भारतीय वन्यजीव संस्थान
Wildlife Institute of India

सूचना का अधिकार
RIGHT TO
INFORMATION

No. A/2-1/2007-WII (Vol. X: 2016-17/Part1)

Dated   29.09.2016

To,

Shri Rustom Cama,
Cama Court,
Next to Cama Hotel,
Khanpur Road,
Ahmedabad – 380 001
Mob. # 9824034754

Sub.: Information sought under Right to Information Act, 2005- reg.

Ref.: Your RTI Application vide dated 30.08.2016, received in this office on 05.09.2016 and your letter dated 22.09.2016

Sir,

Please refer to your applications cited above under RTI Act, 2005. In this context, you were requested to deposit an amount of Rs. 138/- for providing the information sought by you vide our letter dated 15.09.2016.

After receiving the said amount vide demand draft no. 551277 dated 22.09.2016, the information contained in 69 pages, is attached herewith as sought by you under RTI, 2005.

If you are not satisfied with the aforesaid reply, you may appeal to the Appellate Authority i.e. *"Dr. V.B.Mathur, Director, Wildlife Institute of India, P.B.18, Chandrabani, Dehradun – 248 001, Ph. 0135-2640910"*

Thanking you,

Yours faithfully,

(Aseem Shrivastava)
CPIO

29/9/16

Encl: as above.

6/c

Ecology, behaviour and interaction of highly dense population of sloth bear (*Melursus ursinus*) and human-sloth bear conflict in Jessore wildlife sanctuary, Gujarat and Mount Abu wildlife sanctuary, Rajasthan.

Project Report - Phase I

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Project Report - Phase I

1. Title of the project:

Ecology, behaviour and interaction of highly dense population of sloth bear (*Melursus ursinus*) and human-sloth bear conflict in Jessore wildlife sanctuary, Gujarat and Mount Abu wildlife sanctuary, Rajasthan.

2. Name of the Investigator(s):   Dr. N.P.S. Chauhan and Prof. V.C. Soni

3. Funding Agency: Wildlife Institute of India

4. Collaborating Agency (if any):   Wildlife Institute of India

Gujarat and Rajasthan States Forest

Departments

5. Duration of the project: 4 Years

6. Date of Initiation & Completion: 26.04.2007 to 25.04.2011
   of the project

7. Date of Initiation & Completion: 26.04.2007 to 25.10.2008

   of the Phase-I

8. Study Area: Jessore wildlife sanctuary, Gujarat and

Mount Abu wildlife sanctuary, Rajasthan

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Introduction

There are eight species of bears in the world (Waits *et al.* 1999). Bears have a wide global distribution and are found in every continent except Africa, Antarctica and Australia (Nowak and Paradiso 1983). There are significantly more bears in the northern hemisphere than in the southern hemisphere. The spectacled bear of South America is the only bear found predominantly in the southern hemisphere. Bears are found in around 62 countries. Two species occur in Europe, three in North America, one in South America, and six in Asia. Bears live in a variety of habitats and are found from the high arctic (polar bears) to the low land tropical forests (sun bears).

All over the world, bear occupy a special place in human culture and play an important role in a number of indigenous societies. Despite the fact that bears, polar bears, sun bears, grizzly bear and sloth bear, are feared as other wild animals but mostly they have venerated as objects of worship for thousands of years by numerous human culture around the world (Kemf *et al.* 1999). In contrast, bear body parts have been used as medicines since centuries (China over 5,000 years). The use of bear parts in traditional medicine originated in China and later, spread to other central Asian countries such as South Korea, Japan, and Taiwan (Mills and Servheen 1991). Bear bile from the bear gall bladder is the most widely used part in medicine, and other parts used include fat, meat, paws, spinal cord, blood and bones Bear bile is used as medicine used in the treatment of liver disease, heart disease, stomach ailments and illness (Mills and Servheen 1991). Other parts are also used in aphrodisiac or in amulets or food.

All over the world, human activities are severely impacting the habitat of all the eight species of bears, and in recent decades, all species have undergone dramatic decline in number and distribution. Habitat alteration, due to increasing human population to meet the increasing demand of raw material, agricultural land and living space, and killing of bears for sports, medicinal products or other parts, protection of livestock and crops have led to the decline of the species. (Mills and Servheen 1991, Kemf at al. 1999)

Bear population usually requires large area of land to survive. They typically compete directly with people for resources such as space, food, security cover and even life itself. The reproductive rates of bears are some of the lowest among the terrestrial animals (Bunnel and Tait 1981). Detection of population decline may take years of over-exploitation and after identification, population may be difficult to reverse because of the low productivity of bear population (Miller 1990). Now all the eight living species are listed as endangered, threatened and potentially facing a precarious future (Servheen 1990). The sloth bear and sun bear of Southeast Asia, the Asiatic black bear, and the spectacled bear have probably suffered the most significant decline. Loss of habitat and increased human caused mortality pressure are having devastating effects in Asia. They are now absent from large parts of their former range, and remaining populations are increasingly fragmented.

Sloth bear is one of the four species of bears found in India. The other species are brown bear (*Ursus aractos*), Himalayan black bear (*Ursus thibetanus*), and Malayan sun bear (*Helarctos malayanus*). However, its range is shrinking and population is declining in many parts of its range due to the loss and deterioration of its habitat (Johnsingh 1981), increased human population which have altered forest and harassed bears (Cowan, 1972 and Schoen 1990), habitat alteration and over killing (Laurie and Seidensticker 1977), diminished food resources of bears because of extensive damage to its habitat (Murthy and Sankar 1995), from timber and fire wood harvesting (Cowan, 1972 and Servheen 1990) and poaching for its gall bladder, and trapping for keeping in zoos or entertainment and human compete directly with bears by consuming the bears food resources (Rajpurohit and Chauhan 1996). It has been reported that throughout Asia and Indonesia, populations of Asiatic black bear (*Ursus thibetanus*), sun bear (*Helarctos malayanus*) and sloth bear (*Melursus ursinus*) are in jeopardy (Servheen 1990). The number of sloth bear has been declined in many areas where it was very common one or two generations ago. Sporadic attacks on human by sloth bear have also created fear and animosity among the public in many areas of its range. Unlike other three bear species, sloth bear is not considered as an appendix I animal under CITES, therefore international trade is not limited.

Although sloth bear is one of the most widely distributed large mammal, yet little is known of its ecology and behaviour through naturalists. Researchers while working on other species collected

some incidental information on sloth bears (Laurie and Seidensticker 1977). Sloth bear raid agricultural crops and scavenge on meat occasionally. Sunquist (1982) and Joshi *et al.* (1995) followed the study and conducted long-term research on the ecology of sloth bear in Royal Chitwan National Park, Nepal. Sloth bear has probably suffered as much as any large mammal from human impacts on forested areas (Cowan 1972), and the information we have is clearly inadequate as a basis for formulating conservation and management plans for this species.

