip & Zimmermann 2009). Of the four species of large cats that occur in India, the leopard (Panthera pardus fusca) is the most adaptable (Bailey 1993), residing in and around human settlements where it also preys on medium sized domestic animals (Daniel 2009). Since its interface with humans is higher than the other large felids, conflicts are not uncommon and can also be very severe (Athreya et al. 2011). Despite the severe conflict levels, the current understanding of the drivers of human-leopard conflict in human-dominated areas is poor.

In this thesis, I attempt to elucidate the ecological and social factors that drive such conflict in an agricultural landscape in Maharashtra, western India.

Specifically, the main research questions are

(i) At what densities do leopards occur in a human-dominated landscape?
(ii) What is their main prey species and how does it relate to the potential prey base available in the human-dominated landscape?
(iii) What are the conflict levels, specifically, the extent of attacks on humans and livestock by the leopards and the extent of losses that people face due to leopard predation?
(iv) How does translocation of leopards, the most common management strategy used in India today, affect conflict levels?

CHAPTER 2. DENSITY OF LEOPARDS IN A HUMAN-DOMINATED LANDSCAPE
In this chapter, photographic capture-recapture techniques were used to assess the density of the two large carnivores, the leopard and hyaena (Hyaena hyaena), in a human-dominated landscape with density of more than 200 people/km². The total effort carried out was 1110 camera-trap days spanning over 179 km² in a 30 day period in November and December 2008. The density estimates were based on the conventional as well as the spatially-explicit capture-recapture analytical
methods. Similar density estimates were obtained for leopards and hyaenas, at 5/100 km² each, which is higher or comparable to estimates obtained within protected areas in other countries (Spalton et al. 2006; Khorozyan et al. 2008; Balme et al. 2009; Gray & Prum 2011), and within some protected areas (Chauhan et al. 2005; Harihar et al. 2011) in India. Ten other species of wild carnivores, including the vulnerable (IUCN category) rusty-spotted cat (Prionailurus rubiginosus), were photographed in the camera traps. It also highlights the need to also focus on the potential utility of human-use areas for the conservation of wild carnivores while taking into account important factors such as landscape, the ecology of the species, culture of the people and the interaction between humans and carnivore species because all these are likely to affect large carnivore persistence in such landscapes.

CHAPTER 3. DIET OF LEOPARDS IN A HUMAN-DOMINATED LANDSCAPE

The quantum of prey biomass available in the landscape is a key determinant of predator density (Carbone & Gittleman 2002, Karanth et al. 2004). In this chapter, the biomass of domestic animals in a human-dominated landscape has been estimated and examined in relation to the diet of the resident leopards. There is no report of wild ungulate presence from the study area and no evidence was obtained during the field-work. The biomass of domestic species was estimated from interview data obtained from 77 households and the leopard diet was assessed from the scats collected in the area. In all, 265 scats were collected over 238 km² of which 85 provided usable information on the leopard’s diet. The results indicate that 86.56% of the leopard’s diet consists of domestic animals, and the most common prey is domestic dog constituting 40% of the total prey biomass. The biomass of domestic livestock present in a human-dominated landscape was found to be extremely high at 66,527 kg/km², which can theoretically support ten times the leopard density compared to what was obtained using photographic capture recapture. However, the leopards mainly attacked medium-sized domestic animals and not the adult cattle. Furthermore, domestic dogs and cats were seen to be more important dietary components compared to goats and calves, probably because the latter are protected by the farmers. Using Carbone & Gittleman’s (2002) regression equation relating prey biomass to predator density, it was found that the biomass of owned domestic dogs and cats alone can sustain the current density of leopards and hyaenas in the human-dominated landscape.

CHAPTER 4. QUANTIFYING CONFLICTS BETWEEN LEOPARDS AND HUMANS IN WESTERN MAHARASHTRA CROPLANDS.
Human – large felid conflict is an issue of global concern because of the losses people face due to livestock predation, and attacks on humans by large felids (Inskip & Zimmermann 2009; Loveridge et al. 2010a). In this chapter, the level of conflict caused by leopards living in a human-dominated landscape with a density of more than 200 people/km² was studied.

Specifically, Forest Department records, and interview data from

(i) people who had filed claims for compensation,
(ii) randomly selected households and
(iii) a sample of migratory shepherds

were used to obtain information on the livestock losses due to leopard attacks. Generalised linear models (GLM) with binomial errors were used to address the following questions:

(i) What was the risk of losing a goat versus a calf among people who had filed for compensation? Cows were rarely attacked by leopards.
(ii) What variables affected the chances of a household facing a livestock predation event by leopards?
(iii) What affected the farmer’s attitude in terms of his wanting the leopard removed (or not) from the area?

