

IS THE SLOTH BEAR IN INDIA SECURE? A PRELIMINARY REPORT ON DISTRIBUTION, THREATS AND CONSERVATION REQUIREMENTS

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The Sloth Bear *Melursus ursinus* is endemic to the Indian subcontinent. Sloth Bear populations have declined and its range has shrunk over the past century, primarily due to habitat loss. However, even fundamental information on distribution and present status is lacking for most of its range. We collated recent information from literature and by distributing questionnaires to wildlife researchers, managers and naturalists in India. We analysed the data in a spatial framework using satellite based forest-cover maps to assess the status of populations and habitat, and estimated habitat availability and population size for India. Sloth Bears are widely distributed in India, where large patches of tropical forests still exist. However, secure habitat of high quality is estimated to be only about 10% of the forest area in India, and the Sloth Bear population size for all of India is estimated to be between 6,000 and 11,000. The Western Ghats range and central India are the only strongholds of distribution, in terms of population abundance and habitat availability. The protected areas, deciduous forests, large forest patches and contiguous forests support high abundance populations and in other areas, the populations mostly occur in low abundance, or are declining and some have been recently extirpated. In addition to habitat fragmentation and loss, habitat degradation is widespread and is a significant threat. Overall, the Sloth Bear is threatened, although it appears to be secure in some parts of its range. However, if the suggested conservation requirements can be realised quickly, its long term survival can be ensured. The findings of this analysis emphasise the urgent need for a field survey to assess Sloth Bear status and form a base for further research work.

Key words: conservation, distribution, extirpation, fragmentation, habitat loss, India, isolation, Sloth Bear, *Melursus ursinus*, population estimate, relative abundance

INTRODUCTION

The Sloth Bear (*Melursus ursinus*) occurs commonly and is distributed widely across the tropical forests of the Indian subcontinent. However, its distribution is patchy corresponding with the present forest cover. In the past, even until the early 1800s, Sloth Bears may have occurred in most non-arid, low-altitude forests of India. They were reported to be abundant during mid-1800s, but declined severely due to hunting and habitat loss from late 1800s until the 1950s (Gilbert 1897; Dunbar-Brander 1923; Prater 1948; Phythian-Adams 1950; Krishnan 1972). A similar or accelerated habitat loss continued even after 1950, until about the 1980s, primarily due to conversion of forests for agriculture (FSI 1987). The forest cover declined from about 40% of the geographical area of India in the 1950s, to less than 20% in the 1980s, when the decline slowed owing to growth in conservation efforts.

As a result of the continued habitat destruction and degradation, Sloth Bear populations have declined or become fragmented. Recently, they have become locally extirpated in some areas (Krishnan 1972; Garshelis *et al.* 1999; Singh 2001). Despite their widespread occurrence and the threats to their survival, availability of reliable information on their distribution and present status is limited. There has not been an assessment in recent times and there has not been a rigorous estimation of population size for any forest area in

India, nor has there been any systematic monitoring of trends in populations. The extent of their present distribution too, is not fully known. Such fundamental information is urgently required for planning any large-scale conservation for the species, and more importantly, to answer the basic question of whether the Sloth Bear in India is secure. This dearth of information and the need for expanding and updating information were also highlighted in the latest IUCN/SSC Bear Conservation Action Plan (Garshelis *et al.* 1999).

The earliest distributional data for the Sloth Bear is from sportsmen's records, many of which have been published in early volumes of the *Journal of Bombay Natural History Society (JBNHS)*. Mammal surveys were carried out in India during the mid-1800s by pioneering collectors like Blanford, Blyth, Elliot, Jerdon, Hardwicke, Hodgson, Horsfield, and Sykes. However, there were still large gaps in information, particularly on the taxonomy, behaviour and distribution of nearly all mammals (as observed in 1911, by W.S. Millard, R.A. Spence and N.B. Kinnear, the editors of the *JBNHS*). The need for organising a systematic collection to lay a strong foundation for systematic mammalogy in India was realised by the Bombay Natural History Society (BNHS) (Wroughton 1912) and it started the first of the systematic mammal surveys in 1910, and carried it through for the next 20 years. However, these early surveys were not specifically aimed at documenting distribution, but were mostly concerned with collecting

specimens from different localities for taxonomic work and for documenting the diversity of mammals present in the region. Nevertheless, the vast area covered by these early records gave us a fair idea of the broad distribution of mammals, including that of the Sloth Bear, during those times (Prater 1948). However, the accumulation of data did not keep pace with the destruction of habitats. Over 50 years after their predecessors realised the need for systematic surveys, the editors of the *JBNHS* in 1966, H. Santapau, S.J., D.E. Reuben, Z. Futehally and J.C. Daniel regretfully noted that authentic information on the status of species and habitats, based on latest field observations were still very much lacking.