The Sloth Bear (*Melursus ursinus*), also known as the 'Lip Bear', is a mammal of the family Ursidae which is native to the lowland forests of India, Nepal, Pakistan, Bhutan, Bangladesh, and Sri Lanka. Though originally classed as a "bear sloth" due to the shape of its claws and its arboreal habits, it was appropriately reclassified as a bear in the 1800s.

The body is 150 –190 cm long, covered in long, shaggy fur, ranging from auburn to black, with a distinctive "V"-shaped white mark on the chest, a whitish snout and black nose. The snout is long with bare lips and a lack of upper incisors, adaptations for its insect-based diet. The front feet are turned inwards and have 4 inch long, non-retractable, curved claws that are adapted for digging and climbing. The males, weighing 80–140 kg, are larger than the females, which weigh only 55–95 kg. Its pugmarks are very similar to a human footprint. The tail is 15-18 cm (6-7 inches) long, the longest in the bear family. Their natural lifespan is unknown; however, a captive specimen was recorded to have lived 40 years.

Sloth bears are the most nocturnal of bears, though sows with cubs will often move in daylight. They do not hibernate. Sloth bears are excellent climbers, and will stay in trees to feed and rest, though not to escape danger. They are capable of jumping from distances of 10 feet, and can hang upside-down in a sloth-like manner. They mark their territories either by rubbing their flanks against trees, or scraping bark with their claws.

Sloth bear are widely distributed in India. But now due to the continuous habitat loss, fragmentation and degradation and poaching, sloth bear population has drastically decreased in the wild. Sloth bear are facing the problem of its poaching and habitat degradation by the increasing human population (Cowan 1972, Servheen 1990, Garshelis *et al.* 1999a and Kemf *et*

*al.*1999). The increased human population has altered forests and harassed bears and thereby resulted in decrease of their populations (Cowan 1972 and Schoen 1990). Sloth bear populations outside the protected areas have declined significantly because of dramatic decrease in forest cover and poaching within the last 50 years (Garshelis *et al.* 1999a). Santipillai and Santipillai (1990), Khan (1982) and Servheen (1990) have reported that sloth bear population is decreasing in India, Sri Lanka and Bangladesh, and they are facing precarious future. The sloth bear has been reported to be disappeared from many forest areas of its former range (Krishnan, 1972). A serious threat to bears in Asia and America is the killing and capture of bears for use of their parts in primitive medicine, aphrodisiacs, or as pets. In a rough estimate the total world population of sloth bears is appeox. 10,000-23,000. Garshelis *et al.* (1999a) conducted a survey in India during 1993-94 and estimated the median density of 12 bears/100 km^2 in 23 protected areas and showed an estimate of about 5000 sloth bears within the protected areas. Jessore Wildlife Sanctuary (JWLS) in Gujarat and Mount Abu Wildlife Sanctuary (MWLS) in Rajasthan have 96 sloth bears/100 km^2 (NWDB, 2006), which is highest compared to other protected areas (PAs) like Silent Valley National Park in Kerala (56 bears/100km^2), Mudumalai Wildlife Sanctuary (17 bears/100 km^2; Dasai *et al.* 1997), Corbett National Park and Ranthambhore National Park (8 bears/100 km^2). From these estimates, it appears that the sloth bear population is more or less stable in protected areas, which may be due to protection and wildlife management practices. But the sloth bear population is highly threatened an on decline in managed forest and from out side PAs. Akhtar *et al.* (2004), Bargali (2004) and Chauhan *et al.* (2003) estimated sloth bear density in areas outside protected areas in India. From the *Figures* collected by Akhter *et al.* areas out side PAs, average 12 sloth bears/100 km^2. The sloth bear are now classified as endangered by the Government of India under the Wildlife (Protection) Act, 1972 (Amended).

People living in and around the protected areas depend on these forests, which are declining rapidly, exerting tremendous biotic pressure on both human beings and wildlife. Extraction of timber and bamboo and conversion of forests to other uses have adversely impacted sloth bear habitat (Cowan, 1972, and Servheen, 1990). The food resources for bears have diminished because of extensive damage to its habitat (Murthy and Sankar, 1995). With human beings also sharing natural forest food resources, food for bears have become scarce (Rajpurohit and Chauhan,

1996). In search of food, bears frequently invaded human habitation and cultivation areas and raided agricultural crops. Consequently, human-bear conflicts have increased to alarming levels.

Human - bear interactions

In central India, sloth bear has a formidable reputation and considered one of the most fearsome of all the wild animals (Pillarisett, 1993, and Rajpurohit and Chauhan, 1996). It is highly unpredictable in attacking human beings on bumping unknowingly in forest or when mother is with cubs (Prater, 1980, and Pillarisett, 1993). It generally attacks human beings if disturbed while feeding on natural forest resources in its habitat. Though sloth bears kill fewer livestock than Asiatic black bears, in some areas of India and Burma, sloth bears are more feared than tigers, due to their unpredictable temperament. in Madhya Pradesh, India, 48 people died and 686 people were injured in sloth bear incidents during 1989- 1994 (Rajpurohit et al 2000). One specimen, known as the Sloth bear of Mysore (Kenneth 1954), was single-handedly responsible for the deaths of 12 people and the mutilation of 2 dozen others before being shot by Kenneth Anderson. Sloth bears defend themselves when surprised, with the majority of confrontations occurring at night. They typically charge on all fours with their head held low, before rearing on their hind legs and striking at their attackers with their claws and teeth.

Bears have been reported to cause extensive damage to agricultural damage (Peyton 1980, Vaughan et al. 1989, Servheen 1990, Conover and Decker 1991, Reid et al. 1991 and Stowell and Willging 1992). In the alpine pastures in India, brown bear cause extensive livestock depredation, and the migratory grazers often kill them to reduce the predation on their cattle (Sathyakumar, 1999a). Increased incidences of livestock depredation and attack on humans by black bears have also been reported (Sathyakumar, 1999b). In India and Nepal, sloth bear are reported to cause agricultural crop depredation and raid on a variety of crops such as potatoes, sweet potatoes, onions, groundnuts, sugarcane, peanuts, yams and maize (Laurie and Seidensticker, 1977; Iswariah, 1984; Murthy and Sanker, 1995; Rajpurohit and Chauhan, 1996, and Rajpurohit and Krausman, 2000).

