

The Sloth Bear Activity and Movement in Highly Fragmented and Disturbed Habitat in Central India

¹H.S. Bargali, ²Naim Akhtar and ³N.P.S. Chauhan

¹The Corbett Foundation, Ramnagar-244715, Uttarakhand, India

²Central Zoo Authority, New Delhi - 110 011, India

³Wildlife Institute of India, P.O. Box 18, Chandrabani, Dehradun 248001, India

Abstract: The sloth bear (*Ursus ursinus*), endemic to Indian subcontinent, exists in significant number outside the protected areas. Increase in conflict with human being and crop depredation by the bear is posing further threat to the declining population. There is limited information available on sloth bear ecology and this study was among the first detailed studies on the species in India. Purpose of this work was the study of sloth bear in its natural habitat and to suggest measures to mitigate human-bear conflict. Information were collected by making observation on 3 radio-collars bears, two males and one female. Habitat was highly degraded and bears were surviving by feeding opportunistically on all available resources in forests and villages and finding safety in den sites on hillocks of heavy big boulders. Availability of suitable habitat and mitigation of human-bear conflict needs to be given high priority for the long term conservation of bears in the region.

Key words: Conservation • Endangered • Habitat • Human-Bear Conflict • Radio-Collar • Sloth Bear

INTRODUCTION

Sloth bear (*Ursus ursinus*) is one of the four species of bears found in India. Other species are Asiatic black bear (*Ursus thibetanus*), Himalayan brown bear (*Ursus arctos*) and Malayan sun bear (*Ursus malayanus*). The sloth bear is endemic to the Indian subcontinent and found in India, Sri Lanka, Nepal and Bhutan. The recent extirpation of the species has taken place in Bangladesh. Habitat degradation due to increased human population [1-3], diminished food resources [4], trade in body parts [5-7] and increased conflict with humans [8, 9] posing serious threat to the declining sloth bear population in the country as well as in its entire distribution range. Sloth bear is included in Schedule I of Indian Wildlife (Protection) Act 1972 and Appendix I of CITES.

Only limited and anecdotal information was available on sloth bear distribution, habitat use, food habit, activity patterns and behaviour of sloth bear [6, 10-15]. This study was among the detailed studies on sloth bear ecology and

conflict with local communities. It was found that because of the degradation of the habitat bear activities were up to very close to the human habitation resulting in frequent conflict.

MATERIALS AND METHODS

Study Area: The study was conducted in Pendra and Marwahi administrative ranges (regions) of North Bilaspur forest division (NBFD) in the state of Chhattisgarh, central India (Figure 1). It lies between 81°45'–82°13'E longitude and 22°09'–23°7'N latitude. Forests covered only about 337 km² of the total study area of about 1,396 km². Topographically this region includes the Chhattisgarh plains and hilly regions of Maikal range. Forests of the study area consists northern tropical dry deciduous peninsular sal forest, northern tropical dry mixed deciduous forest and northern tropical moist mixed deciduous forest [16]. Presence of small hillocks of big boulders offers safe den sites to the sloth bear population.

Corresponding Author: Harendra Singh Bargali, Deputy Director, The Corbett Foundation, Ramnagar-244715, Uttarakhand, India. Tel: +91 5947284156, Mob: +91 9411540340.