Even now, for many of the forest areas in India, basic information on the presence or absence of Sloth Bears is not available. For some areas, such data may exist at a local level, but is not available to a wider readership. There have been a few attempts to collate such data (Jaffeson 1975; Garshelis *et al.* 1999) and to develop a larger database (Wildlife Institute of India's National Wildlife Database, WII/NWDB). However, most of the information on distribution and abundance used by these earlier studies is either outdated, refers to unconfirmed sources, or was originally obtained based on incorrect methods. They also contain substantial errors or lacuna. For instance, over 20% of the Protected Areas (PAs – includes national parks and wildlife sanctuaries) listed as being inhabited by Sloth Bears in the Bear Action Plan (Garshelis *et al.* 1999) or in WII/NWDB do not hold Sloth Bears or their presence there is doubtful (e.g. Namdapha, Sariska national parks). Over 100 PAs that certainly or possibly have Sloth Bears were not included in those lists (e.g. Cauvery, Koyna wildlife sanctuaries). Some of the data presented in those lists were from the early 1980s, where the present status of Sloth Bears is unknown. Moreover, there is hardly any information on Sloth Bears found in the forest areas outside PAs.

Considering the deficiency in data and the threats to Sloth Bear populations, a countrywide field survey to assess the population abundance and the threats to the populations and their habitat is urgently needed. To lay a theoretical foundation for such a field survey, we analysed currently available data in a spatial framework to assess Sloth Bear status and investigated the relationships among the status of populations, habitat and landscape parameters. We also estimated habitat availability and population size in India based on these data.

METHODS

We distributed over 800 questionnaires (Appendix 1)

to wildlife researchers, wildlife managers, naturalists, and non-governmental environmental organisations working in various parts of India. Forests from where Sloth Bears had already been reported or where Sloth Bears were likely to occur were emphasised. In addition, we pooled our personal observations on Sloth Bears that we had acquired during our respective wildlife studies, from about 25 different areas, spread across India (in the Western Ghats, central India and western Shivalik/Terai areas). Printed issues of five journals, from 1990 to 2002, namely *JBNHS*, *Indian Forester*, *Tigerpaper*, *Sanctuary Asia* and *Hornbill* were searched for information on Sloth Bear distribution and status. Only reports referring to specific observations of Sloth Bears were used. Any passing mention of Sloth Bear presence, as in checklists, without further confirmation was disregarded. In addition, issues of the *JBNHS* published from 1910-72 were searched specifically for information on areas where Sloth Bears were reported or suspected to have become extinct recently, to verify if they existed in those areas in the past. The information given by questionnaire respondents was verified with our observations, other persons knowledgeable about the reported area, or with literature, if any available. However, we recognise that it may not be possible to completely avoid errors in this type of database, which is based substantially on second-hand information. Any such infrequent errors, however, would not influence the broad patterns and regional-level status that we discuss here. For the areas where the Sloth Bear was reported to be "absent" or "locally extirpated", being certain about its absence there, would not be realistic, and so we assumed that there was a high probability that the Sloth Bear did not occur there or occurred only at very low densities.

Sizes of PAs were taken from Rodgers *et al.* (2002), and for non-PAs, sizes given by the respondents were used. To estimate potential habitat available for Sloth Bears in India, tropical forests falling within or contiguous with the known distributional limit were used. The potential habitat in PAs was estimated from Rodgers *et al.* (2002), and for non-PAs, from the State forest cover estimates of FSI (1997). Relative composition of forest cover in India, in terms of the main tropical forest types, was calculated from ICFRE (2000). For all analyses, only the five major tropical forest types, namely, Wet Evergreen, Semi-evergreen, Moist Deciduous, Dry Deciduous and Dry Scrub (or thorn forest) were considered.

The relative abundance rank assigned by the respondents for each reported location and the size of those locations were used to calculate the proportion of area falling into each rank. Since a few areas were expected to have population estimates based on reliable and rigorous methods, we disregarded the data on population sizes given by the

respondents or those found in literature. Instead, we used the relative abundance ranking provided by the respondents to estimate Sloth Bear population size. These rankings were more reliable because they were based on both sightings and signs, and often on a long-term knowledge of the area. We calibrated the relative abundance ranks, with minimum and maximum likely average densities corresponding to each rank (rare = 1-2; occasional = 2-4; frequent = 6-10; abundant = 8-14 bears / 100 sq. km). These average density ranges were developed based on the estimate the first author has made during a radio tracking study on Sloth Bears in Panna, central India (K. Yoganand, unpublished data), and the first-hand knowledge we have gathered while working in other Sloth Bear habitats across India. This range of density values reflects the uncertainty in estimation and is assumed to bracket the likely average density value for each abundance rank.

Forest cover maps of the UNEP-World Conservation Monitoring Center and satellite data of the NOAA Advanced Very High Resolution Radiometer (data from 1992-93), were used to delineate the forest cover in India. Forest areas were categorised into four size classes (< 151 sq. km; 151-300 sq. km; 301-800 sq. km and > 800 sq. km) and four isolation levels (< 1 km; 1-5 km; 5-20 km; > 20 km). Forest patches where Sloth Bears were reported were used to delineate distribution extents and prepare a range map.

RESULTS AND DISCUSSION

Database

Out of the 800 questionnaires distributed, 367 were returned with information ranging from Sloth Bear presence in an area to rankings of relative abundance and perceptions of population trend and possible threats. The literature search yielded 125 more records and we had personal observations for 26 areas, totalling 518 records. About 30% of these were multiple or unverifiable records for some areas. Records covered 361 forest areas, including PAs (53%) and non-PAs (reserve forest, private forests, and some non-protected areas), spread out in 26 different States and Union Territories of India. Wildlife researchers provided 42%, Forest Department personnel provided 33%, and naturalists and non-governmental environmental organisations provided 25% of the records. Of the 361 areas, Sloth Bears were reported to be present in 260, not found in 94, and 7 areas needed reconfirmation.

