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Authors: K. YOGANAND, CLIFFORD G. RICE AND A. J. T. JOHNSINGH

SLOTH BEAR *Melursus ursinus*

Order *Carnivora*
Family *Ursidae*
Genus *Melursus*
Species *ursinus*

INTRODUCTION

The sloth bear is entirely tropical and sub-tropical in distribution, endemic to the Indian subcontinent, perhaps evolved within its limits, and possesses several morphological, physiological and behavioural adaptations to the tropical habitat and the myrmecophagus (feeding on ants and termites) feeding niche it relies on.

Most tropical regions are impacted by expanding human population and accompanying socio-economic inequality and underdevelopment. This has lead to the destruction of forest habitats and has put the wildlife of tropical regions in a precarious status. The sloth bear's range has shrunk in recent times and the populations have become fragmented, threatening its overall survival. Active management of the existing populations and their degrading habitat is necessary for the long-term conservation of the species.

DESCRIPTION

Physical characteristics

Sloth bears are typically black, but sometimes have a blackish brown tinge on the coat. Rarely, fully brown individuals have been observed (Pocock 1933, Prater 1965, Brander 1982). A V- or U-shaped, whitish or buff coloured breast patch is present, although lacking in rare cases, as in some Sri Lankan individuals (Pocock 1933). The long, pale muzzle is sparsely covered with thin, short, greyish white hair. The forehead region from just below the eyes up to the ears, and sides of the head are covered with short black hair. The neck region, from behind their thick ears to the shoulder, possesses dense, long hair (up to 30 cm

long). The rest of the body is covered with long coarse hair, perhaps variable in colour, texture and length according to season (Pocock 1933), and lacks underfur.

Sloth bears stand 65-85 cm at shoulder and are 140-170 cm from nose to tail. Adult males weigh between 80 and 150 kg, are larger than adult females, which weigh between 60 and 100 kg (Prater 1965, Garshelis *et al.* 1999a, Yoganand K. unpubl. data).

The rhinarium has a mobile projection, with which it can close the nostrils. This is perhaps an adaptation to its mode of feeding on ants and termites (Pocock 1933). Compared to other bear species, the lips and tongue are exceptionally protrusible, which helps in feeding on these social insects. The posterior part of the palate is broad and long, a feature common in other ant-eating mammals. A typical characteristic of this species is the structure of the anterior palate, which has a shallow, concave, saucer like area bordered by the incisors and a transverse ridge formed between the upper canines (Erdbrink 1953). Sloth bear possess the same number of teeth as other bears (6 upper and 6 lower incisors, 2 upper and 2 lower canines, 8 upper and 8 lower premolars, and 4 molars in the upper jaw and 6 in the lower). Both incisors are present, in a reduced state, in the milk dentition (Pocock 1933). However, they lose the first two upper incisors at an early stage, which is a characteristic feature of this species (Erdbrink 1953). The molars are relatively small compared to those of other bears, in keeping with the softer and more easily digestible diet.

The front claws of sloth bears are long (up to 7 cm) and curved, an adaptation for digging. They vary to some extent in colour, from greyish to dirty-white or ivory-white. The claws on the hind leg are shorter (about 3 cm). The short hind legs of the sloth bear are suggestive of an adaptation for digging, as the hind legs might help in stabilising the body when the forelimbs dig (Harris and Steudel 1997). The soles on the feet are naked. The five digital pads are arranged in a line and are fused together up to their distal ends.

Nomenclature and taxonomy

The first description of the sloth bear was given by Shaw (Shaw and Nodder 1791) who named it *Bradypus ursinus* or a bear-like sloth. This species was initially assumed to be a sloth because of the shared characteristics with sloths – long claws and the absence of upper middle incisors (Erdbrink 1953). Meyer (1793, cited in Erdbrink 1953) was the first to recognise this animal as a bear and not a sloth, and gave it an appropriate name *Melursus lybius*. De Blainville (1817) gave it the name *Ursus labiatus*, identifying the animal as belonging to the genus *Ursus*.

Lydekker (1884, cited in Erdbrink 1953) felt that this species should be placed in the genus *Ursus*, because the dentitional differences from other bears are not so great as to warrant a separate genus. On account of other significant differences, Erdbrink (1953) suggested recognition at a subgenerical level and named it *Ursus (Melursus) ursinus* Shaw.

Although the subfamily *Ursinae* is agreed to be of monophyletic origin, there is disagreement as to the relationship within the subfamily. Goldman *et al.* (1989) suggested that all ursids should be classified in the single genus *Ursus*. Talbot and Shields (1996) supposed that the greater morphological divergence of sloth bear was likely to be due to recent adaptive change and not accompanied by molecular evolution. Waits *et al.* (1999) examined the phylogenetic relationships of the bears using mitochondrial DNA analyses and attempted to resolve outstanding ambiguities. They concurred with earlier studies (Zhang and Ryder 1993, Talbot and Shields 1996) that the sloth bear is the basal ursine bear (Figure 1) and a sister taxon to the later five species of bears (excluding the giant panda and the Andean (spectacled) bear that diverged much earlier). The genetic and morphological differentiation of the sloth bear therefore supports the separate placement in the genus *Melursus* (Wozencraft 1989, Corbett and Hill 1991, Waits *et al.* 1999).