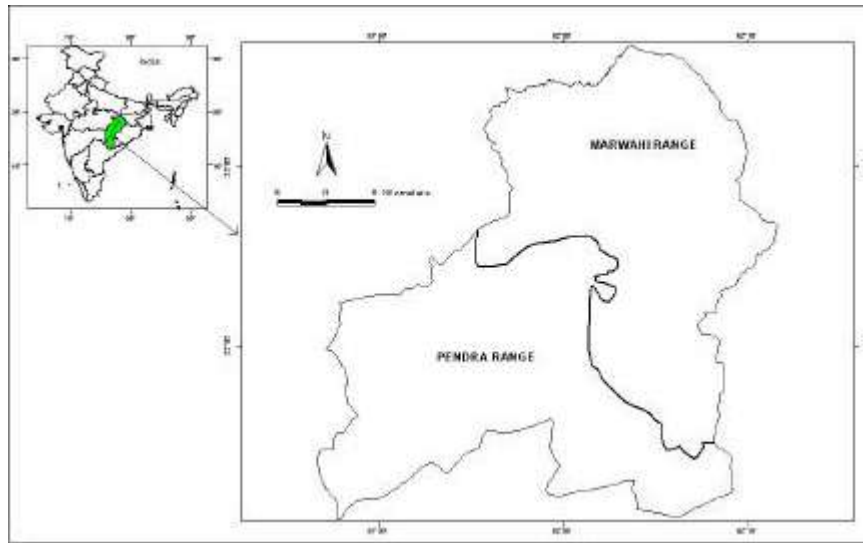


Fig. 1: Map showing the North Bilaspur forest division, the study area

Study area can be divided into three distinct seasons, summer (Mar–Jun), monsoon (Jul–Oct) and winter (Nov–Feb). There were 178 villages and with human population of about 180,000 and cattle population of about 150,000. All the villages in the study area are connected through a network of roads that are drivable during winter and summer, but not during the monsoon season.

Methods

Bear Capture, Radio-Collaring and Monitoring: Activity pattern of sloth bear was studied by making direct observation on radio-collared bears as well as by recording opportunistic observation on other bear without radio-collars (April 1998 - December 2000).

Study was conducted on three radio-collared bears, one female (female bear 2) and two male bears (male bear 1 and male bear 5). Leg snares and culvert traps were used to capture bears during February-June 1999 and bears were monitored till December 2000. Intra-muscular injection of Ketamine hydrochloride and Xylazine hydrochloride was used in combination to immobilize the bears [8]. Two different locations were selected to radio-collar bears, one with flat terrain interspersed with agricultural crop fields and villages while another location included crop fields, villages and big hillocks of heavy boulders.

All radio-collared bears were continuously monitored on foot using Yagi antenna from the time of their emergence during evening till they returned to their

den sites next day morning. Attempts were made to locate and follow all the radio-collared bear twice a month. Information on location, activity of bear and other relevant parameters were recorded after every 30 minutes.

In case of situations when bears were found inside dense vegetation, it was tried to move in carefully to locate the bear or hear the sound so that activity can be confirmed and visited the site once bear moved away. Various activities of the bear were categorized into moving, resting, digging (for termites and ants) and feeding (fruits or crops). Bear presence in different habitats were recorded to study habitat use of radio-collared bears. Habitat was categorized into a number of categories such as mixed sal, scrub land, mix forest, rocky outcrop, dry river course and habitation and agriculture. Information on location of bear (forest, village and crop field) and other parameters such as distance of nearest human habitation and water source was also recorded.

Preparation of Vegetation Map and Analysis of Bear

Activity: Indian Remote Sensing Satellite-1B Linear Imaging Self Scanning Sensors (IRS-1B LISS II B, 1996) false colour composite (FCC) along with Survey of India Toposheets (E/16, F/13, F/14, I/4, J/1 and J/2), Forest Survey of India maps and secondary information were used to prepare the vegetation map on a 1:50,000 scale. ARC VIEW version 3.1 and ARC/INFO version 8.0.2 were used in the Geographic Information System (GIS) domain to digitize and generate vegetation map.

Harmonic mean method (95%) was used to calculate core areas of activity in Calhome programme [17] using all locations [18]. All the location inside the 95% core area were overlapped on vegetation map using ARC VIEW and ARC/INFO software in Geographic Information system (GIS) domain to calculate activity of bears in different habitats.

RESULTS

A total 1920 locations were recorded for all three radio-collared bears. Out of 1833 locations inside the core area, 599 locations were of male bear 1, 615 of female bear 2 and 619 of male bear 5.

Observation on Non-Collared Bears: There were 135 sightings of non-collared bears in which total 228 individuals were observed. These were 56.3% sightings of a single bear, 24.4% of 2 bears, 17.8% of a group of 3 bears and 1.5% of group of 5 bears. Sightings of mother with a single cub consisted of 4.4%, while in 10.4% sightings mother was accompanied by 2 cubs. White (albino) bears were sighted 6 times (4.4%). Most of the sighting (65.9%) were during 1701-1900h when bears emerged from their den sites, followed by 9.6% sightings between 1901-2100h when bear started moving in search of food and water and 9% sightings between 0301-0500h when bears were returning to their den sites early in the morning (Figure 2). There were 65.2% sightings just in the vicinity of den sites when bears were relaxing on den boulders, descending from den sites and cubs were playing around mother, whereas, 34.8% sightings were in forests, villages or crop fields.