Distribution range in India

Sloth Bear range in India extends from the southernmost forests of the Western Ghats in the south to the forests of the Shivalik ranges along the foothills of the Himalaya, in the north. The Aravalli Hills of Rajasthan to the west and the

floodplain habitats of Assam to the east, form the limits of its range west to east. Within this extent, Sloth Bears are found in most areas where large patches of forests exist (Fig. 1). However, the populations have become fragmented at both scales, between and within regions, into several discrete units. Outside these main units, some isolated forest patches in the middle of Deccan Plateau in the states of Karnataka and Andhra Pradesh, and the isolated, broken hills of the Eastern Ghats of Tamil Nadu hold Sloth Bears. The Sloth Bear reports from Garo Hills, Mizo Hills and Tripura State in the Northeast need confirmation.

Distribution among forest types

Sloth Bears occur more frequently in Moist and Dry Deciduous Forests (42% and 33% respectively, together constituting 75% of the reported areas), and less frequently in Wet Evergreen (13%) and Dry Scrub (6%) type of forests. In terms of area, over 90% of the area where Sloth Bears occur is Moist and Dry Deciduous forests (Fig. 2). A large proportion of Dry and Moist Deciduous Forests hold Sloth Bears at high-abundance (64% and 46% of areas, respectively), whereas, Sloth Bears occur in low-abundance in a majority of Evergreen and most Dry Scrub areas. The Dry Scrub type constitute about 8% of the forest cover of India, whereas, it forms only a little over 1% of the area of occurrence of Sloth Bears. In summary, the Sloth Bear seems essentially to be a tropical deciduous forest species.

Population status

Of the 260 areas where Sloth Bears were reported to be present, relative abundance ranking was given for 213 areas. Of these, only in 4.2% of the areas Sloth Bears were "abundant", in 44.1% they were "frequent", in 36.2% they were "occasional", and in 15.5% they were "rare". Over two-thirds (68%) of the high-abundance areas (ranked as abundant or frequent) were in PAs, in contrast to 59% of the low-abundance (ranked as occasional or rare) areas or 67% of areas where Sloth Bears were "rare" were in non-PAs.

Sloth Bears occur in high abundance mostly in central Indian and Western Ghats regions. Of the areas where Sloth Bears exist in high abundance (n=80), about 58% were either large or moderately large areas. However, some areas (20%) were also very small in size. Most of these small or very small areas, however, are contiguous with adjoining forests or are part of large forest patches. Among the areas with low abundance (n = 69), about two-thirds are small or very small in size (Fig. 3). The rest of the areas having a low abundance of Sloth Bears, despite larger sizes are perhaps due to other factors. In addition to size, isolation, location in the range (central or peripheral), habitat quality, degradation level and

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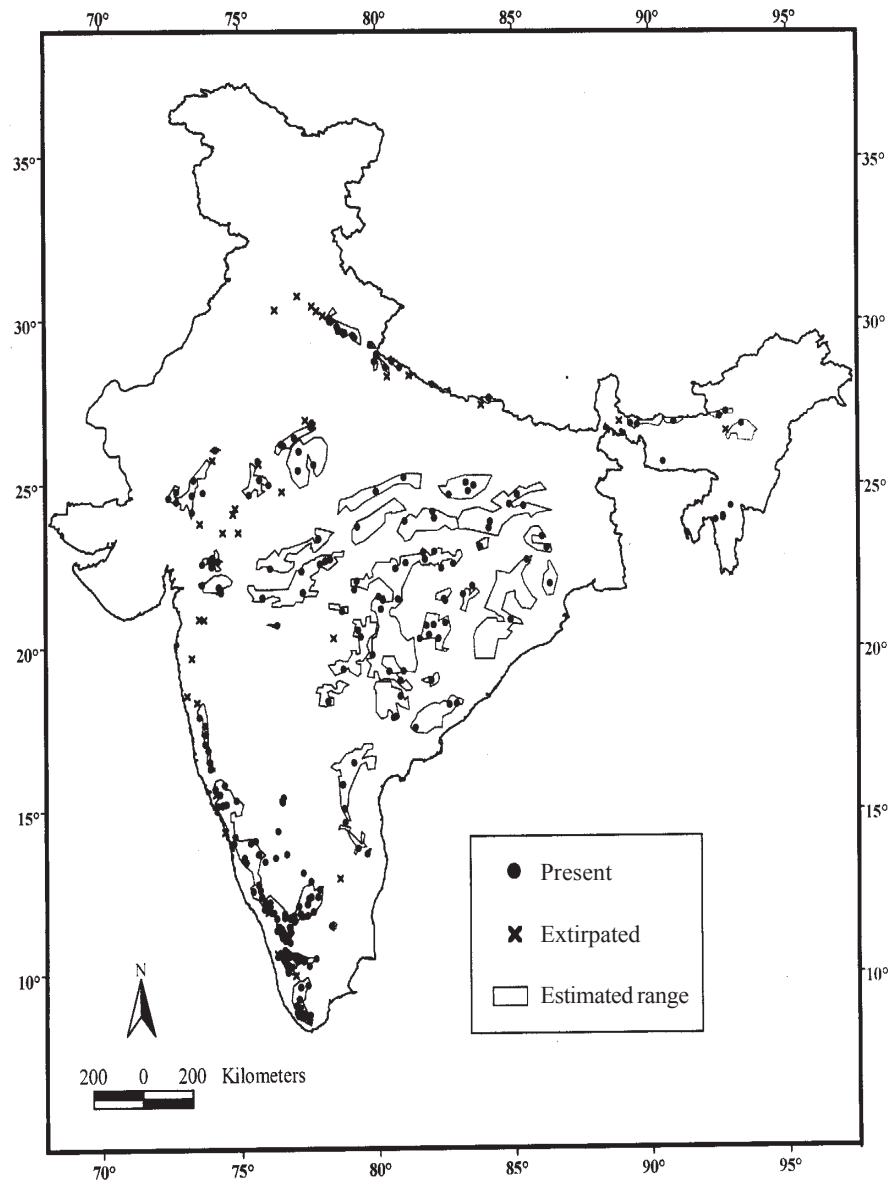