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In Jessore Wildlife Sanctuary (JWLS), Gujarat and Mount Abu Wildlife Sanctuary (MWLS), Rajasthan, human-sloth bear conflict has been a serious problem. In both the sanctuary, bears are causing lot of nuisance. Incidences of human mauling and killing are frequent. During summer season bear raid the wheat crop and maize in winter season, and invade human habitation and crop fields in search of food items. Occurrence of bear inside the villages and villagers in the patchy and degraded forests, bear habitat, has resulted in serious problem of human-bear conflicts; human casualties and crop depredation by bear are on the increase, which in turn, are posing threats to the survival of sloth bear.

In this report, we have documented about the gravity of the problem, problem areas and human casualties with respect to places of occurrence, season, time and circumstances of attack. Mitigation strategies are also suggested. The study would help plan conservation and future scientific management of the species.

Study Area

Jessore Wildlife Sanctuary

Jessore is historic site of the district, situated on the Gujarat-Rajasthan border. The JWLS is in Banaskantha district and located between 24° 20'-24° 31' N latitude and 72° 23'-72 ° 37' E longitudes. The total area of the sanctuary is 180.66 km². The sanctuary is well connected by roads. The hill of Jessore has one of the good blocks of forest in entire Aravalli hills. The hill of Jessore in north Gujarat forms the counterpart of hills of Abu in Rajasthan. They are the hills of western end of the mountain range-The Aravalli. Hill of Jessore, along the Aravalli in Sabarkantha and Banaskantha, fall in semi-arid zone and act as barrier against progressing arid environment from north in Rajasthan. Thus a tourist either on the way to or coming back from Mount Abu may plan to visit JWLS. It would enhance knowledge about medicinal plants on one hand and give thrill of the oldest hill system on the other. The hill forest of Jessore is rich in floral and faunal resources. Kedarnath temple on the hill is religious site. A trek of 4-5 km from the foothill of the mountain to Mahadev temple (Kedarnath) is indeed rewarding. Kapasia forest adjoining Rajasthan is just flat land, which supported khair and ber forests in the past. Previously, area of about 3000 ha was a good habitat for sloth bear which is now colonized by dense forest of *Prosopis juliflora*, planted three decades ago. Reverse process has just started when the forest department uprooted *Prosopis juliflora* and planted indigenous species in some areas as a part of habitat improvement activity. Hill forest in the sanctuary acts as barrier against desertification and provides ecological security.

The sanctuary provides environment stability and security to the watershed in the region. The area is considered as an important habitat for the sloth bear, a threatened species in the region. The sanctuary is recognized as an area of high conservation value due to richness of medicinal plant species. It is an important area in north Gujarat for nature and environment education. Terrain of the major part of the area is hilly. Forest types are: 5A-dry mixed deciduous and 6B-northern (Champion and Seth 1968). The sub-types of the forests are: 5A/C - southern dry mixed deciduous forests, 5B/DS1 - *Zizyphus* forests, 6/E1 - 'Dhav' (*Anogeissus*) forests, 5/DS1 - dry deciduous scrub 'Khair' (*Acacia catechu* forest), 5/2C2 - secondary dry deciduous and 6/E3 -

Prosopis juliflora forests. Dry deciduous forests constitute following habitats *viz Zizyphus* forest, "Dhav" forest, dry deciduous scrub, and secondary dry deciduous and *Prosopis juliflora*. Tree cover is relatively good. Good forests of 'ber' and 'khair' have been transformed into interior forests of *Prosopis* or low scrub. Ber forests were once most important habitats for sloth bear. Water availability during pinch period is very low and fresh water points with assured water supply need to be developed. An area of 3000-4000 ha in Kapasia village was a prime habitat for sloth bear which has been transformed into a dense forest of *Prosopis* after plantation carried out in the past. Sheep and goats spread the seeds of *Prosopis* in the natural forest which results into profuse regeneration. Invasion of the unwanted shrub brings negative impact on the habitat.
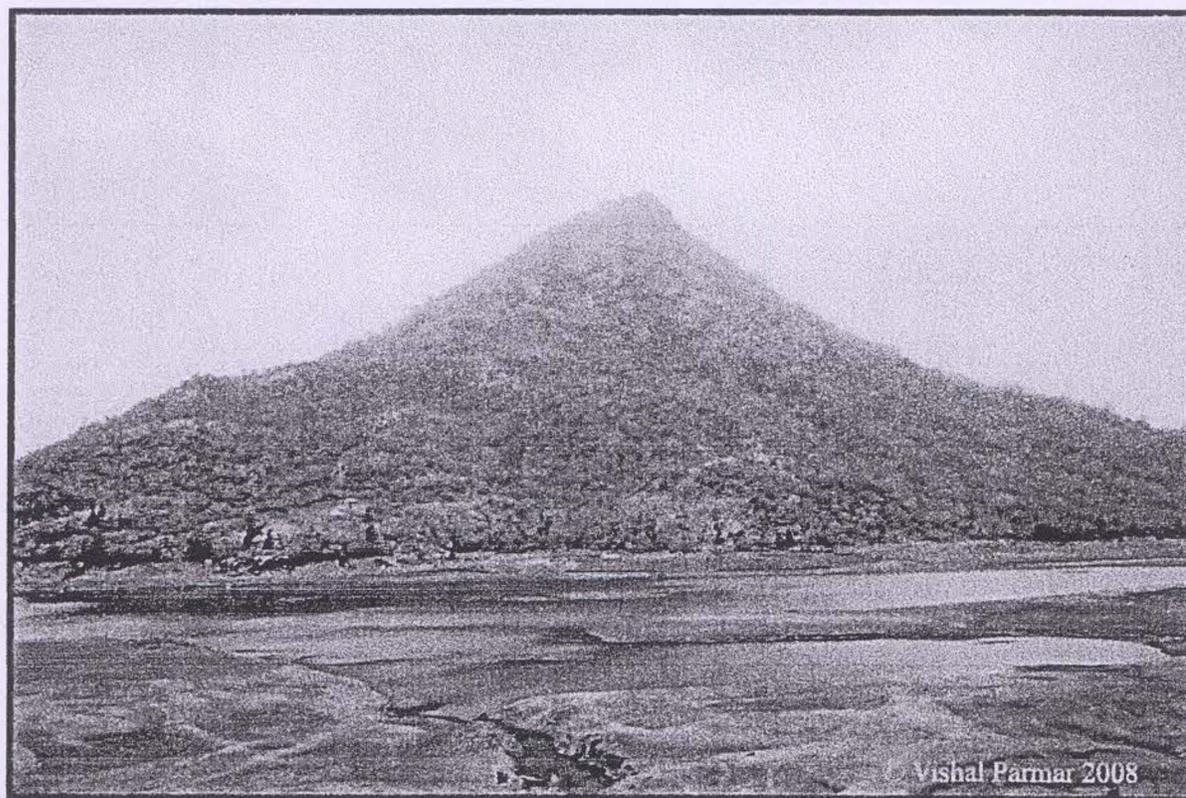
There are 18 villages of Dhanera and Palanpur talukas of Banaskantha district. There are different communities such as Thakur, Chauhan, Koli, Kumbhar, Mali, Rabari, Harijan, Waghari and Agrawals in the villages located near the sanctuary. The tribal communities of the area are Majirana, Garsia, Gomar, Damor, Khokharia, Dama, Dhojara, Dharangi, Vansia and Kharaddi. Economy of the people is mainly agriculture based. Cattle rearing are the other major occupation of the villagers as well as of 'Rabaris'. The people depend on the forests for fuelwood, fodder,

livestock grazing, honey, 'timru' leaves, gums, wild fruits and medicinal plants. Honey collection is the major damaging factors, adversely influencing the habitat. Nilgai (*Boselaphus tragocameleus*) invades the crop lands and cause damage to farmers.



