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# Status of the Leopard *Panthera pardus fusca* in India

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**I**n Asia, isolated and threatened populations of the leopard occur in other countries but the animal survives well throughout India. Since the beginning of the conservation era in India in 1970, the population has consistently improved. No other Asian countries have populations in thousands.

## Leopard population

The Indian forests supported large numbers of leopard in the past - 150,000 leopards were hunted in 50 years from 1875 to 1925, according to official records (Ranganathan 2001). With loss of forests and depletion of ungulates everywhere, the leopard turned to hunting livestock, now an important part of its prey.

Of 35 States and Union Territories in India, 25 have reported leopard populations, and another three states (Meghalaya, Manipur and Sikkim) are likely have a few leopards. Leopard counts in 16 states in 1997 and 2001-2002 recorded an increase from 6,252 to 8,150, a growth of about 30% in four to five years. Eight states did not count leopards in 2001, but reported 1,641 leopards in 1997. Two other small states, Jammu & Kashmir and Nagaland, did not count leopards in 1997, but reported 49 leopards in 2001. If the population of 1997 of eight states which did not report to the Government of India in 2001, is added to the population of the rest of the states, without making a projection, the population of leopards in India would be 9,844 in 2001. If growth in these states followed similar trend as in the other 16 states, the population can be projected to 10,340. Some wildlife experts believe the population may be underestimated because sighting of leopards and cubs is difficult in forests. Based on projection and some estimates, another study has reported a population of 14,000 leopards.

## Population trend

In India, the leopard population dipped low in the 1970s and 1980s but improved subsequently as a result of conservation measures. The counting of tiger and leopard is done every four years in Indian forests, which gives some trend about the changes in distribution and population. As per official data, the number increased consistently from about 6,830 in 1993 to 7,890 in 1997 and about 9,850 in 2001. Madhya Pradesh accounts for the highest number of leopards followed by Uttaranchal, Gujarat, Himachal Pradesh, Maharashtra, Himachal Pradesh, Karnataka, Andhra Pradesh, Rajasthan and Orissa (Anon 2004a).

A study of the leopard population in Gujarat showed that the number grew at an average annual rate of 5.6 percent during the past two decades. Similarly, consistent growth of the species was reported in most Indian states. After critical examination of various data, the trends of population change and official reports of the Government of India, based on leopard counts in 1997 and 2001, a range

of 9,800 to 10,400 leopards in 2001 and about 12,000 leopards at present may be reasonable estimates.

## Habitats and density changes with respect to the moistness of forests

According to a recent report on the forest cover with a canopy density of more than 10%, the total forest cover in India is 675,538 km<sup>2</sup>. Of this area, 630,284 km<sup>2</sup> is in 25 States and Union Territory which have leopards (Anon 2001). A substantial area in Jammu & Kashmir, Himachal, Uttaranchal and Arunachal is in the high Himalayas where the leopard does not occur. Also, some districts with forest cover do not have leopards. Thus, the leopard does not use a substantial area of these states. Based on the above logic, it can be guessed that about 500,000 km<sup>2</sup> of India's forest cover is potential leopard habitat. Of the other 10 States and Union Territories, 7 do not have leopards, whereas occurrence of a few leopards in the other three states is guessed.

Based on rainfall and moistness of forests, leopard supporting states have been classified into four groups:



Indian leopard in the Gir Forest (Photo P. Jackson)

1. semi-arid region (rainfall less than 100 cm),
2. moderate rainfall region (rainfall between 100 to 155 cm),
3. high rainfall region (rainfall between 150 to 225 cm) and
4. very high rainfall region (rain forests above 225 cm).

In some states, there exists more than one climatic region and major forest types. In such cases, the forest type predominantly found in areas of leopard occurrence is considered.