Fig. 1: Estimated range of Sloth Bear in India, as derived from the present forest cover, a limited field survey and an extensive questionnaire and literature survey. Locations of forest areas presently having Sloth Bears and where they have been recently extirpated are marked

human-induced mortality may be the other factors determining distribution and abundance.

Isolation, from the nearest large forest patch or Sloth Bear population, appears to be another factor related to abundance (Fig. 4). It has been found that 58% of the high-abundance areas (n = 100) are contiguous or only slightly isolated (< 1 km distance). Only 10% of the highly isolated (> 20 km distance) areas have high Sloth Bear abundance, and in a majority of these areas, Sloth Bears were on the decline. In contrast, the areas where Sloth Bear population trend was rated as increasing (n = 24), 79% are not isolated, or minimally isolated. Most (65%) of these increasing populations also occur in large or moderately large areas

(Fig. 3). Of the rest (35%; areas smaller than 301 sq. km), most are contiguous with adjoining forests. Also, most of the increasing populations are in the centre of the range, where large forest patches still occur, in contrast to the declining ones, which are along the peripheries of the range. Some forests are better protected now and hence the habitats are probably recovering from past degradation. Bear populations may also be recovering from former low levels in these areas.

Sloth Bears have become locally extinct in 35 forest areas in recent times. Most of these areas lie in the northern Western Ghats (Maharashtra and Gujarat states), the north-western semi-arid area (Rajasthan, Gujarat, Madhya Pradesh) and the western Shivalik/Terai (Uttarakhand, Uttar Pradesh;

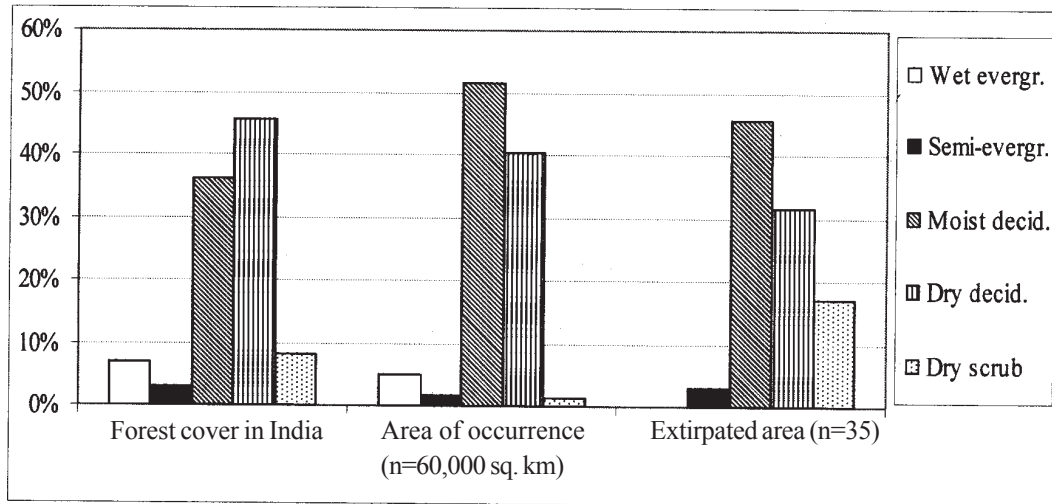


Fig. 2: Relative composition of forest cover in India, relative distribution of area of occurrence of Sloth Bears and relative composition of areas where Sloth Bears have recently been extirpated, in terms of five major tropical forest types

Fig. 1). However, some areas are in the southern and middle Western Ghats region (mostly in Kerala). Furthermore, information from the north-eastern region was scanty and there might be areas where Sloth Bear populations might have recently been extirpated. Of the extirpated areas, 71% are small or very small and none is large in size (more than 800 sq. km; Fig. 3). However, some areas (29%) are also moderately large (between 301 and 800 sq. km), indicating that, apart from size, other factors too contributed to local extinction, such as isolation, which seems to be a major factor. It was found that 69% of the extirpated areas (n = 35) are highly or moderately isolated (Fig. 4) and only 7 areas are not or only slightly isolated. Also, most of the extirpated areas are on the peripheries of the Sloth Bear range. It is important to note

that patch size or isolation *per se*, often may not cause Sloth Bear decline or extirpation, but these conditions aggravate the impact, of human caused habitat degradation and killing, on Sloth Bear populations, by limiting growth of populations and immigration of Sloth Bears from adjacent areas.