Jessore Wildlife Sanctuary

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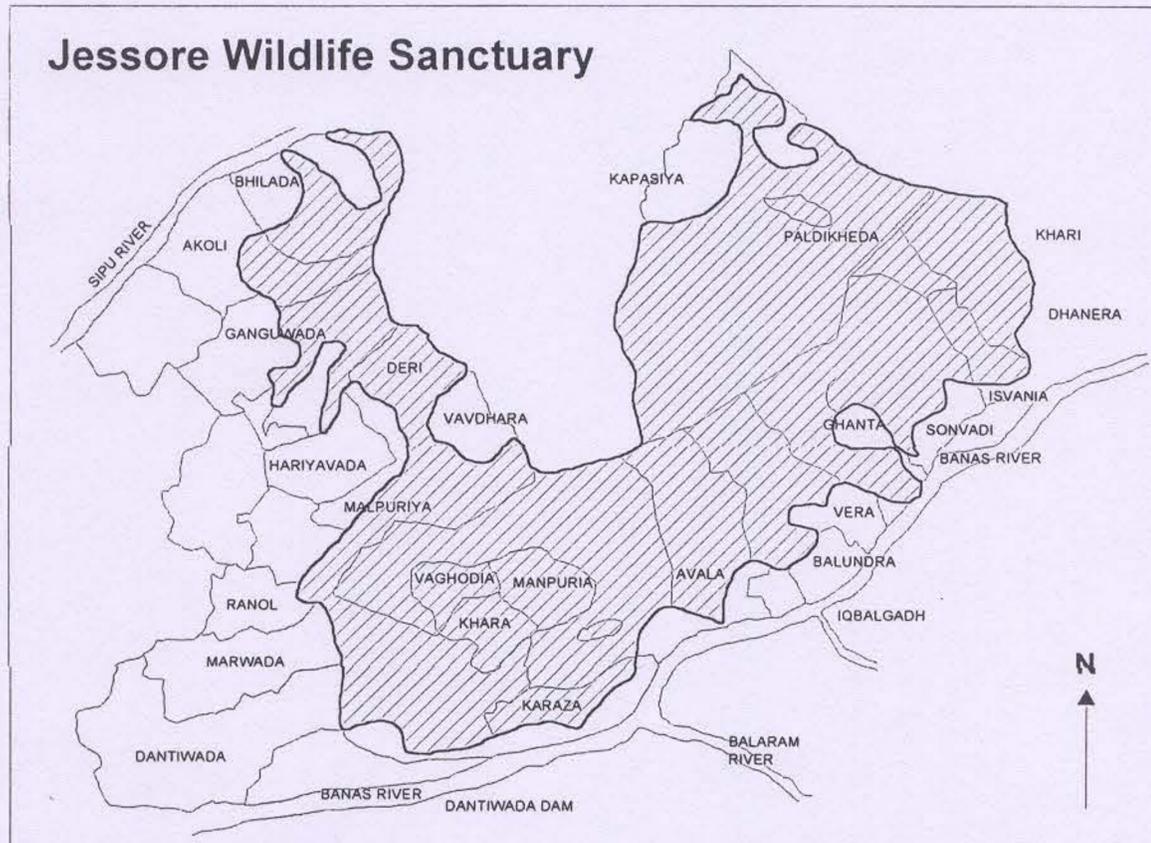
Mount Abu Wildlife Sanctuary

MWLS is situated in the oldest mountain range (Aravalis) in Sirohi district of Rajasthan and comprises an area of 288.84 km^2. MWLS has a unique ecosystem comprising of rare, endangered, and endemic flora and fauna. The sanctuary provides an ideal habitat and supports large population of sloth bears that can be observed in forests or along roadsides. Few contiguous forest patches exist between the MWLS and forests in the state of Gujarat; and are potential corridors for bear movement. Other than these few contiguous forest patches, the remaining part of the sanctuary is biogeographically isolated. For the long term survival of sloth bear, information regarding habitat use, distribution within the sanctuary, interactions with humans, and protection of contiguous forest patches as corridor areas to prevent the insularization of the population is crucial for the sloth bear survival in its westernmost distribution in Rajasthan and the adjoining Gujarat State.