It has been found that population density in Indian forests declines with increasing rainfall and moistness of forests. Leopard abundance was high in the dry region and low in the moist region. In the semi-arid bio-geographic zone of Gujarat, Rajasthan and Haryana States, population density was 22.1 km<sup>2</sup> per leopard (1,505 leopards in 33,273 km<sup>2</sup>). In dry deciduous forests of 10 states in the Deccan and north India (Table 1), every leopard has forest cover of 48 km<sup>2</sup> (6,276 leopards in 301,427 km<sup>2</sup>). The density further declined to one leopard for every 109.3 km<sup>2</sup> in five

states - Bihar, Jharkhand, Orissa, Karnataka and Tamil Nadu. In evergreen forests, leopard abundance is very low, with only one leopard occurring in every 204.8 km<sup>2</sup> (781 leopards in 159,916 km<sup>2</sup>) in seven states - five in the north-east, Kerala and West Bengal. There may be some error in the categorization of states, but this analysis indicates a definite trend of decline of populations in areas with increasing rainfall, density and moistness of forests, although other factors also contribute the population distribution.

To examine this trend at state level, distribution of leopard in different habitats and districts is critically examined and analyzed in Gujarat, where leopard occurs in 17 out of 25 districts.

In the semi-arid region of Gujarat, the population density is 7.9 km<sup>2</sup> per leopard (817 leopards in 6,457 km<sup>2</sup> of forest area). Density is lower in the high rainfall area with dense forests where only one leopard was counted in every 33.3 km<sup>2</sup> of forest cover. On average, leopard density in the habitats of Gujarat is about 13.9 km<sup>2</sup>/leopard, which is higher than any other state in India (Anon. 2001 and Anon 2003).

Analysis of the leopard distribution in different habitats showed a definite trend in India. The arid zone, having a harsh environment with low resources, may support a very low concentration of leopard, whereas semi-arid and tropical regions, having thorn and deciduous forests, are ideal for the leopard. Dense moist forests with extensive cover have moderate to poor leopard density and abundance decreases with increasing moistness, vastness and density of forests.

#### Factors contributing to population growth

Enforcement of protection measures, including implementation of the Wildlife (Protection) Act 1972, has contributed greatly to detecting poaching and decline in major wildlife. Constitution of a Protected Area network across the country has also improved habitats and increased the leopard population. Public awakening to wildlife has had a significant effect on conservation of forests and wildlife.

Developmental activities may have a negative impact on biodiversity but

**Table 1.** Distribution of leopards in different types of forests in the states of India

Sr. no	Name of states	Forest cover as per FSI, Dehra Dun, 2001 (area in km <sup>2</sup> )	Leopard population 2001-02	Density in km <sup>2</sup> per leopard
1	<b>Semi-arid Zone</b> Gujarat, Rajasthan, Haryana	33,273	1,505	22.1
2	<b>Moderate rainfall zone-Tropical deciduous forests:</b> Andhra Pradesh, Goa, Dadara-Nagar Haveli, Madhya Pradesh, Chhatis-gadh, Maharashtra, Uttar Pradesh, Uttaranchal, Himachal Pradesh and Jammu & Kashmir	301,427	6,276	48.0
3	<b>High rainfall zone-Tropical semi-evergreen /semi-moist region:</b> Bihar, Jharkhand, Orissa, Karnataka, Tamil Nadu	135,427	1,241	109.3
4	<b>Very high rainfall zone-Ever green forests/moist region:</b> Assam, Arunachal Pradesh, Mizoram, Nagaland, Tripura, West Bengal and Kerala	159,916	781	204.8
	<b>Total of leopard's states</b>	<b>630,284</b>	<b>9,844</b>	<b>64.0</b>
5	<b>Non leopard states:</b> Punjab, Andaman & Nicobar, Lakshdweep, Delhi, Pandichery, Chandigadh, Daman & Diu, Meghalaya, Manipur, Sikkim	45,254	-	-
	<b>Grand Total</b>	<b>675,538</b>	<b>9,844</b>	<b>-</b>

some agricultural activities provide opportunities and enhanced resources for the leopard. For example, construction of a network of small and medium sized dams during the past three decades has improved availability of water, even during scarcity. The dams, ponds and availability of moisture in the irrigated land have enhanced the abundance of some small animals, which have been easy prey for leopards. Also, irrigated crops, such as sugarcane, have provided shelter and breeding ground for the leopard, and extended its habitat closer to human settlements.