Observation on Collared Bears

Activity pattern: Once out of their dens bear used to forage entire night and return to their respective den sites early in the morning. Male bear 1 was found moving most of the times. There were more digging activities during the monsoon season (17.7%). In few cases, during winter (1%) and summer (0.5%) seasons, bear was found resting on boulders of the den sites on hillocks. Female bear 2 was found mostly moving during winter and monsoon seasons while during summer season, mostly it was found busy in feeding (41.1%). Digging was not recorded during the summer season but it was significantly increased during monsoon (28.3%) season. Male bear 5 was found moving most of the times during winter and summer seasons while it was found digging (51.3%) most of the time during monsoon season. During monsoon season, in case of all bears, there were more digging activities than feeding activities (feeding on fruits) (Table 1). Their activity and resting period averaged to 13 and 11 hours respectively.

Seasonal habitat use of collared bears: Other than Male bear 5, other bears were found most of the times in scrub land in all the seasons (Table 2). In case of male bear 1, in all seasons, use of scrub land was followed by the habitation and agriculture. Female bear 2 used scrub land most of the times and it was followed by the use of habitation and agriculture during the monsoon season but it was also found in mixed sal forest (21.9%) than habitation and agriculture (21.4%) during the summer season. Male bear 5 was found in habitation and agriculture (42.8%) most of the times during the winter season while in other seasons mostly it was found in scrub forest (Map 1).

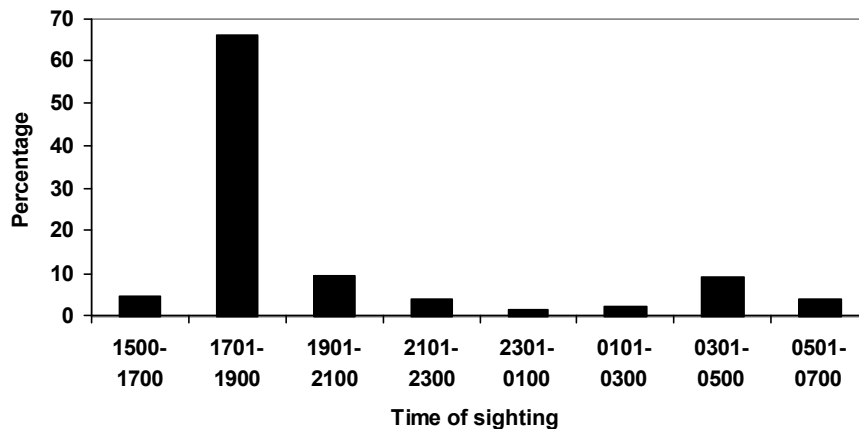
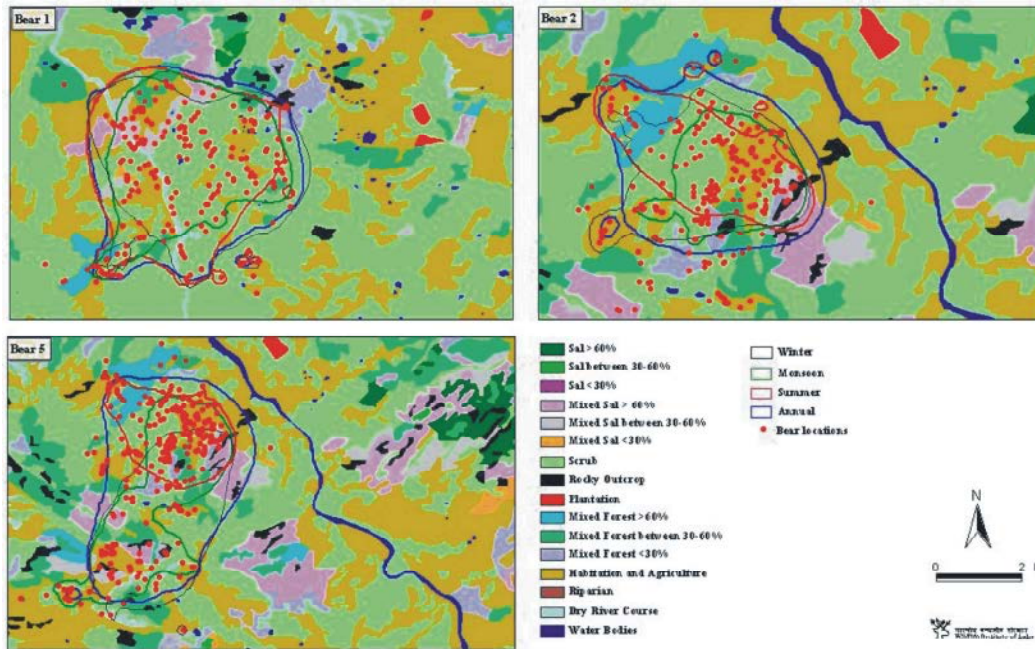