Mount Abu Wildlife Sanctuary

© Vishal Parmar 2008
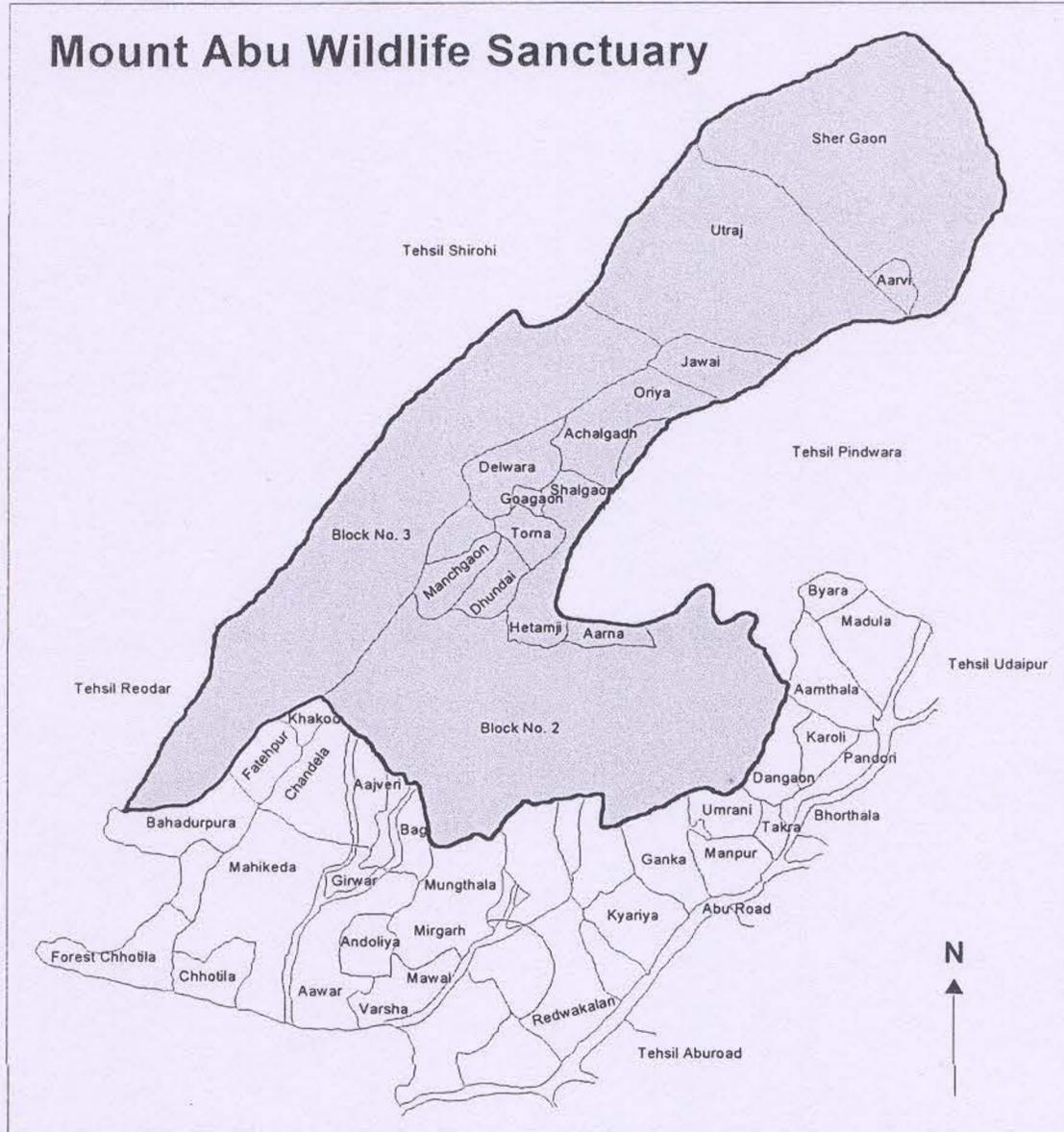
Both the JWLS and MWLS are rich in flora and fauna. The main plant species are *Acacia catechu* (Khair), *A. tortalis* (Israel baval), *A. nilotica* (Desi baval), *Zizyphus sp.* (Ber), *Anogeissus latifolia* (Dhav), *A. pendula* (Dhavado), *Wrightia tinctoria* (Dudhalo), *Boswellia serrata* (Salehi), *Uterculia urens* (Kadaya), *Albizia lebbeck* (Siris), *Ficus sp.* (Vad), *Prosopis juliflora* (Gando baval), *Lannea coromandelica* (Modad), *Ficus glomerata* (Golar) and *Bamboo* in the sanctuary. Sloth bear is the flagship species of sanctuary. Leopard (*Panthera pardus*), wolf (*Canis lupus*), striped hyena (*Hyaena hyaena*), jungle cat (*Felis chaus*), Indian civet cat (*Viverricula indica*), caracal (*Felis caracal*), ratel (*Mellivora capensis*), wild pig (*Sus scrofa*), nilgai (*Boselaphus tragocamelus*), Indian fox (*Vulpes bengalensis*), Indian hare (*Lepus nigricollis*), jackal (*Canis aureus*), common langur (*Presbytis entellus*), common mongoose (*Herpestes edwardsi*), palm squirrel (*Funambulus pennanti*), Indian pangolin (*Manis pentadactyla*), Indian porcupine (*Hystrix indica*) and field mouse (*Mus booduga*) are the important mammalian species. The varied topography, thick forests and water bodies are some of the attributes, which contribute to the avian species richness in the area. The area is a combination of dry deciduous scrub with a few evergreen species, which serve as a good habitat. The important issues, problems and threats in these areas are *viz* invasion of *Prosopis juliflora* and degradation of forests bordering Rajasthan, grazing by local and migratory livestock including sheep and goats from neighboring villages and from Rajasthan, settlement and demarcation, fuel wood cutting, minor forest produce collection and forest fire, and frequent droughts and water scarcity.

Project Objectives

Phase - I

i. To assess the human-sloth bear conflicts: nature and extent of problems and circumstances.

ii. To formulate recommendations for mitigation of human-sloth bear conflict.

Phase - II

i. To assess the distribution and population abundance of sloth bears in relation to habitat characteristics (terrain and vegetation) in the two sanctuaries.

ii. To study social organisation: group size, structure, age and sex ratio and intra-specific behaviour.

iii. To quantify habitat use pattern and assess impacts of biotic pressures on bear habitat and develop habitat suitability model.

iv. To assess habitat connectivity (corridor link) between the two sanctuaries and its biological characteristics (vegetation cover, composition and biotic pressure) and functional status (use and intensity) with reference to sloth bear population.

v. To assess ranging and activity patterns and movement of sloth bears between two sanctuaries using telemetry.

vi. To study food habits and seasonal changes in the dietary intake of sloth bear.

vii. To formulate recommendations for habitat restoration and suggest conservation and management plans for sloth bears in the two sanctuaries.

Methodology

i. To assess the human-sloth bear conflicts: nature and extent of problems and circumstances.

To study the human-sloth bear conflicts, information on nature and extent of the problems: human mauling or killing, spatial and temporal occurrence of human casualties, if any, and agricultural crop damage has been collected in specially designed formats by interviewing the local people and verifying the cases from the forest department. The assessment of the crop damage pattern was done area-wise and on seasonal basis. The bear distribution and movement pattern data have been correlated with the human mauling and killing incidences. Circumstantial evidences, whether people use the forest areas for non-timber forest produce collection, grazing cattle or work in crop fields or vicinity of villages when bear activity was maximum etc, have also been recorded. Verification of the payment of compensation for human casualties has also been done. During the study period, the victims or his or her relatives were interviewed directly.

Assessment of the crop damage was done both qualitatively as well as quantitatively. Transects, depending on the extent of crop fields were laid into the crop fields, and at 10-15m interval along each transect, nature and extent of crop damage: phenology and growth phases, within a radius of 1m, were recorded. Productivity within random plots (2x2 m each) was compared with the normal yield in the areas to estimate the losses.

b. To study the socio-economic condition of people living in and around possible corridor link and their dependency on the resources of these areas.

During the survey work, information on the area profile: land use pattern, cropping pattern, and intensity of infestation of sloth bear and other animals in nearby villages was collected from the villagers. To study the impact of sloth bear menace on the rural and grazier community, socio-economic condition of people was evaluated. Demographic information such as village population, number of families, family details and their livestock was also collected by using

questionnaire format. From selected families, information on family size and structure, educational status, occupational pattern, members involved in farming and outside jobs, number of dependents, land holdings, crop pattern and productivity, and earnings from agricultural and horticultural crops, family income etc was also collected in specially designed formats.

c. To formulate recommendations for mitigation of human-sloth bear conflict.