Pocock (1933) distinguished two races: the first, *Melursus ursinus ursinus,* occurring in continental India and the second, *Melursus ursinus inornatus*, found only in Sri Lanka. The Sri Lankan race has much shorter hair on the body, making it appear less shaggy. Also the race *inornatus* is smaller in general dimensions, including the dimensions of teeth (Erdbrink 1953). Nevertheless, these observations are yet to be objectively assessed.

Evolutionary history

The sloth bear may have existed in its present form from the beginning of the Pleistocene Epoch (Erdbrink 1953), a period when the bears speciated and dispersed (Kurten 1968, Talbot and Shields 1996). A fossilised fragment of a humerus bone from the Pleistocene was found in the Kurnool basin of Andhra Pradesh and it is identical to modern specimens. According to Erdbrink (1953), it is not clear if the fossilised cranium from the early Pleistocene or late Pliocene found in the Shivaliks, is an intermediate stage between the sloth bear and the ancestor of the brown bear (*Ursus arctos*). This fossil, named *Melursus theobaldi* by earlier workers, has teeth of intermediate size between *M. ursinus* and other bears. However, because this fossil has a palate of the same peculiar form as present day sloth bear, Erdbrink believed that *M. theobaldi* is clearly a direct ancestor of the sloth bear.

The sloth bear probably radiated from the ancestral stalk of ursids during the mid-Pliocene (Erdbrink 1953, Kurten 1968, Goldman *et al.* 1989, Talbot and Shields 1996) and evolved within the subtropical region, developing several morphological characteristics suited to its feeding niche and its habitat. Several features of the sloth bear appear to be concordant with the convergent evolution in other mammalian anteaters (Redford 1987, Joshi *et al.* 1999), including low reproductive rate, solitary habits, extended parental care, extensive carrying of young by the mother, and a low basal metabolic rate (McNab 1992). However, the low reproductive rate, solitary habits and extended parental care are features of the *Ursidae* in general. The basal metabolic rate of sloth bear too is similar to the omnivorous American black bear (*Ursus americanus*) (McNab 1992). Thus, it appears that the only feature that distinguishes the sloth bear from other omnivorous bears is the carrying of the young. This feature, however, is more likely to have been evolved because of predation pressure in the sloth bear habitat rather than myrmecophagy (Joshi *et al*. 1999).

GEOGRAPHICAL AND ECOLOGICAL DISTRIBUTION

Past and present distribution

The sloth bear is endemic to the Indian subcontinent. It is found in India, Nepal, Bhutan, and Sri Lanka (and perhaps in Bangladesh), in most low-altitude, non-arid areas where forest cover still remains. In India, it ranges from the southern tip of the Western Ghats mountain ranges to the foothills of the Himalayas (Figure 2). Its western distribution is limited by the desert regions of Rajasthan. To the east, the range is bounded by the wet forests of the Naga hills of north-eastern India. To the north, along the Himalayan foothills, its range overlaps slightly with the range of the Asiatic black bear (*Ursus thibetanus*). In the north-eastern portions of its range (in the states of Assam and Mizoram), it may overlap with the range of Malayan sun bear (*Ursus malayanus*).

In Nepal and Bhutan, sloth bears occur in the lowland terai grasslands and the Shivalik hill ranges, but has recently been extirpated in parts of Nepal (Garshelis *et al.* 1999a). It may still occur in the wet forest regions of eastern Bangladesh (Khan 1988, cited in Servheen 1990) bordering the Mizoram state of India, from where it has been reported (Yoganand *et al.* 1999). However, it has been extirpated from the moist deciduous forests of central Bangladesh (Khan 1982, Servheen 1990). In Sri Lanka, it is presently found only in the northern and eastern lowland forests, and even in these areas it may no longer occur in most of the degraded areas. In the past, it was also found in the north central and in the eastern areas of the southern province, including the hill country (Santiapillai and Santiapillai 1990).

In the past, sloth bears appear to have been found in largely the same area as the present range, except that the present range has shrunk along its peripheries and has become fragmented overall, concurrent with shrinking forest cover and perhaps to some extent due to over-hunting (Garshelis *et al.* 1999a). Recent local extirpations and population declines have also been reported from the north-western populations (in the state of Rajasthan), a few isolated forests in the northern Western Ghats and adjoining areas, along the north-western Shivalik hills (no recent record of sloth bears to the west of River Ganga), the northern forested areas of the state of West Bengal bordering Sikkim and Bhutan, and in the north-eastern states of India (Yoganand *et al.* 1999).