Population projection

We used minimum and maximum likely average densities and the proportional forest area corresponding to each abundance rank, and then projected those to 60,000 sq. km of potential habitat in PAs, and 200,000 sq. km of potential habitat in non-PAs. This yielded minimum and maximum population estimates of 9,858 and 17,424 Sloth Bears in India. Out of these, about 30% are in PAs. Although over two-thirds of the

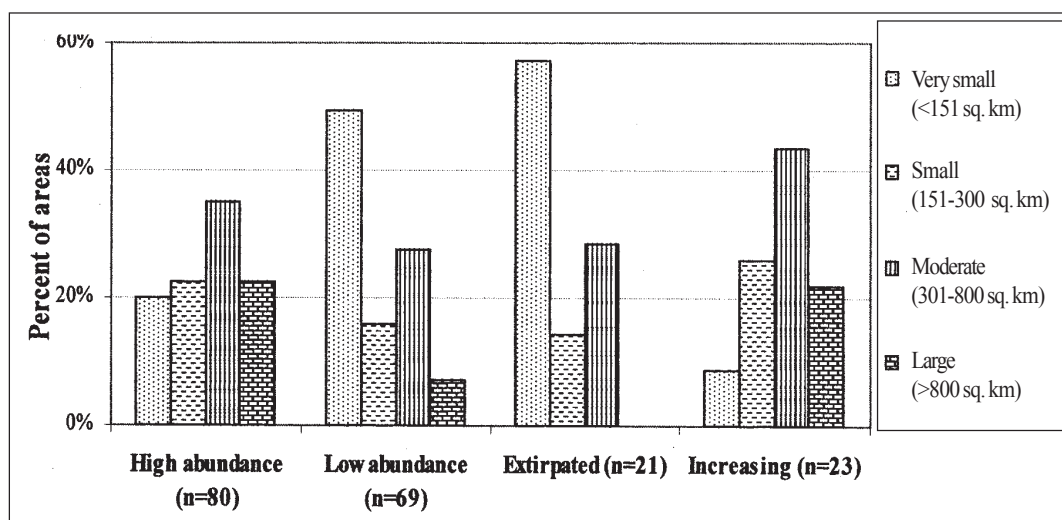


Fig. 3: Relative distribution of forest areas in each size class (demarcated by administrative boundaries) for each status category of Sloth Bear populations

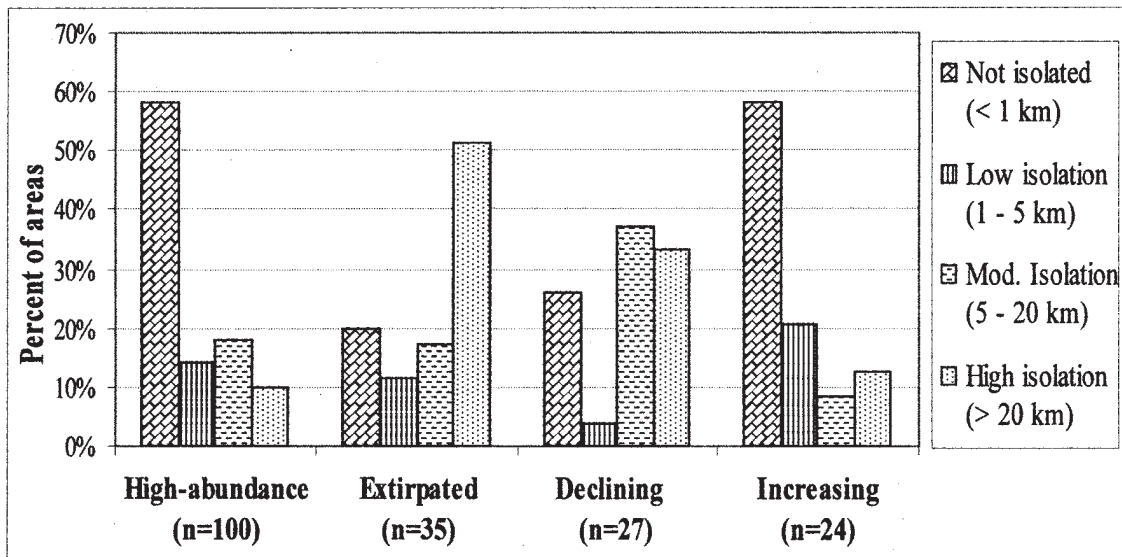


Fig. 4: Relative distribution of forest areas in each isolation class (isolation from nearest large forest patch or Sloth Bear population) for each status category of Sloth Bear populations

population are estimated to be in non-PAs, it is likely that this is an overestimate, for the following reasons. Non-PAs were represented by a disproportionately low sample (only about 20,000 sq. km or 10% of the potential non-PA habitat are represented in this data set). Also, most of the non-PAs from where data were received were adjoining PAs and hence are likely to have high abundance of Sloth Bears. However, these are not representative of all non-PAs, as locations away from or non-contiguous with PAs are likely to have poorer habitat and populations in low abundance. The extent of potential Sloth Bear habitat used in the population projection is estimated from total forest cover, which included up to 40% degraded areas (FSI 1997, NFAP-MEF 1999). These degraded areas would reduce the estimated potential habitat by a substantial amount. Considering these factors, we assumed that a well-represented non-PA data set would have about half the abundance level of the present one (as indicated by the limited data we have). Consequently, the estimated population size in non-PAs would reduce by half. This reduction means that the estimated total population size could be between 6,000 and 11,000, with PAs holding about a little over half of the total population.