Results

In Mount Abu and Jessore wildlife sanctuaries, inspite of the fact that there is increasing biotic pressure, encroachment on the forest land and continuous habitat degradation, the sloth bear population have become overabundant and showing an increasing population trend. More often sloth bear are going into the agriculture fields and human habitations and as a result, there is a serious human-sloth bear conflicts in form of human casualties and agricultural crop raiding. From July 2007, we started village survey in MWLS and JWLS and collected information on human-sloth bear conflicts: nature and extent of problems and circumstances in a well designed format.

Human-sloth bear conflicts

Information on human-sloth bear conflicts was collected from the forest department, through survey of villages and by conducting interview of victims or their family member(s) in and around JWLS and MWLS. During the study period from July-2007 to December-2008, there were 31 human casualties in the vicinity of JWLS and 44 in MWLS (**Table 1**). The data collected from the forest department revealed only 15 cases of human casualties from 2000 to 2008. Whereas, based on questionnaire survey of different villages in the two sanctuaries, there were 75 human casualties. In an overall situation, there is increasing trend of human casualties in both the sanctuaries from 1997 to 2008 (**Table 2**).

Table 1. Number of human causalities in MWLS and JWLS.

Study area	No. of human casualties	Male	Female	Children
MWLS	44	30	9	5
JWLS	31	20	9	2
Total	75	50	18	7

Table 2. Human casualties by sloth bear in MWLS and JWLS.

Year	No. of attacks	
	MWLS	JWLS
1997	0	1
1998	0	1
1999	0	1
2000	5	2
2001	6	2
2002	7	5
2003	3	5
2004	9	4
2005	4	4
2006	7	6
2007	3	0
2008	0	0
Total	44	31

Initially in the absence of compensation scheme, several human casualties were not reported to the forest department. Subsequently, although compensation scheme was started, but even then all the cases were not reported to the forest department due to cumbersome procedure of payment of ex-gratia amount. Out of 75 incidences of human casualties in MWLS and JWLS, male mauling cases (67%) were more than female mauling cases (24%) and children (9%) **(Figure 1 and Table 1)**. Locations of human casualties in MWLS and JWLS are shown in the following maps.

Mount Abu wildlife sanctuary

LEGEND

———	Sanctuary boundary
- - - -	Forest boundary
—·—·—	Compartment boundary
········	River, Streams, Nallas
🏠	Village
⊙	Affected Villages

Jessore wildlife sanctuary

Map legend:
- Sanctuary boundary
- Roads
- River, Streams, Nallas
- Village
- Affected villages

Villages labeled on map: Bhilada, Akoli, Ganguwada, Vavdhara, Hariyavada, Deri, Malpuria, Ranol, Vaghodia, Khara, Manpuria, Marwada, Karza, Awala, Dantiwada, Kapasiya, Paldikheda, Khari, Ghanta, Iswani, Sevania, Vera, Balundra, Iqbalgadh, Sonwadi

Rivers: Sipu River, Banas River, Balaram River

In JWLS, there were less (41%) human casualties than those of MWLS (59%) **(Figure 2)**. In JWLS and MWLS, out of 75 human casualties, 62% cases occurred in forests, 29% in crop fields, and 6% in villages during 1997 to December 2008 **(Figure 3)**. The victims were found engaged in different activities like defecation, walking, collection of NTFP, farming, cattle grazing and moving in vicinity of villages or houses at the time of bear attacks. In crop fields, incidences occurred mainly when the victims were involved in farming activities. In forests, incidences of mauling and killing were highest when the victims were engaged in cattle grazing, walking, defecation and NTFP collection.