The forests of the Western Ghats and the central Indian highlands are currently the two strongholds of the sloth bear (Yoganand *et al.* 1999, Figure 2). The populations in Terai/Shivaliks and in the north-eastern India have probably become isolated from the rest and face high poaching pressure. In terms of forest type, dry and moist deciduous forests together hold the major proportion of the sloth bear population (about 90%). About 30% of the forest remaining in India are of dry deciduous type, and these forests hold about 50% of the sloth bear population. However, sloth bears appear to occur at higher densities in the moist deciduous forests compared to other forest types (Yoganand *et al.* 1999).

Adaptation to the environment

Sloth bears exhibit several adaptations to their sub-tropical and tropical habitat and to their diet. The various interacting selective pressures on the species have apparently constrained it to evolve several seemingly paradoxical morphological features. To suit the tropics, it has no underfur; however, it has a long coat that perhaps helps in defending it from insect bites and also perhaps to exaggerate its size to predators (such as tiger and leopard) or conspecifics. The sloth bear's low metabolic rate and high thermal conductance (McNab 1992) may be advantageous in the hot climates where it lives, in that it reduces heat production and facilitates heat loss. Sloth bears seem to also have a behavioural adaptation to avoid hot weather conditions in their habitat by reducing daytime activity (Yoganand unpubl. data). In accordance with what Clutton-Brock and Harvey (1983) suggested as advantages of having large body size, we speculate that the large body size of the sloth bear might help it to conserve heat; to travel great distances in search of its dispersed, seasonal food; to enhance the ability to survive on qualitatively poorer food of insects and fruits; to enable it to break hard termite mounds and to dig deep into social insect colonies; or to help it store fat and live on it during periods of shortage and during parturition denning.

The monsoonal climate of the Indian subcontinent and the resultant seasonality of resource availability may have acted as selective pressures on the ancestor of the sloth bear to evolve to its present form, as suggested by Laurie and Seidensticker (1977). They also suggested that the sloth bear's morphological and behavioural adaptations that are mostly driven by food finding are adapted for hard times when the food is limited. Abundant fruit availability is limited to a few months, there is an annual variability in the production of fruits and there is also a spatial variability in fruit availability across its range. Sloth bears have to subsist on other stable food resources like termites that are available more or less year-round. Although the sloth bear has diverged towards a diet comprising a lot of social insects, it has retained the ability to use a variety of foods, in conformation with its omnivorous ancestry.

POPULATION BIOLOGY

Population size and density

The only rigorous density estimate for any population of this species was made by Garshelis *et al.* (1999b). They used mark-recapture models to estimate density, based on sightings of bears accompanying radiocollared bears in Royal Chitwan National Park, Nepal. They arrived at a population estimate of 250 bears or 27 bears / 100 km^2 (excluding dependent young). Yoganand K. (unpubl. data) using radio-collared animals, and familiarity with unmarked but identifiable animals in a 240 km^2 intensive study area in Panna National Park (a dry, low productive habitat as compared to Chitwan), estimated a density of 6-8 bears / 100 km^2.

Sex and age composition

Laurie and Seidensticker (1977) classified 56 adult bears that they encountered in Chitwan between 1972 and 1975. Twenty-nine were males and 27 were females yielding a sex ratio of 1 male : 0.93 female. However, 59 lone bears were unclassified by them and since it is difficult to sex lone bears in the field (Yoganand *pers. observ*., Garshelis *pers. commun*.) it seems likely that the lone females were underestimated in their study. Joshi *et al.* (1995) captured 18 sloth bears in Chitwan between 1990 and 1993 for radio-collaring (mostly in culvert traps), out of which 10 were males and 8 were females, giving a sex ratio of 1 male : 0.8 female. Yoganand K. (unpubl. data) used both Aldrich foot-snares and culvert traps to capture bears in Panna. The sex ratio of the 12 adult bears that were captured turned out to 1 male : 1 female. If these capture methods have an equal probability of capture between sexes (Johnson and Pelton 1980), the sex ratios thus obtained reflect reality. However, if these methods were biased towards capturing more males than females (Dave Garshelis

pers. commun.), then the sex ratio would be biased. Thus, both capture methods and field observations may underestimate females and the real sex ratio may be skewed toward females. Joshi *et al.* (1999) sexed 9 cubs from five litters and the sex ratio was 3 males to 6 females (1 male : 2 females), but this sample size is too small to give a precise estimate of sex ratio at birth or to indicate a difference between birth and adult sex ratios.

Reproduction

Mating generally takes place between May and July and the cubs are born between November and January (Jacobi 1975, Laurie and Seidensticker 1977, Joshi *et al.* 1999, Yoganand K. Unpubl. data). The actual period of pregnancy is shorter, as the fertilised egg is implanted after a period of delay (Puschmann *et al.* 1977), similar to what is observed in the temperate bear species. However, there are reports of cubs being born in other times of the year, especially in Sri Lanka (Norris 1969, Laurie and Seidensticker 1977, Phillips 1984, Gopal 1991).

Cubs are born in secure dens (either natural caves or dens dug by the mother bears). Females sequester themselves in dens for 6-10 weeks, hardly coming out to forage, living on fat reserves and metabolic water during that period (Jacobi 1975, Joshi *et al.* 1999, Yoganand K. unpubl. data). A litter size of two is most common (Laurie and Seidensticker 1977, Joshi *et al.* 1999, Yoganand K. unpubl. data) and litters of three are rare. Litters of one have been commonly observed, although some may represent two-cub litters with early mortality (Joshi *et al.* 1999).