Fig. 2: Time of direct sightings of non-collared sloth bears in Nbfd during 1998-2000 (n=135)



Map 1: Core area of bear activity in different habitats and seasons

Table 1: Activity pattern of radio-collared bears in different seasons in North Bilaspur forest division.

Activity	Male bear 1			Female bear 2			Male bear 5		
	Winter%, n=210	Summer%, n=197	Monsoon%, n=192	Winter%, n=229	Summer%, n=192	Monsoon%, n=194	Winter%, n=203	Summer%, n=221	Monsoon%, n=195
Denning	18.6	10.7	17.2	13.1	16.7	13.9	10.9	14.8	13.3
Digging	2.4	11.2	17.7	6.5	-	28.3	9.8	2.3	51.3
Feeding	29.1	28.8	13.5	37.1	41.1	23.7	31.6	38.4	6.7
Moving	48.9	48.8	51.6	42.9	40.7	34.1	47.7	43.5	27.7
Resting	1.0	0.5	-	0.4	0.5	-	-	0.5	-
Water	-	-	-	-	1.0	-	-	0.5	1.0

Table 2: Habitat use by radio-collared bears in different seasons in Nbfd

Vegetation	Male bear 1			Female bear 2			Male bear 5		
	Winter%, n=210	Summer%, n=197	Monsoon%, n=192	Winter%, n=229	Summer%, n=192	Monsoon%, n=194	Winter%, n=203	Summer%, n=221	Monsoon%, n=195
Mixed Sal	4.3	8.1	5.8	0.4	21.9	0.5	9.3	10.4	10.8
Scrub	62.3	47.8	52.1	45.9	41.7	46.9	36.0	58.3	39.4
Dry river C	4.3	5.6	3.6	-	-	-	2.0	-	1.0
Mix Forest	4.3	4.5	9.4	7.9	15	5.7	8.9	9.1	6.6
Habitation & Agriculture	24.8	34.0	29.1	34.4	21.4	41.3	42.8	21.7	35.4
Rocky outcrop	-	-	-	11.4	-	5.6	1.0	0.5	6.8

Table 3: Percentage use of forest, crop field and village area by radio-collared bears in different seasons in Nbfd

Place	Male bear 1			Female bear 2			Male bear 5		
	Winter%, n=210	Summer%, n=197	Monsoon%, n=192	Winter%, n=229	Summer%, n=192	Monsoon%, n=194	Winter%, n=203	Summer%, n=221	Monsoon%, n=195
Crop field	49.0	42.1	41.2	27.1	25.5	29.4	30.1	22.6	45.1
Forest	46.2	55.3	53.1	44.1	74.5	43.3	50.2	72.9	53.3
Village	4.8	2.6	5.7	28.8	-	27.3	19.7	4.5	1.6

Table 4: Distance of human habitation from radio-collared bears in different seasons

Bear/Distance	Male Bear 1			Female bear 2			Male bear 5		
	Summer %, n=197	Winter %, n=210	Monsoon%, n=192	Summer%, n=192	Winter%, n=229	Monsoon%, n=194	Summer%, n=221	Winter%, n=203	Monsoon%, n=195
<500	34.5	32.8	37.5	59.4	76.9	93.3	69.2	85.2	83.6
501-1000	54.8	56.7	39.1	28.1	17.9	6.7	20.8	14.3	16.4
1001-1500	10.2	9.5	22.4	12	5.2	-	10	0.5	-
1501-2000	0.5	1	1	0.5	-	-	-	-	-

Bear activity in forests, crop field and village:

During winter season male bear 1 was found most of the times in crop fields (49%) while during rest of the seasons it was found mostly in forest than crop fields. During winter and monsoon seasons there were more sightings in village areas in comparison to summer season. Female bear 2 and Male bear 5 were found mostly in forests areas followed by their presence in crop fields and villages. Female bear 2 was not found in villages during the summer season while during rest of the seasons it was located inside the villages as well. Male bear 5 was found to use village in summer as well and there were less recordings inside villages during winter season (Table 3).