Interview data and Forest Department records on compensation, report not a single human death by leopards in the 179 km² study area although rare accidental attacks on humans did occur. In the case of livestock losses, a total of 242 livestock were killed in three years in the study area between April 2006 and February 2009 whereas the mammalian livestock density in the study area was found to be ~400/km². As with leopards elsewhere, mainly medium-sized stock were attacked, with the probability of goats begin killed twice that of calves and almost no cows were killed. All the night time attacks on livestock occurred near houses, but no humans were attacked during the time of the livestock attack although people do try and save their livestock when they hear it cry out in the night. The results also indicate that leopards were not a major reason for mortality for goats but were for the owned domestic dogs. Furthermore the results indicate that ineffective protection and the presence of dogs is likely to increase the probability that a farmer will face a leopard attack on his livestock. Also, the probability that a farmer wants the leopards removed from his area increases if he has faced a previous attack on livestock. This is despite the presence of the Forest Department compensation system in the area.
Compensation is provided with the intention of making people more tolerant of their losses but is not seen to be effective system even in other countries (Kaczensky 1999; Frank et al. 2005; Marker & Dickman 2005; Nyhus et al. 2005; Rabinowitz 2005; Azevedo & Murray 2007; Gusset et al. 2007; Inskip & Zimmermann 2009). Furthermore, a livestock has to die before the government assists the farmers and the death of a single animal can be a significant loss for the poor farmer. Thus it is recommended that the focus of state assistance should be proactive and focus on better protection of livestock.

The results of this research work questions the way in which the term ‘conflict’ is employed in the Indian context. The leopards are not attacking people even though both share the habitat at relatively high densities. Nor are people proactively killing leopards because of cultural tolerance on the one hand and exposure to severe legal penalties on the other. Furthermore, livestock losses are also much lower than one would expect given the high density of livestock and leopards in the landscape. This work highlights the need for reorientation of perception of conflict and for formulating proactive conflict preventive measures.

CHAPTER 5. THE ROLE OF LEOPARD TRANSLOCATIONS IN CONFLICT MITIGATION: EFFICACY AND ALTERNATIVES

In this chapter, analysis of historical data obtained from the forest department on human-leopard conflict is used to identify the drivers of serious conflict. In Junnar Forest Division, a human-dominated irrigated landscape that adjoins the Ahmednagar district of Maharashtra a large-scale translocation programme was carried out where a large numbers of leopards were captured from human-use areas and released into adjoining forests. The patterns of conflict, especially attacks on humans, that followed the translocation intervention are assessed and the reasons for the same are discussed in this chapter. Capture of leopards from human-use areas and release in adjoining forests is the most common management strategy used in India even today.

In the densely populated Junnar district in Western Maharashtra, India, 28 leopards were captured in an area of 3828 km$^2$ (with 239 people/km$^2$) and released into forested areas at an average translocation distance of 39.5 km (± 1.8 km SE), in 2001 and 2002. Eleven more leopards were relocated into these forests from other districts in the same period. By the end of 2002, these releases were stopped. Fifty seven leopards that were captured thereafter were translocated to other remotely located forests in Maharashtra.
Between 1993 and 2001, an average of 4 attacks on humans occurred each year and after the translocation exercise the average escalated to 17. Linear and logistic regression results show that (i) attack frequency on humans in the Junnar region increased following releases nearby and decreased when leopards were released far away, (ii) attacks on humans became more deadly when the number of leopards introduced from other districts increased, and (iii) attacks on humans were most likely to occur in regions where the largest number of leopards had previously been introduced from other areas. The difference is particularly striking compared to the previous year when the same leopards had lived without attacking people in the same area.

Possible behavioural explanations for the increased conflict could be increased stress, loss of fear towards humans during capture, spatial disorientation and upheaval of the social structure of an otherwise strongly territorial species such as the leopard, following release into a new area. In a country like India where large carnivores share space with large numbers of humans, who are traditionally more tolerant, the focus should be on proactive methods that lead to a greater social acceptance of the presence of these carnivores while maintaining the lowest possible levels of conflict.

**CHAPTER 6. CONSERVATION AND MANAGEMENT OF LEOPARDS IN HUMAN-DOMINATED AREAS IN INDIA**

The results of this research have direct bearing on managing human – leopard conflict in India. For the first time, evidence of a fairly high density of resident, breeding leopards living among high density of humans and subsisting entirely on domestic animals, particularly domestic dogs and cats has been obtained. The results of this work also show that an intervention that is biologically inappropriate can severely worsen conflict, with attacks on people commencing after the intervention, in this case large-scale capture and release of leopards. The results also find that effective livestock protection reduces losses and that the abundance of domestic dogs and cats forms a major prey base for leopards in a human-dominated landscape. This work shows that even though a compensation procedure exists, following a livestock loss, the farmers tend to demand removal of leopards. Thus, it is crucial that the Forest Department assist people to better protect their livestock and prevent losses.