ECOLOGY AND BEHAVIOUR

Habitat

Sloth bears are found in a variety of habitats ranging from wet evergreen forest to dry deciduous and degraded scrub forests. However, their abundance varies in the different habitats, probably depending on resource availability. An analysis based on abundance ranks reported by forest managers, biologists and naturalists working in about 300 forest areas in India indicated that moist deciduous forests had the highest abundance followed by dry deciduous, scrub and evergreen forests (Yoganand *et al.*1999). The highly productive "terai" grasslands (alluvial grasslands along the foothills of the Himalayas), along with the associated moist deciduous forests of the Shivalik hills holds high sloth bear densities, the highest reported density being 27 bears / 100 km^2 from the Royal Chitwan National Park of Nepal (Garshelis *et al.* 1999b).

Sloth bears preferred areas with dense cover in Panna (Yoganand K. unpubl. data). They used escarpment areas and *Lantana* shrub patches frequently for day-resting and foraging. In Chitwan too, they were primarily concentrated in areas with thick cover, although they used all habitats (Laurie and Seidensticker 1977). Joshi *et al.* (1995) observed that sloth bears preferred alluvial grasslands during the dry season. Males moved to upland Sal (*Shorea sp.*) forest during the wet season, perhaps to facilitate foraging on termites, as this becomes difficult in the flooded lowlands. They apparently moved to different habitats and areas according to the availability of food.

Baskaran (1990) reported that (in Mudumalai Wildlife Sanctuary in southern India) sloth bear sign was more frequent in dry deciduous forests and this habitat had greater fruit abundance, more cover and less human disturbance than other habitats in the area. A survey across the lowlands of Nepal indicated that sloth bears were either absent or occurred at low densities in areas with high human use, despite having high termite densities (Garshelis *et al.* 1999b). Thus, although the sloth bear abundance in an area is related to the abundance of resources, which in turn is related to the type of habitat, the level of human disturbance in that area may influence abundance as well.

Ranging and activity

In Chitwan, male sloth bears occupied larger annual home ranges than females (Joshi *et al.* 1995), which was primarily due to larger wet season ranges. Mean home range sizes were 9.4 and 14.4 km^2 for females and males, respectively. Wet season ranges of both males and females were larger (by 1.9 times) than the dry season ranges, and this difference was unrelated to movements to upland Sal forest (Joshi *et al.* 1995). Yoganand K. (unpubl. data) observed that the sloth bears in Panna had much larger annual home ranges (ranged from 25 to 100 km^2 – 95% kernel estimate) and varying sizes of seasonal ranges.

In Chitwan, Joshi *et al.* (1999) found that although the bears were active at all times of the day, they were most active at night (except for females with cubs and subadult bears, which were more active during day and rested at night). Laurie and Seidensticker (1977) observed that the main period of activity of bears was during the evening and night in Chitwan. Sunquist (1982) found that the one adult male bear he studied in Chitwan was active at anytime of the day although the main period of activity was at night. In Panna, sloth bears were mostly nocturnal and crepuscular and they used dens to rest during the day (Yoganand K. unpubl. data). The thermal environment largely influenced this pattern of activity and

usage of day-resting dens in Panna. Thermoregulation is perhaps also responsible for the mostly nocturnal habit of the sloth bear in most of its range.

Food habits

The diet of the sloth bear consists mostly of social insects and fruits. These are predominantly ground-living ants and termites that are common and found in large colonies, and sugar-rich fruits of commonly occurring plants that produce large fruit crops. They climb trees to feed on honey-bee hives and sometimes to feed on fruits (Laurie and Seidensticker 1977, Yoganand K. unpubl. data). But usually fallen ripe fruits are eaten off the ground. Sloth bears break into termite mounds with their front claws, suck in the termites and blow away the debris, and also feed on the 'cartons' which hold the termite brood. They turn over rocks and logs to feed on ant and termite colonies. They also dig as deep as 1.5 m into ground to feed on large underground colonies of social insects (such as ants of the genus *Dorylus*).

Fruits of *Zizyphus mauritiana, Ficus glomerata, Diospyros melanoxylon, Buchanania lanzan, Cassia fistula, Aegle marmelos, Lantana camara, Grewia asiatica, Cordia domestica, Syzigium cumini, Phoenix humilis*, and flowers of *Bassia latifolia* are eaten frequently where these plants occur commonly. The availability of fruits varies with the season as do abundance and nutrient quality of social insects. The diet of the sloth bear follows these patterns of food availability (Joshi *et al.* 1997, Yoganand K. unpubl. data).