Livestock, especially sheep and goats, are abundant in states of west and northwest India, including Gujarat, Rajasthan, Haryana, Madhya Pradesh, Uttaranchal and Himachal, which support 68 % of India's leopard population, livestock, especially sheep and goats, are abundant. There are human settlements in the forests and a good number of seasonal migratory livestock. Many naturalists believe that human settlements in the forests, up to a limited scale, are beneficial for the leopard. The prey base has dwindled in deep forests and caused this extremely adaptable cat to shift its base to fringe areas. It is very convenient for the cat to descend on villages to hunt goats, sheep, cattle, poultry and stray dogs and then withdraw to the hills. The foothills have also become the meeting point for livestock and man. There is a gradual shift now by leopards towards a new prey base (i.e. livestock), which is not only more abundant than its original prey, but also a much softer option. Sugarcane and maize fields have become the seasonal ambush cover for the cat. Thus, a new prey-base and convenient ambush cover in a new hunting ground have been adopted by this versatile big cat, resulting in conflict with humans in some areas.

### What is the optimum density?

Some areas of India, have a high concentration of leopards and conflicts with humans are at a critical level. This includes areas such as Baria division in Gujarat State, Borivli National Park

on the outskirts of Mumbai (Bombay), and some areas in Uttaranchal State. A high population density of about 40 leopards in 103 km<sup>2</sup> occurred in Borivli National Park and leopards killed several people in the nearby city in 2003 and 2004. Estimation of the density of leopard in Indian forests has included forested areas with no leopards. Thus, the actual density of the animal in leopard habitats is higher than the figures in Table 1.

In Gujarat, the distribution and concentration of the leopard has been critically examined and estimates of density in forest areas of those districts with leopards calculated. In total forest cover of 13,847 km<sup>2</sup>, 999 leopards were counted. with an average density of 7.2 leopards per 100 km<sup>2</sup>, whereas there are 10.4 leopards for the Protected Areas in the state (349 leopards in 3,345 km<sup>2</sup> of 11 national parks and wildlife sanctuaries). This showed that leopard concentration is higher in the forests than in the Protected Areas. Among Protected Areas, one leopard has 7.2 km<sup>2</sup> in Gir National Park; 5 km<sup>2</sup> of forests in Jambughoda Wildlife Sanctuary; 8.5 km<sup>2</sup> in Barda Wildlife Sanctuary; 18.6 km<sup>2</sup> in Jessore and Balaram & Ambaji Wildlife Sanctuaries and 10 km<sup>2</sup> in Vansada National Park and Purna Wildlife Sanctuary, and 3 km<sup>2</sup> in Ratanmahals Wildlife Sanctuary according to the 2002 leopard census.

The highest density of leopard in Gujarat occurs in Dahod district (Baria forest division) where a total of 165 leopards were estimated in about 600 km<sup>2</sup> of forest in June 2004, an average density of one leopard for every 3.6 km<sup>2</sup>. When analysis is narrowed by excluding forests having no leopards in the district, the density of the leopard would be one leopard for every 3 km<sup>2</sup> in the main concentration zone of the forest ranges in Baria, Limkheda and Dhanpur talukas in Dahod. In this district, human-leopard concentration is the highest in the state, maybe in the country also, and a total of 52 people were killed and 665 people were injured during past 10 years (1994 to 2003). This density in Baria forests and also in Borivli National Park, near Mumbai is certainly very high, and

above the limit of tolerance. In very high concentration areas, the extent of habitat is more than accounted for as leopards shelter in the hill forests in daytime and come down to peripheral villages for food.

The above figures, especially for Protected Areas in India, may not provide a real picture because villages within leopard distribution range are key places for food, but they are not counted as part of leopard habitat. In the absence of appropriate studies, it is difficult to estimate the carrying capacity of an area. However, based on the above records, it can be roughly stated that about 8-10 km<sup>2</sup> per leopard, depending on the habitat condition, may be the appropriate density for managing leopards in semi-arid and tropical regions having thorn and tropical deciduous forest. In semi-evergreen and evergreen forest, the optimum density of the animal would be less.

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