Figure 1. Human casualties by sloth bear in MWLS and JWLS.
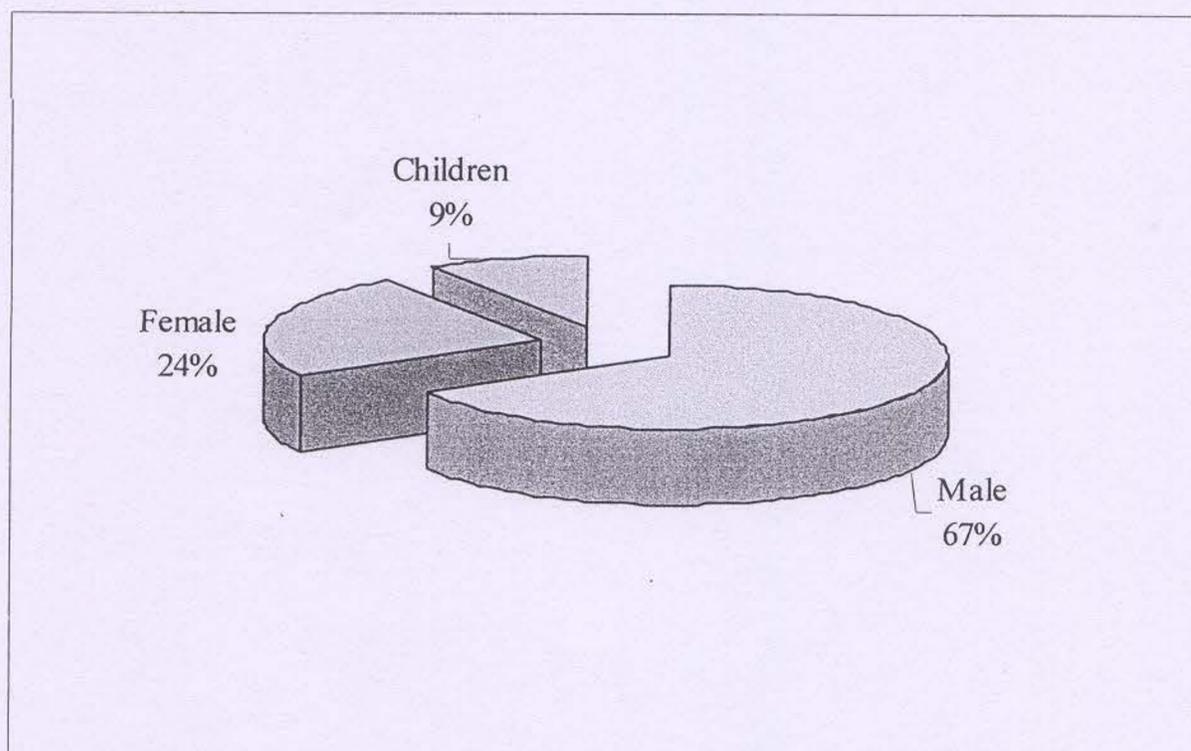
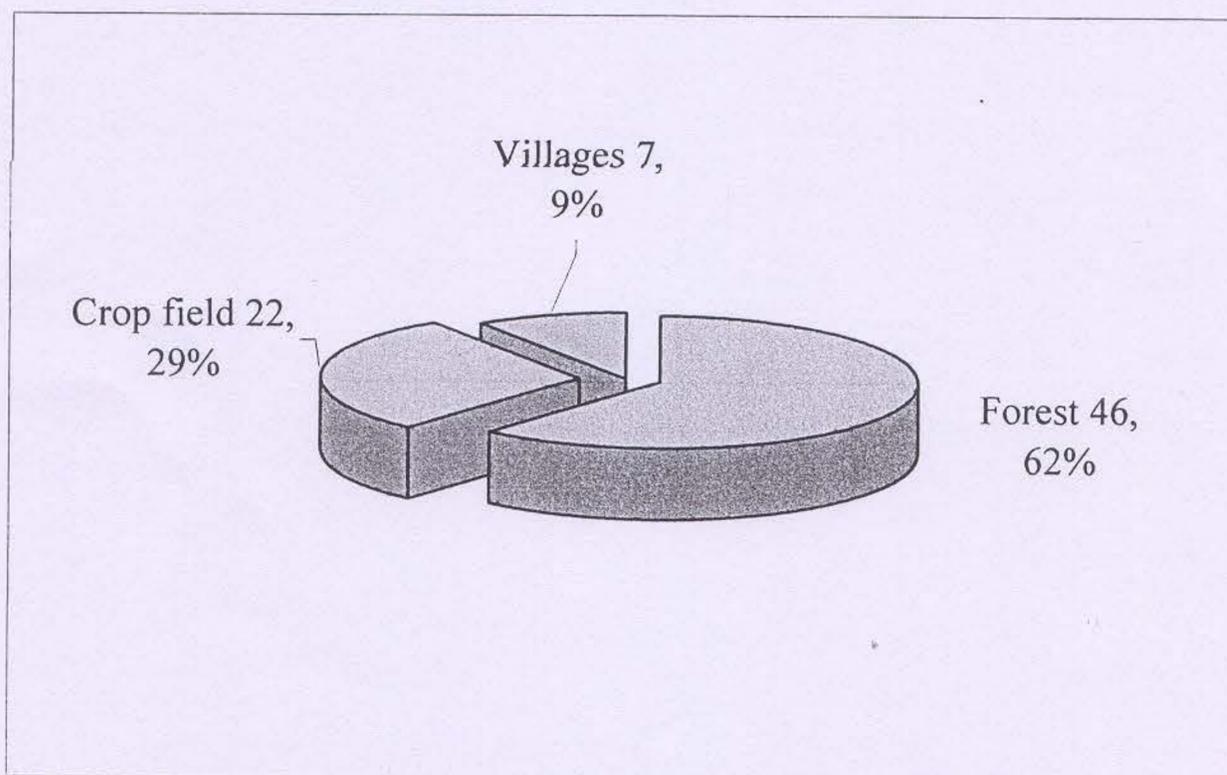**Figure 2. Comparison of human casualties in MWLS and JWLS.**

Jessore WLS, 31, 41%

Moutn Abu WLS, 44, 59%
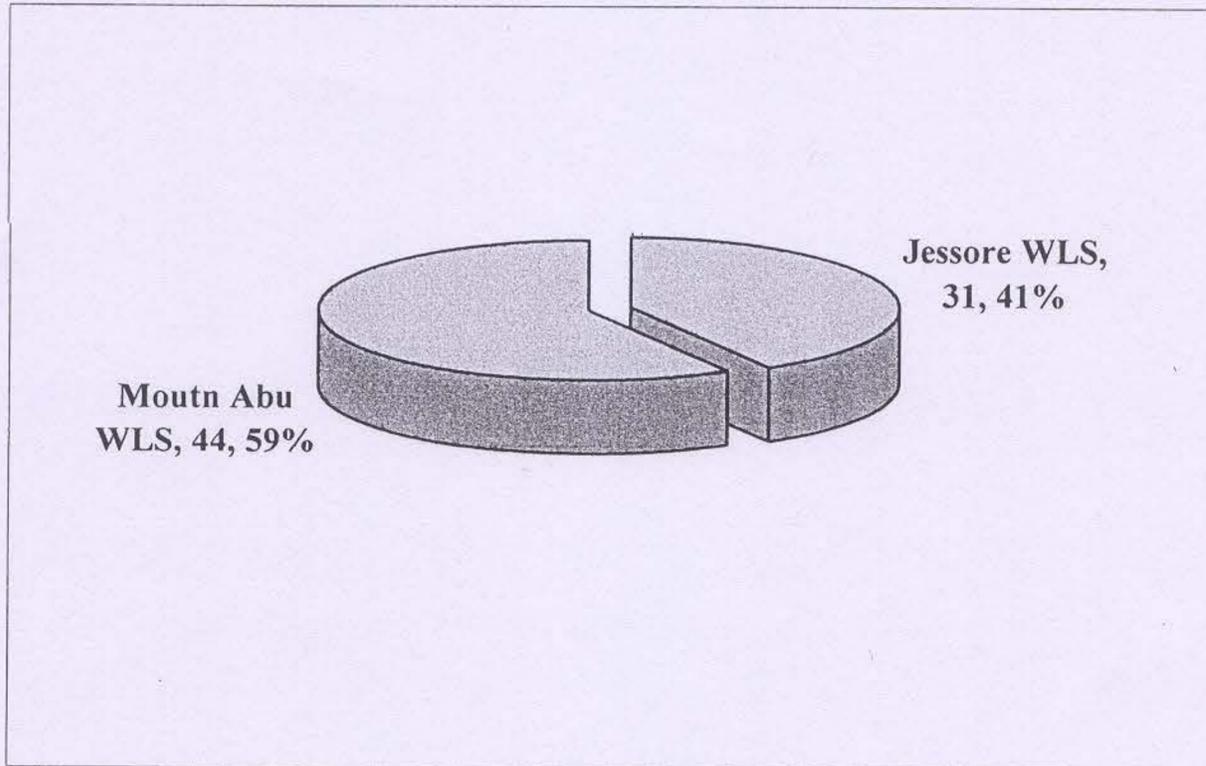
Figure 3. Place of human casualties by sloth bear in MWLS and JWLS.

Villages 7, 9%

Crop field 22, 29%

Forest 46, 62%

Mount Abu wildlife sanctuary

In MWLS, out 27 surveyed villages 17 were more affected from sloth bear nuisance. There were total 44 cases of human casualties. Incidences of male mauling 30 (69%) were higher than those of female mauling cases 9 (20%) and children 5 (11%) **(Table 3, Figure 4).**

Table 3. Human casualties by sloth bear in MWLS.