In Chitwan, 83% (percentage composition, in terms of relative number of identifiable fragments) of the year-round sloth bear scats was composed of insect remains (Joshi *et al.* 1997). During the non-fruiting season, insects composed 95% of scats and during the fruiting season 58% of scats. Termites were the principal insect prey during all seasons in Chitwan (about 60% composition in the non-fruiting season and 45% in the fruiting season) and fruits comprised a main portion (38%) of their diet during the fruiting season (Joshi *et al.* 1997). However, in Panna, fruits (51% of the consumed biomass) and ants (36% of consumed biomass) were the main food items annually. Termites constituted only about 10% of the consumed biomass annually. In Panna, during the dry season (main fruiting season), fruits contributed about 70% of the consumed biomass and ants about 16%. During the monsoon, fruits contributed 36% and ants 52% of the consumed biomass.

The form that Joshi *et al.* (1997) used to represent diet (composition of scat remains, rather than having converted it to consumed biomass of food items) overestimated the contribution of insects to sloth bear diet and underestimated fruits, to a considerable extent. The studies

prior to Joshi *et al*. (1997) indicated a higher occurrence of fruits than insects in the diet. This could be attributed to the higher abundance and diversity of fruiting plants and longer fruiting season in the habitats south of Chitwan (in the peninsular India). However, the methods used for scat analyses in the past studies had a tendency to underestimate the proportion of insects in the diet. On the whole, the diet of the sloth bear appears to vary across its range, depending on the availability and abundance of various insects and fruits.

Social behaviour

Sloth bears are solitary, but territoriality has not been observed (Laurie and Seidensticker 1977, Joshi *et al.* 1999). Individual home ranges overlap considerably, though the extent of overlap varies among localities, perhaps depending on the resource abundance in an area (Joshi *et al.* 1999, Yoganand K. unpubl. data). Joshi *et al.* (1999) observed that seasonal home ranges overlapped extensively among adults of the same sex (>50%) and between adults and subadults of both sexes (>70%) and that the zones of overlap were used in proportion to their area. However, they observed that subadults and females with dependant young limited their activity to daylight hours and they proposed that this might be to temporally avoid other bears or predators.

All adult males that use the home range of a female may attempt to mate with her when she comes in oestrus. Groups of males congregate around a receptive female and all may breed, apparently in a rank order, as the same order of mating may occur among the same group of males with different females (Joshi *et al.* 1999, Yoganand K. unpubl. data). Occasional noisy interactions between bears were observed during all times of the year, mostly between males. During the mating period there are increased noisy interactions and fighting between males (Laurie and Seidensticker 1977, Joshi *et al.* 1999, Joshi *et al.* 1999, Yoganand K. unpubl. data).

Cubs are frequently carried on their mothers' backs from the time they leave the den until they are about six months of age (Laurie and Seidensticker 1977, Joshi *et al.* 1999). Carrying cubs by the mother seems to be a defence against attacks by predators or other bears. Cubs stay with their mothers for 1.5 or 2.5 years, becoming independent just before the breeding season (Joshi *et al*. 1999). Thus, females breed at either two- or three-year intervals. The mother-young unit is the only long-lasting social grouping exhibited by the sloth bear (Eisenberg and Lockhart 1972, Joshi *et al.* 1999, Yoganand K. unpubl. data).

Sloth bears sometimes gather at abundant food sources, such as a dense patch of a fruiting plant (Johnsingh pers. observ., Yoganand K. unpubl. data). Pairs of subadults (siblings

independent of the mother or unrelated individuals) have been observed to associate for extended periods (Laurie and Seidensticker 1977, Joshi *et al.* 1999). Joshi *et al.* (1999) suggested that this coalition is formed to defend them from older bears or predators. They also recognise that the social system of the sloth bear fits well within the range observed among other bear species, although some traits like cub-carrying and mutual tolerance may be related to myrmecophagy.

Prey/predator relation

Predation has been surmised to be responsible for several behavioural traits of the sloth bear. Joshi *et al.* (1999) reported that in Chitwan, females with cubs and subadults of both sexes were rarely active at night, whereas adult males and lone adult females were at least as active at night as during the day. They proposed that this difference was related to avoidance of nocturnal predators. However, Yoganand K. (unpubl. data) discerned that the activity patterns of sloth bears in Panna are not much affected by predator activity and daytime heat was the major influencing factor. Predators are probably the reason female sloth bears give birth in an underground den, staying in the den for several weeks attending to the cubs, and carrying the cubs on their back for several months while foraging.

Tigers attack and kill sloth bears occasionally (Joshi *et al.* 1999 and the references therein), however encounters between them are fairly common (Yoganand unpubl. data). Leopards (Kurt and Jayasuriya 1968), dholes, and even jackals (filmed in the BBC film “Land of the Tiger”) could be a threat to cubs. Sloth bears do not climb trees as a means of escape or in response to disturbance, but either run away or respond with a loud charge and stand-up display. They may also actively avoid predators or humans when they became aware of their presence well in advance (Yoganand unpubl. data). Laurie and Seidensticker (1977) observed that the aggressive behaviour of sloth bears may be a consequence of not being able to rely on trees for escape, in a habitat that holds tree-climbing predators like leopards, and also makes it advantageous to live in fairly open habitats.