Distance from human habitation and water source:

It was found that, because of degraded and fragmented habitat, mostly bears were within 1000 m distance from human habitation. Most of the times, male bear 1 was recorded within 500-1000m from human habitation. Whereas female bear 2 and male bear 5 were located mostly within 500m from human habitation in all the seasons (Table 4). Irrespective of seasons, limits of movement of the male bear 1, female bear 2 and male bear 5 were found mostly within 500 m from water sources.

DISCUSSION

The activity pattern of an animal depends on or is an outcome from a complex compromise between optimal foraging time, social activities and environmental constraints [19]. It could be considered as an adaptation to seasonal and diurnal variation of environmental factors [19-21].

In NBFD, sloth bears were nocturnal and crepuscular. They were active in the evening, night and early in the mornings. During day time bears were found to be remaining inside dens only. Generally, bears used to come out of their dens during evening forage throughout the night and retire in the morning. To start foraging during evening bears used to leave dens earlier during summer than in winter season. There might be individual

differences in activity pattern but overall trend for males and females activities was almost the same.

It seems that nocturnal habits of bears apparently resulted from human-induced modifications to the environment and to avoid direct conflict with humans [22, 23] and this might explain the nocturnal habits of bears feeding in orchards [24] and campgrounds [22]. On the other hand, diurnal activity of bears could be considered as a consequence of low levels of human activity, however, in natural environment there could be other reasons as well.

In NBFD availability of degraded habitat and frequent disturbance by anthropogenic pressures appears to be the reason compelling bears to stay inside the dens during the day time. Similarly, in Chitwan National Park, Nepal, it was found that the sloth bears were active during the night than in the middle of the day [13]. This was consistent with previous observations on sloth bear [6, 15]. Most of the sloth bears sightings were during 1700-1900h when bears emerged from their den sites. There were more chances of sighting a bear in the vicinity of den sites at the time of their emergence as after that, in search of food, they used to move in different directions. During winter bears usually emerged from their dens only after sunset. It appears that this was to avoid conflict with human beings. Sometimes bears were observed resting in the open on boulders of the hillocks or under trees early in the mornings.

During summer, sloth bears escaped from daytime intense heat by confining themselves inside dens. It appears that boulders covering the dens used to become hot by the evening making den hot from inside as well. This made bears to come out of their dens early in the evening and rest on boulders as before entering into forests bears used to make sure that cattle and people are returned from the forests.

During monsoon, sloth bears were found emerging from dens before it became dark. During this season digging was mainly to search for termites and ants. Groundnut and corm crop were also raided by bears during this season. Because of lack of irrigation facilities

agriculture activities were limited during monsoon to early winter season only.

Among non-collared sloth bears, most of the sightings were of single bear, followed by group of 2, 3 and 5 bears. Mothers were usually seen with cubs on their back or walking along. When there were 2 cubs, they were mostly playing together and following the mother. Often mothers turned aggressive when other bears approached them closely.

In Pendra and Marwahi ranges, den sites were located on the fringes of human habitation. While classifying the habitat into three broad categories i.e. crop field, village and forest land, the kitchen garden was excluded from the crop field. Human habitation, road network and kitchen gardens were considered under village category. Being mobile and opportunistic, ursids shift from one habitat to another habitat in accordance with the change in abundance and distribution in food. Sloth bears are reported to be involved with crop depredation in many parts of their range [4, 6, 25]. In addition to feeding on fruits and flowers of various plants, myrmecophagus adaptations in sloth bears enables them to feed on termite and ants so that they can compete with other ursids and help them survive in less fruiting season as well.

Mostly bears were found mostly moving then busy in other activities. It was observed that, in a degraded habitat, after descending from the den sites sloth bears used to cross forest patches and villages to explore their foraging area. It was noted that bear used to move quickly so that they can reach to the maximum distance in their home range and come back safe to their den sites early in the morning using the same route passing through villages and forest patches. Maximum digging activities were recorded during the monsoon season as rain water softens the soil and digging for ants and on termite mounds becomes easy for bears [26-30]. As there were no crops grown in winter, bears were mainly found feeding on fruits of *Ficus* and *Zizyphus* species on edges of crop fields or in kitchen garden of village houses. Other than mother with cub, often bears were observed foraging in proximity to each other. Sloth bear foraging or walking close to each other with few signs of serious antagonism were the clear indication of mutual tolerance [6, 31].