Habitat Status

Tropical Dry and Moist Deciduous Forests are the dominant forest types in India, constituting over 80% of the tropical forests (Fig. 2). About two-thirds of these forests presently hold or are thought to hold Sloth Bears, out of which about 40% are degraded (FSI 1997) and probably have Sloth Bears only at very low densities. Therefore, only about

30% of the forest area of India can be considered as high quality habitats for the Sloth Bear. Even within these high quality habitats, only about 25% - 30% might be protected (NFAP-MEF 1999, Rodgers *et al.* 2002) and can be considered secure habitat. In other words, only about 10% of the forest area or 2% of the geographical area of India can be considered as secure habitat of high quality for the Sloth Bear. However, the decline in forest cover in India seems to have been arrested and in the last two decades there has only been a marginal decrease in the forest cover and only a marginal increase in degraded areas (data period 1981-95; NFAP-MEF 1999). In fact, from 1993 onwards, the forest cover seems to have increased considerably, from 19.3% to 20.6% of the geographical area of India (FSI 2001). These statistics on increase in forest cover are debatable, considering the inconsistency in estimation methods. Nevertheless, the encouraging trend is that forests with over 40% canopy density have increased from 11.17% in 1993-95 to 12.68% at present, indicating a recovery from degradation. Also, the area under PAs has increased from 109,652 sq. km in 1988 to 154,573 sq. km in 2002, raising the level from 17% to 23% of forest cover of India (Rodgers *et al.* 2002).

The Western Ghats and central Indian highlands still have relatively extensive habitats for Sloth Bears. The Sloth Bear population is contiguous over large areas in these regions and they also seem to occur in high abundance in several areas in these regions. However, these regions are also considerably fragmented. The north-western semi-arid region is highly isolated from the adjacent central Indian forests and is also severely fragmented, as are the western

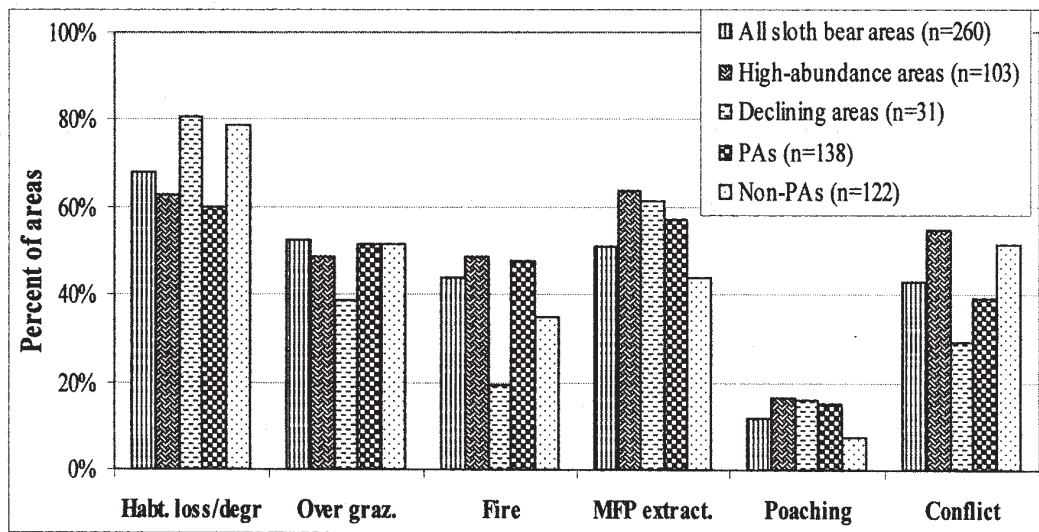


Fig. 5: Percent of forest areas having Sloth Bears facing various threats, as reported in literature or by respondents to a questionnaire survey

and eastern Shivalik/Terai regions that have also become isolated from the rest of the populations. The fragmented Eastern Ghats range has some large patches of forests in the southern, middle and northern parts, which however are isolated from each other and are largely fragmented within the patches.

Threats

Respondents considered habitat loss or degradation, overgrazing, over-extraction of minor forest produce and related human disturbances, fire damage, and conflict with humans, as the top five threats to the Sloth Bear and its habitat (Fig. 5). Surprisingly, poaching (including poaching of cubs to be kept captive) was considered a lesser threat. Habitat loss or degradation was the most frequent threat in the Sloth Bear areas, reported in 68% of the areas. It was consistently ranked as the top threat in groups of areas (including high-abundance, PAs, non-PAs, extirpated, declining), indicating its widespread prevalence, except in the areas where Sloth Bear populations were reported to be increasing. In the areas where populations were reported to be declining, habitat loss or degradation was reported in over 80% of the areas, suggesting that this threat contributes greatly to population decline.