Sloth bears probably consider humans as predators. At close quarters they reacted to human presence, as they would do to a predator (Laurie and Seidensticker 1977, Yoganand K. pers. observ.). They usually roared and ran away, or roared and attacked humans before retreating. Bear attacks on humans are common throughout the range, where bears and humans co-occur (Garshelis *et al.* 1999a, Yoganand *et al.* 1999, Rajpurohit and Krausman 2000).

Communication

Ewer (1973) suggested that the chest markings of the sloth bear may serve to accentuate a threat posture while rearing on hind legs when facing a predator or human. The chest markings and whitish muzzle perhaps act as a visual means to enhance identification and communication when interacting with conspecifics and other cohabitants. Other endemic Asian bears that coexist with tigers (Asiatic black bear and Malayan sun bear) also have the white chest marking, perhaps for the same reasons. Sloth bears are more vocal than other bears, except Malayan sun bears and Andean (spectacled) bears (*Tremarctos ornatus)*, which are probably as vocal as sloth bears (Dave Garshelis *pers. commun.*). They use a variety of calls (summarised in Laurie and Seidensticker 1977) in various contexts, such as, while feeding, when interacting with other bears, or encountering predators and humans. Laurie and Seidensticker (1977) suggested that the sounds they make while feeding may function as an advertisement call and promote intra- and interspecific avoidance.

Sloth bears have been observed to mark trees with their teeth and claws, perhaps for social spacing (Laurie and Seidensticker 1977, Joshi *et al.* 1999, Yoganand K. unpubl. data) or to establish a dominance hierarchy; females could be marking as a means of advertising oestrus condition. Laurie and Seidensticker (1977) observed occasions when adult males scraped the trunks of trees with their fore paws, left claw marks and rubbed their flanks on the trunk. They observed fresh marks only between January and April. Yoganand K. (unpubl. data) observed bears in Panna climbing up soft-trunked trees to a height of up to 8 m and clawing the trees, sometimes also biting the branches. They also sometimes left their faeces around the base of the tree. Most trees were repeatedly marked, perhaps by several individuals. Fresh markings were mostly observed between March and June. Tree marking could serve as a means of visual and olfactory communication among bears, particularly during breeding season.

CONSERVATION

Habitat Status

Garshelis *et al.* (1999a) noted that the ongoing habitat loss and degradation is affecting the continued existence of sloth bears in India. Most Indian sloth bear populations outside protected areas are probably decreasing, and this also holds true for Nepal and Sri Lanka (Santiapillai and Santiapillai 1990). In Nepal, there are only three protected reserves where sloth bears occur (Garshelis *et al.* 1999a). In Bangladesh, the prospects are even poorer as

habitats are heavily disturbed. As an exception, survival prospects for sloth bear in Bhutan are promising, although suitable habitats occur only in a small area along the southern lowlands bordering India.

The degradation and loss of forests, especially outside protected areas, poses a major threat to sloth bear populations. Fragmentation of forests may lead to isolated, non-viable bear populations (Garshelis *et al.* 1999). Degradation, in the form of overgrazing, tree-felling, fire, conversion and reclamation for other uses, and over-extraction of forest resources that are essential for sloth bear survival appear to be occurring throughout the sloth bear range, particularly in the dry forests (Yoganand *et al.* 1999).

Population status

The sloth bear is listed as "Vulnerable" by the IUCN (1996), listed under Appendix I of CITES (all trade and export are banned), protected under Schedule I of the Indian Wildlife (Protection) Act of 1972, and under the Fauna and Flora Protection Ordinance of Sri Lanka. In Nepal, however, the sloth bear can be legally hunted with a license or killed to protect property and people (although very few are legally hunted). Reliable data on its abundance and other population parameters that are essential to determine its exact status are not yet available.

There have been several estimates of total sloth bear population size (Table 1). Jaffeson (1975) conducted the first survey of the status of the sloth bear population in India. Based on mailed questionnaires (to which nine persons, mostly from southern India responded), he estimated an average density of 6 bears / 100 km^2. He extrapolated this density to 260,000-290,000 km^2 of forested range to get an estimate of 7,300 to 8,000 sloth bears in India. In a later survey using questionnaire responses, information from Wildlife Institute of India's database and other published literature, Garshelis *et al.* (1999a) gave an estimate, with reservation, of the world population of the sloth bear as between 10,000 and 25,000, occurring in 56,000 km^2 of protected areas and 200,000-300,000 km^2 of forests outside protected areas. Santiapillai and Santiapillai (1990) estimated a population of 300 to 600 sloth bears in Sri Lanka assuming a density of 5 to 10 bears / 100 km^2. In Royal Chitwan National Park, Nepal, Garshelis *et al.* (1999b) estimated a population of 200-250 bears. They also conducted a survey in most parts of the sloth bear range in Nepal, and estimated that Nepal's sloth bear population as less than 1,000 bears.