In Nbfd and activity pattern, habitat use and movement of sloth bear seem to be correlated with phenology of food plants, crop stages, food availability and disturbance factors such as non-timber forest produce collection, livestock grazing and human activity. In other studies too, distribution, movement and habitat

use of bear have been shown to be related to food availability [31-40].

CONCLUSION

Presence of bears close to human habitation indicated forceful use of degraded habitat by the sloth bear. The only safe den sites in such a degraded habitat were within the hillocks of big boulders and presence of such hillocks was close to the human habitations. In search of food bears had to pass through small forest patches, crop fields and villages in the evening to forage throughout the night. Bear used to come back to their safe den sites early in the morning from same evening tracts where presence of humans in the surroundings used to result in an encounter.

ACKNOWLEDGMENTS

We thank V.B. Sawarkar, former Director, Wildlife Institute of India, for his cooperation and guidance. We thank P.K. Mishra, former PCCF Madhya Pradesh Forest Department and staff of both Madhya Pradesh and Chhattisgarh state forest department for their help and cooperation. We also thank our field assistants P. Singh and late K. Kumar for their assistance. Finally we thank all villagers and victims for their cooperation during the fieldwork.

REFERENCES

1. Cowan, I. McT., 1972. The status and conservation of bears (Ursidae) of the world-1970. International Conference on Bear Research and Management, 2: 343-367.
2. Johnsingh, A.J.T., 1986. Diversity and conservation of carnivorous mammals in India. Proceedings of the Indian Academy of science, Bangalore, pp: 73-89.
3. Schoen, J.W., 1990. Forest management and bear conservation. International Congress of Ecology, 5: 1-7.
4. Rajpurohit, K.S. and N.P.S. Chauhan, 1996. Study of animal damage problems in and around protected areas and managed forest in India phase-I: Madhya Pradesh, Bihar and Orissa. Wildlife Institute of India, Dehradun, India.
5. Garshelis, D.L., A.R. Joshi and J.L.D. Smith, 1999. Estimating density and relative abundance of sloth bears. *Ursus*, 11: 87-98.