Although conflict with humans was considered a threat in over 40% of all Sloth Bear areas, it is disproportionately more frequent in areas of high Sloth Bear abundance. However, this may just be a coincidence, as frequency of conflict would depend greatly on the degree of use of these forest areas by people (K. Yoganand, unpublished). Poaching was reported to be a threat in only 12% of all areas, and not more than 20%,

even in non-PAs, declining or extirpated areas. Poaching was reported mainly from eastern and north-eastern parts of central India, western Terai, and central and northern parts of Eastern Ghats. Many of the forests adjoining, or in between the areas reported to have poaching, are highly likely to face poaching, but have not been reported to be so. This suggests that either poaching of Sloth Bears was truly infrequent or respondents and authors were unaware of poaching or reporting poaching was considered a disgrace and was intentionally not reported. In summary, small sizes of forest patches, fragmentation and resultant isolation, loss of deciduous forests, habitat degradation, and possibly poaching are the major threats facing Sloth Bear populations. However, a comprehensive threat assessment can be accomplished only based on data from extensive field surveys.

CONSERVATION REQUIREMENTS

It is not possible for us at this stage, with the limited data and without a comprehensive field assessment, to make specific recommendations. The first author is presently conducting such a field assessment and based on that assessment a landscape level conservation plan for the Sloth Bear will be prepared. Therefore, on the basis of the present analysis, we suggest certain general conservation requirements:

1. Populations should be maintained in all the regions of India, keeping the regions as the basic units for conservation planning, rather than considering the whole of India as one unit.
2. Forest areas along the fringes of Sloth Bear distributional

range, highly fragmented regions, and isolated populations need to have specific conservation plans focussed on the Sloth Bears.

3. Sloth Bears may be reintroduced to extirpated areas where large, contiguous deciduous forests still exist (e.g. Rajaji National Park, in the part to the west of River Ganga).
4. Until suitable population estimation techniques are developed, Sloth Bear populations should be monitored using indices of population abundance and a statistically sound protocol. One such protocol was outlined by Yoganand and Rice (in review), which was also demonstrated at a workshop held for the Sloth Bear range PA managers, in Panna, in September 2001. This population monitoring method uses incidences of Sloth Bear signs as indices of population abundance. The survey involves counting Sloth Bear scats and diggings along forest trails, obtaining the required number of replicate samples to achieve enough statistical power to detect changes in the population. This method can be used to monitor changes in Sloth Bear population, in an area, over time, but its utility for comparing Sloth Bear abundance among different areas appears to be minimal.
5. Large patches of deciduous forests are required to be protected, to maintain Sloth Bears in high abundance, and these can act as source populations for surrounding smaller patches.
6. Contiguity between forest patches needs to be maintained (and should be restored where it has been lost), to facilitate movement among patches and dispersal to peripheral or weakly connected areas.
7. Habitat degradation in small or isolated areas that still hold Sloth Bears needs to be arrested, if these populations are to be stopped from becoming locally extinct.
8. Habitats should be restored in degraded areas where populations are declining. This restoration would also significantly expand the habitat available for Sloth Bears (over 400,000 sq. km of administrative forest area in India is composed of degraded forest, scrub or with no forest cover – FSI 1997).
9. PAs in India sustain about half of the population of Sloth Bears, which perhaps is as small as 3,000. PA coverage of Indian forests should be increased to include a greater proportion of Sloth Bear habitats, particularly in the stronghold areas. For instance, central Indian forests require to be better covered in the PA network (Rodgers *et al.* 2002). Large patches of forests and areas that are important in providing connectivity

between forest patches should be given a priority in future expansion of the PA coverage.

10. Many PAs are small in size and isolated from each other. PA sizes should be increased to include at least 800 sq. km of area, where forests exist, so as to hold a viable population of at least 50 adults (assuming a median density of 6 bears/100 sq. km).
11. Conflicts between people and bears that result in physical attacks should be managed effectively. There are some measures that could be applied over a wide area, where bear attacks are defensive, to reduce the frequency of attacks (K. Yoganand, unpublished). These measures include; asking people to avoid localities of dense shrub cover, avoid using the forests in the crepuscular period, suggesting that the forest management does not allow people to use localities or habitats that are frequently used by Sloth Bears (such as escarpments and hillocks). In areas where the conflict is of a different nature or is serious, site-specific assessment needs to be done to determine appropriate conflict reduction measures.
12. Localities where poaching of bears or bear cubs might be occurring frequently should be identified and the poaching stopped.

CONCLUSION

We have conducted this spatial analysis based primarily on derived data and the limited experience we have researching the Sloth Bear and surveying its habitat. However, broad-level patterns in the Sloth Bear distribution and some underlying factors causing such patterns have been identified by this analysis. We have produced a notable distribution map that can be a base for further improvements. We have also assessed the status of Sloth Bear populations and their habitats and evaluated the possible threats. Nevertheless, the methods that were followed to obtain the original data by various respondents and authors are largely unverified and we have neither a measure of accuracy nor an estimate of error in the data. Therefore, the results presented here are best viewed as a starting point from which more detailed assessments of Sloth Bear conservation can be developed.