Yoganand *et al.* (1999) estimated population size for India by carrying out a questionnaire survey and calibrating the abundance ranks received from the respondents, based on their studies in central India and observations elsewhere. They estimated minimum and maximum values for average densities for each abundance rank (abundant = 8 and 12 bears / 100 km^2; frequent = 6 and 8 bears / 100 km^2; occasional = 3 and 4 bears / 100 km^2; rare = 1 and 2 bears / 100 km^2) and then proportionately extrapolated those average densities to 50,000 km^2 area of suitable protected reserves, and 200,000 km^2 of other potential sloth bear habitat outside reserves. They arrived at a minimum and maximum estimate of 9,000 and 13,000 sloth bears for India.

Existing sloth bear populations face direct threats from both poaching and capture of cubs. Poaching has reportedly caused the decline of sloth bear populations in western central India, terai areas, eastern and north-eastern India (Yoganand *et al.* 1999). Garshelis *et al.* (1999a) reported that sloth bear populations in India appear to be significantly threatened by poaching for trade in body parts, particularly gall bladders. This was deduced from Servheen (1990) who obtained records from TRAFFIC Japan and other agencies that monitor trade in wildlife parts. The sloth bear's low reproductive rate makes it very susceptible to poaching. The capture of cubs from the wild (either stealing the cubs from dens or after killing the mothers) to be reared and used as performing bears poses a significant threat (Santiapillai and Santiapillai 1990, Yoganand K. *pers. observ.*, Seshamani G. and Satyanarayan K., World Society for Protection of Animals, *pers. commun.*). In addition, a considerable number of bears may be persecuted and killed by rural residents as a result of the conflict they have with the bears. Conflict in the form of crop depredation by bears, extraction of forest resources (fruits, honey) by people, destruction and degradation of forest habitats by humans and their livestock and physical encounters in forests leading to attacks are generally common wherever bears and people co-exist (Yoganand *et al.*, 1999).

Conservation implications

Forest areas along the fringes of sloth bear distributional range and isolated habitats need to be managed specifically for bears. Field methods to assess habitat, estimate relative densities, and monitor population trends need to be developed. Field surveys to assess the status of populations and habitat condition throughout the sloth bear range are urgently needed. Anecdotal information on distribution needs to be updated by reliable field surveys.

Garshelis *et al.* (1999a) suggested that the sloth bear distribution should be mapped in relation to forest cover, and discrete population units need to be delineated. These

population units should be the focus of conservation strategies, such as the inclusion of additional protected reserves, corridors between areas, and buffer zones around protected areas. Regeneration of forests outside reserves and restoration of degraded habitats would significantly expand the habitat for sloth bears. Although difficult, managing forests in human dominated landscapes to meet the resource needs of both the local people and wildlife is essential for successful conservation. Attending to the problem of bear-human conflict and managing it in a site-specific way will help generate local support for conservation. Poaching for trade in bear parts and cubs should be curtailed.

Sloth bears have relatively small home ranges compared to other bears and do not make extensive seasonal movements (Joshi *et al.* 1995, Yoganand K. unpubl. data). However, home range sizes vary, apparently in relation to local resource abundance (3- to 5-fold difference between Panna and Chitwan). Due to the low reproductive rate of this species and seasonality of its required resources, moderate to large-sized reserves are required to maintain viable populations. Most protected areas that hold a secure future for the sloth bear are isolated, and travel corridors would be beneficial, but perhaps unrealistic in the human dominated landscapes of the Indian subcontinent. As Garshelis *et al.* (1999a) rightly observe, sloth bear conservation should not be incidental to conservation strategies designed for other species. In order to conserve this species that is unique in its ecology , behaviour, and evolutionary history, we need specific conservation plans and an active management of the existing populations.

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TABLES AND FIGURES

Figure 1: Phylogeny of *Ursidae* based on mitochondrial DNA analysis (from Waits *et al.* 1999)