6. Laurie, A. and J. Seidensticker, 1977. Behavioural ecology of the sloth bear (*Melursus ursinus*). Journal of Zoology, 182: 187-204.
7. Servheen, C., 1990. The Status and conservation of the bears of the world. International Conference on Bear Research and Management Monograph, 2: 32.
8. Bargali, H.S., 2003. Ecology of the problematic sloth bear (*Melursus ursinus*) and mitigation of human-bear conflicts in North Bilaspur forest division, Madhya Pradesh. Ph.D. Thesis, Saurashtra University, Rajkot, India.
9. Bargali, H.S., N. Akhtar and N.P.S. Chauhan, 2005. Characteristics of sloth bear attacks and human casualties in North Bilaspur forest division, Chhattisgarh, India. Ursus, 16(2): 263-267.
10. Baskaran, N., N. Sivaganesan and J. Krishnamoorthy, 1997. Food Habits of the sloth bear in Mudumalai wildlife sanctuary, Tamil Nadu, Southern India. Journal of Bombay Natural History Society, 94(1): 1-9.
11. Fletcher, F.W.F., 1911. Sport on the Nilgiris and in Wynaad. Macmillan and Co., Ltd., London.
12. Jerdon, T.C., 1874. Mammals of India. John Whelon, London.
13. Joshi, A.R., D.L. Garshelis and J.L.D. Smith, 1995. Home ranges of sloth bears in Nepal: implications for conservation. Journal of Wildlife Management, 59: 204-214.
14. Sterndale, R.A., 1884. Natural History of the Mammalian of India and Ceylon. Thacker, Spink and Co., Calcutta.
15. Sunquist, M.E., 1982. Movements and habitat use of a sloth bear. Mammalia, 46: 545-547.
16. Champion, H.B. and S.K. Seth, 1968. A revised survey of forest types of India, Government of India.
17. Kie, J., 1994. Program CALHOME: A home range analysis program MS-DOS version 1.0., Forestry Sciences Lab. 2081, East Sierra Avenue, Fresno, CA.
18. Dixon, K.R. and J.A. Chapman, 1980. Harmonic mean measures of animal activity areas. Ecology, 61: 1040-1044.
19. Aschoff, J., 1964. Survival value of diurnal rhythms. Symposia of the Zoological Society of London, 13: 79-98.
20. Cloudsley-Thompson, J.L., 1961. Rhythmic activity in animal physiology and behavior. Academic Press, New York, pp: 236.
21. Nielsen, E.T., 1983. Relation of behavioral activity rhythms to the changes of day and night. A revision of reviews. Behaviour, 89: 147-173.
22. Ayres, L.A., L.S. Chow and D.M. Graber, 1986. Black bear activity patterns and human induced modifications in Sequoia National Park. In Bears- Their biology and management: Proceedings of the 6th International Conference on Bear Research and Management, Grand Canyon, Ariz., February 1983. Edited by P. Zager. International Association for Bear Research and Management, Washington, D.C, pp: 151-154.
23. Lariviere, S., J. Huot and C. Samson, 1994. Daily activity patterns of female black bears in a northern mixed-forest environment. Journal of Mammalogy, 75: 613-620.
24. Waddell, T.E. and D.E. Brown, 1984. Exploitation of two subpopulations of black bears in an isolated mountain range. The Journal of Domestic Management, 48: 933-938.
25. Rajpurohit, K.S. and P.R. Krausman, 2000. Human sloth bear conflicts in Madhya Pradesh, India. Wildlife Society Bulletin, 28(2): 393-399.
26. Bargali, H.S., N. Akhtar and N.P.S. Chauhan, 2004. Feeding ecology of sloth bears in a disturbed area in central India. Ursus, 15(2): 212-217.
27. Davidar, E.R., 1983. Sloth bear's (*Melursus ursinus*) method of hunting of termite nests. Journal of Bombay Natural History Society, 80: 637.
28. Gopal, R., 1991. Ethological observations on the sloth bear (*Melursus ursinus*). Indian Forester, 117: 915-920.
29. Joshi, A.R., D.L. Garshelis and J.L.D. Smith, 1997. Seasonal and habitat-related diets of sloth bears in Nepal. Journal of Mammalogy, 78(2): 584-597.
30. Schaller, G.B., 1967. The Deer and the Tiger: A study of wildlife in India. University of Chicago Press, Chicago.
31. Joshi, A.R., J.L.D. Smith and D.L. Garshelis, 1999. Sociobiology of the myrmecophagous sloth bear in Nepal. Canadian Journal of Zoology, 77: 1690-1704.
32. Alt, G.L., G.J. Matula, F.W. Alt and J.S. Lindzey, 1980. Dynamics of home range and movements of adult black bears in northeastern Pennsylvania. pp: 131-136 in C.J. Martinka and K.L. McArthur, eds. Bears- Their biology and management. Bears Biol. Assoc. Conf. Ser. 3. U.S.Gov. Print. Off., Washington, D.C.
33. Clevenger, A.P., F.J. Purroy and M.R. Pelton, 1992. Brown bear (*Ursus arctos* L.) habitat use in the Cantabrian Mountains, Spain. Mammalia, 56: 203-214.

34. Craighead, J.J., J.S. Sumner and G.B. Scaggs, 1982. A definitive system for analysis of grizzly bear habitat and other wilderness resources. Monograph 1. Wildlife-Wildlands Institute, University of Montana Foundation, Missoula, Montana.
35. Hamer, D. and S. Herrero, 1987. Grizzly bear food and habitat in the Front ranges of Banff National Park, Alberta. International Conference on Bear Research and Management, 7: 199-213.
36. Hamilton, A.N. and F.L. Bunnell, 1987. Foraging strategies of coastal grizzly bears in the Kimsquit River Valley, British Columbia. International Conference on Bear Research and Management, 7: 187-197.
37. Johnson, K.G. and M.R. Pelton, 1981. Selection and availability of dens for black bears in Tennessee. *Journal of Wildlife Management*, 45: 111-119.
38. Lindzey, F.C. and E.C. Meslow, 1977. Home range and habitat use by black bears in south-western Washington. *Journal of Wildlife Management*, 41: 413-425.
39. Smith, T.R., 1985. Ecology of black bears in a bottomland hardwood forest in Arkansas. Ph. D. Thesis, Univ. of Tenn., Knoxville.
40. Tietje, W.D. and R.L. Ruff, 1980. Denning behavior of black bears in boreal forest of Alberta. *Journal of Wildlife Management*, 44: 858-870.