Given the results presented here, the Sloth Bear appears to be secure in only some parts of its range in India. Considering that its total population size may be as low as 6,000 and not all the regional populations are safe and even the stronghold areas are threatened by fragmentation and degradation, the Sloth Bear in India is threatened. However, the potential exists to establish secure populations

throughout the Sloth Bear range, if the conservation requirements outlined here are accomplished quickly.

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REFERENCES

- DUNBAR-BRANDER, A.A.D. (1923): Wild animals in central India. First Indian Edition (1982), Natraj Publishers, Dehradun, India. 296 pp.
- FSI (1987): State of the forest report: 1987. Forest Survey of India, Dehradun. 87 pp.
- FSI (1997): State of the forest report: 1997. Forest Survey of India, Dehradun. 72 pp.
- FSI (2001): State of the forest report: 2001. Forest Survey of India, Dehradun. 130 pp.
- GARSHELIS, D.L., A.R. JOSHI, J.L.D. SMITH & C.G. RICE (1999): Sloth bear conservation action plan. *In*: Bears: Status survey and conservation action plan (Eds. Servheen, C. & B. Peyton). IUCN/SSC Bear and Polar Bear Specialist Groups. IUCN, Gland, Switzerland. 309 pp.
- GILBERT, R. (1897): Notes on the Indian Bear (*Melursus ursinus*). *J. Bombay Nat. Hist. Soc.* 10: 688-690.
- ICFRE (2000): Forestry Statistics of India. Indian Council for Forestry Research and Education, Dehradun. 308 pp.
- JAFFESON, R.C. (1975): *Melursus ursinus* survival status and conditions. R.C. Jaffeson, Washington, D.C. Unpublished Report.
- KRISHNAN, M. (1972): An ecological survey of the large mammals of peninsular India. *J. Bombay Nat. Hist. Soc.* 69: 47-49.
- NFAP-MEF. (1999): National Forestry Action Programme - India. Vol. 1. Ministry of Environment and Forests, Government of India, New Delhi, India. 179 pp.
- PHYTHIAN-ADAMS, E.G. (1950): Jungle memories: Part V – Bears. *J. Bombay Nat. Hist. Soc.* 49: 1-8.
- PRATER, S.H. (1948): The Book of Indian Animals. Bombay Natural History Society, Mumbai, India. 324 pp.
- RODGERS, W.A., H.S. PANWAR & V.B. MATHUR (2002): Wildlife protected area network in India: A Review (Executive Summary). Wildlife Institute of India, Dehradun, India. 44 pp.
- SINGH, H.S. (2001): Regional planning for Sloth Bear (*Melursus ursinus*) conservation in the western India. Unpublished.
- WROUGHTON, R.C. (1912): Bombay Natural History Society's mammal survey of India. *J. Bombay Nat. Hist. Soc.* 21: 392-410.

IS THE SLOTH BEAR IN INDIA SECURE?

Appendix 1: The questionnaire that was mailed to wildlife researchers, managers, naturalists, and non-governmental organisations working in various parts of India, to gather information on Sloth Bear distribution and status.

SLOTH BEAR DISTRIBUTION AND STATUS – QUESTIONNAIRE SURVEY

Wildlife Institute of India is carrying out a study on the ecology of the Sloth Bear in Panna National Park with the support of the US Fish and Wildlife Service. As part of the study, we are conducting a questionnaire survey to assess the status and distribution of the Sloth Bear throughout India. The information you provide will be valuable for the conservation of the species. Choose from the choices, or give your brief answers. Please make copies if you have information for more than one area. We appreciate your help and concern for the Sloth Bear.

Reporter Name: _____ Title: _____

Address: _____

Name of the forest area: _____

Forest status: National Park/ Wildlife Sanctuary/ Reserve Forest/ Private Forest/ Non-protected

Forest type: Evergreen/ Moist Deciduous/ Dry Deciduous/ Grassland/ Hilly, Rocky area/ Degraded scrub

1. In your area, the Sloth Bear is Abundant/ Frequent/ Occasional/ Rare/ Not found

2. Its distribution is: Widespread/ Localised/ Seasonal

3. Approximate number of Sloth Bears in your area: _____

Approximate area covered in your estimate: _____ sq. km/ ha

4. Your abundance estimate is based on: Sightings/ Signs/ Forest Dept. census/ Interviewing local people

5. Bear diggings (excavations for feeding on ants & termites) are: Common/ Rare/ Not seen

6. Bear population trend: Increasing/ Declining/ Stable

7. What are the threats to bears in your area? Habitat loss/ Degradation/ Grazing/ Felling/ Fire

Minor forest products collection/ Encroachment/ Monoculture plantations/ Trade in Bear parts/ Cub poaching

Conflict with people/ Killing nuisance Bears/ any other (please specify)

8. Were the Sloth Bears formerly present, but extinct now? Yes/ No
If yes, what reasons would you give?

9. Prospect for Sloth Bear survival in your area: Good/ Fair/ Poor

10. Any other comments:

Kindly return filled-up forms (complete or part) to: K. Yoganand, c/o Dr. A.J.T. Johnsingh, Wildlife Institute of India, P.O. Box 18, Dehradun 248001, U.P., India.