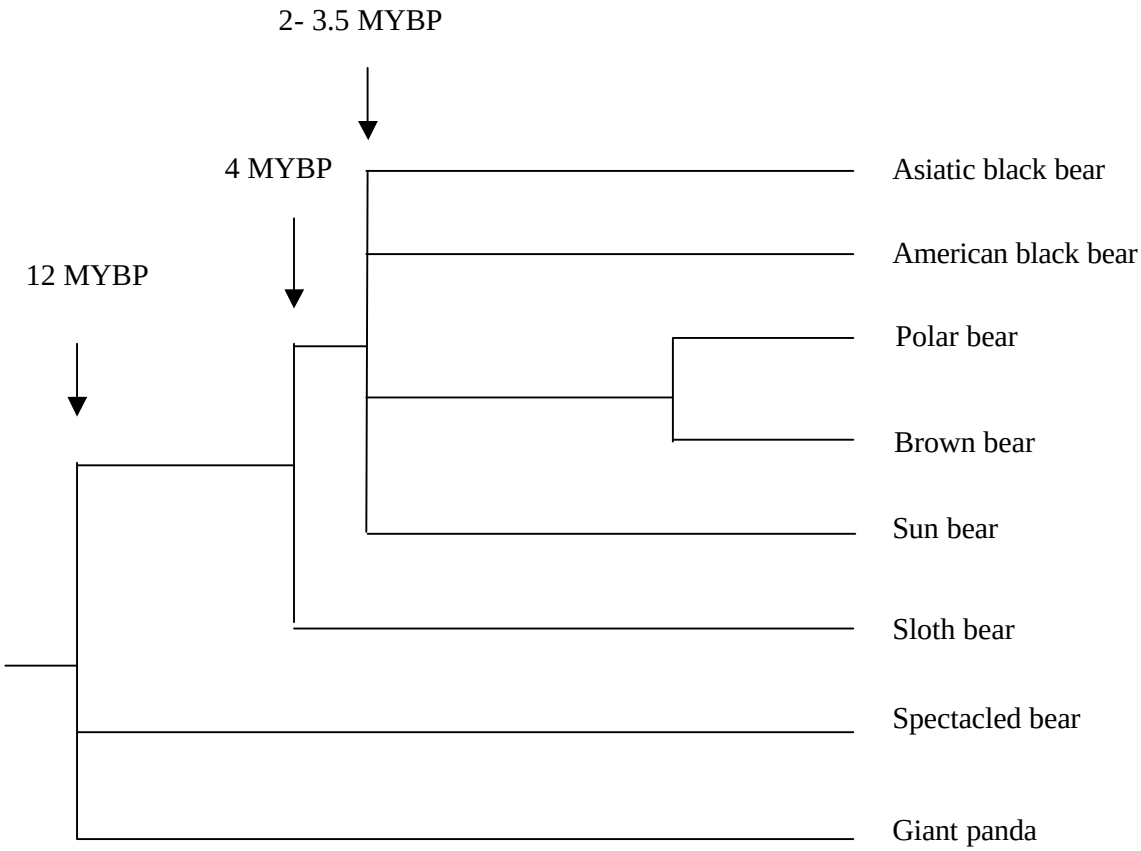

Figure 2: Distribution range of the sloth bear (Map)

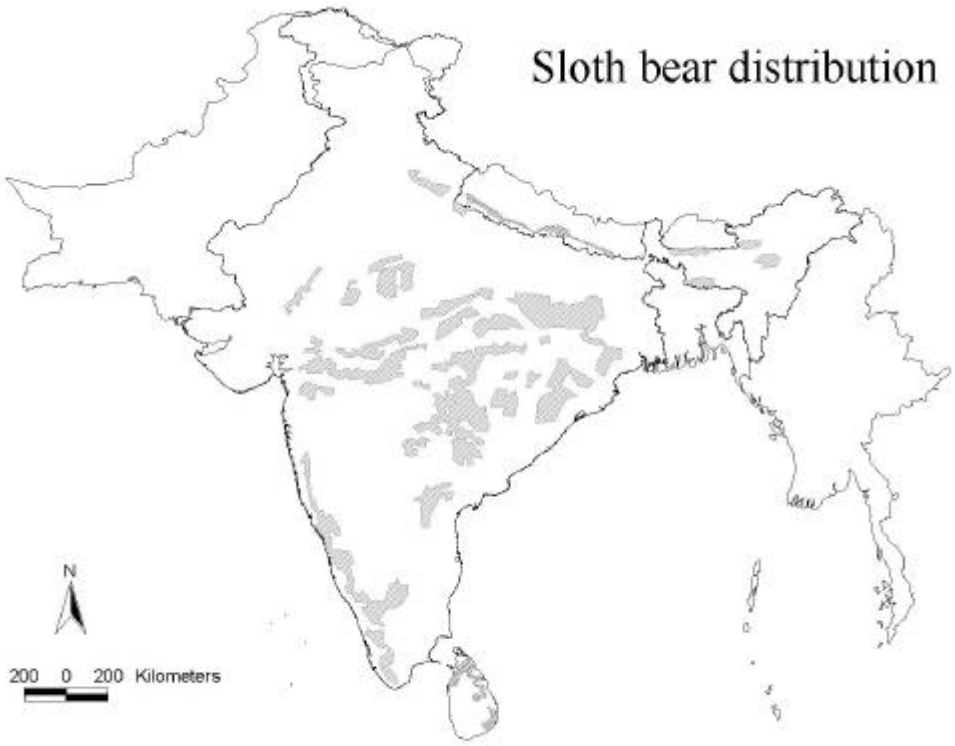

Table 1: Estimates of sloth bear population sizes

Region	**Assumed density**	**Area of extrapolation**	**Population size**	**Authors**
India	6 bears / 100 km^2	260,000 to 290,000 km^2	7,300 to 8,000	Jaffeson (1975)
Sri Lanka	5 to 10 bears / 100 km^2	5,800 km^2	300 to 600	Santiapillai and Santiapillai (1990)
Nepal	NA	17,000 km^2	<1,000	Garshelis *et al.* (1999b)
India	1 to 12 bears / 100 km^2	250,000 km^2	9,000 to 13,000	Yoganand *et al.* (1999)
World	NA	256,000 to 356,000 km^2	10,000 to 25,000	Garshelis *et al.* (1999a)