Gender	No.
Male	30
Female	9
Children	5
Total	44

Figure 4. Human casualties by sloth bear in MWLS.
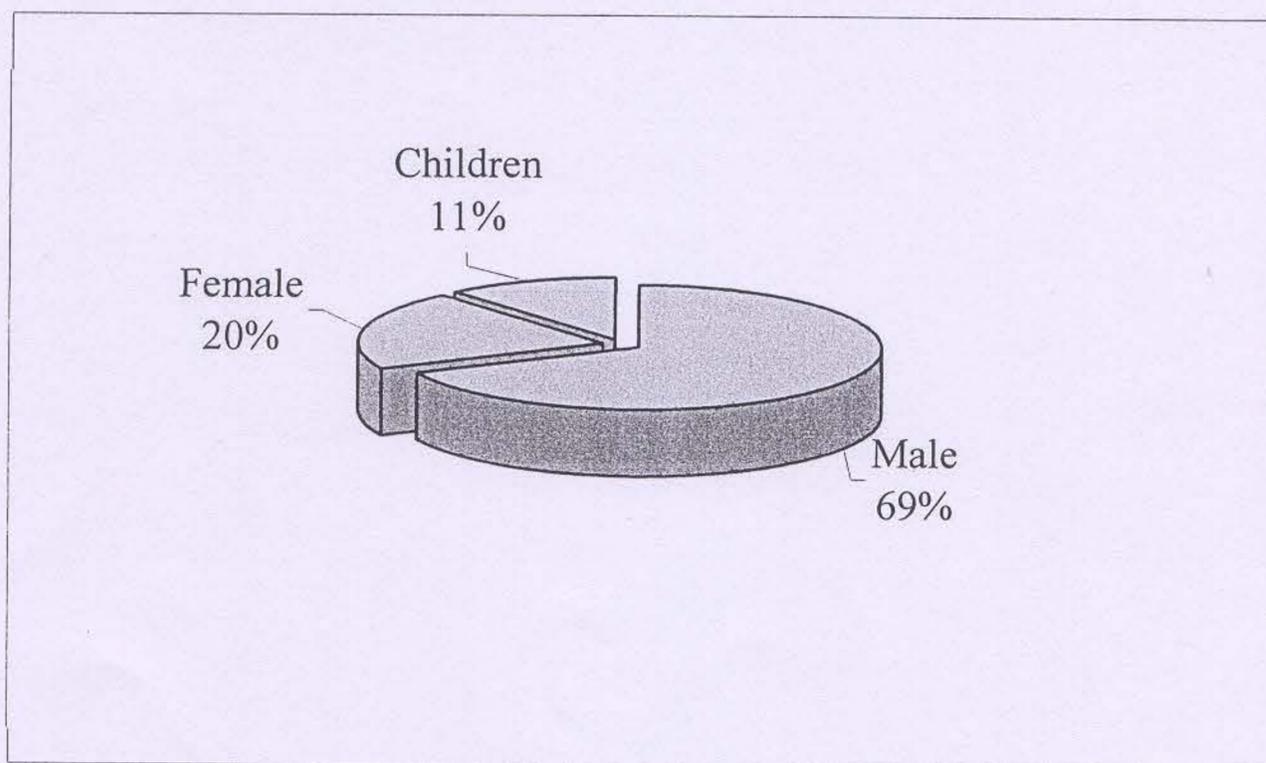
In MWLS, there was marked monthly variation in occurrence of human casualties; number of attacks increased from April (n=1) to November (n=6) **(Figure 5).** Thus the number of incidences varied in different seasons. Maximum incidences were recorded during winter season

(36%, n=16). There were 34% (n=15) and 30% (n=13) cases during monsoon and summer seasons respectively **(Table 4, Figure 6).**
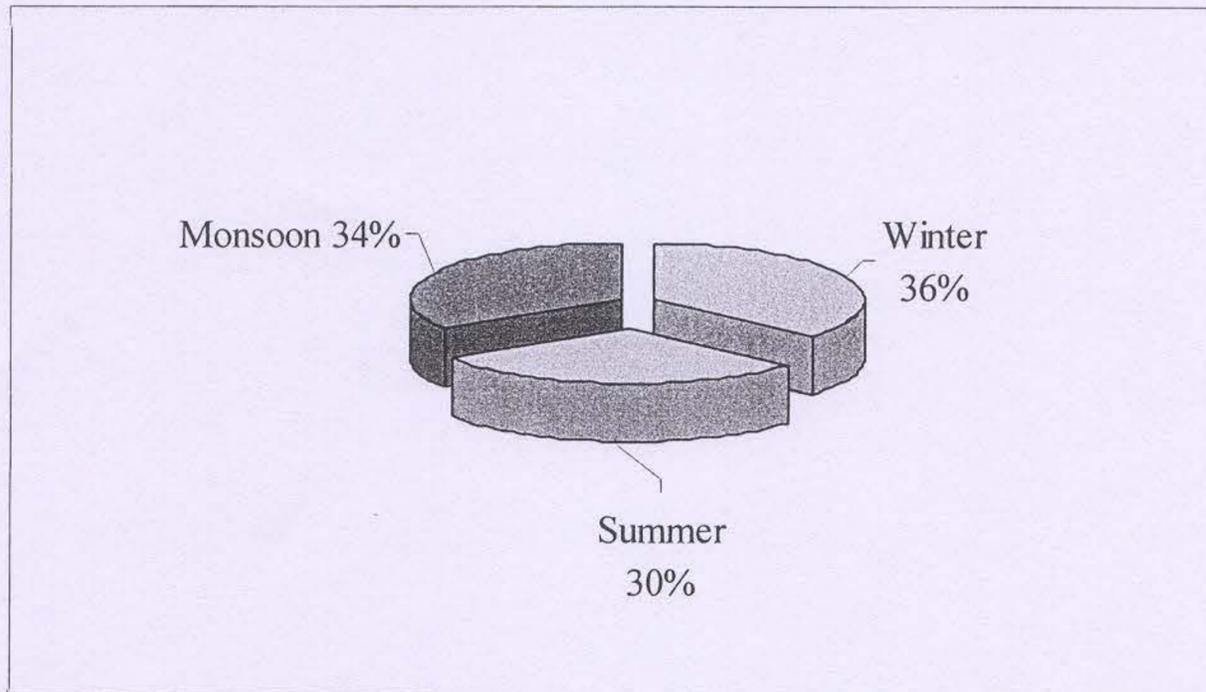
Figure 5. Monthly variation in human casualties from 1997 to 2008 in MWLS.
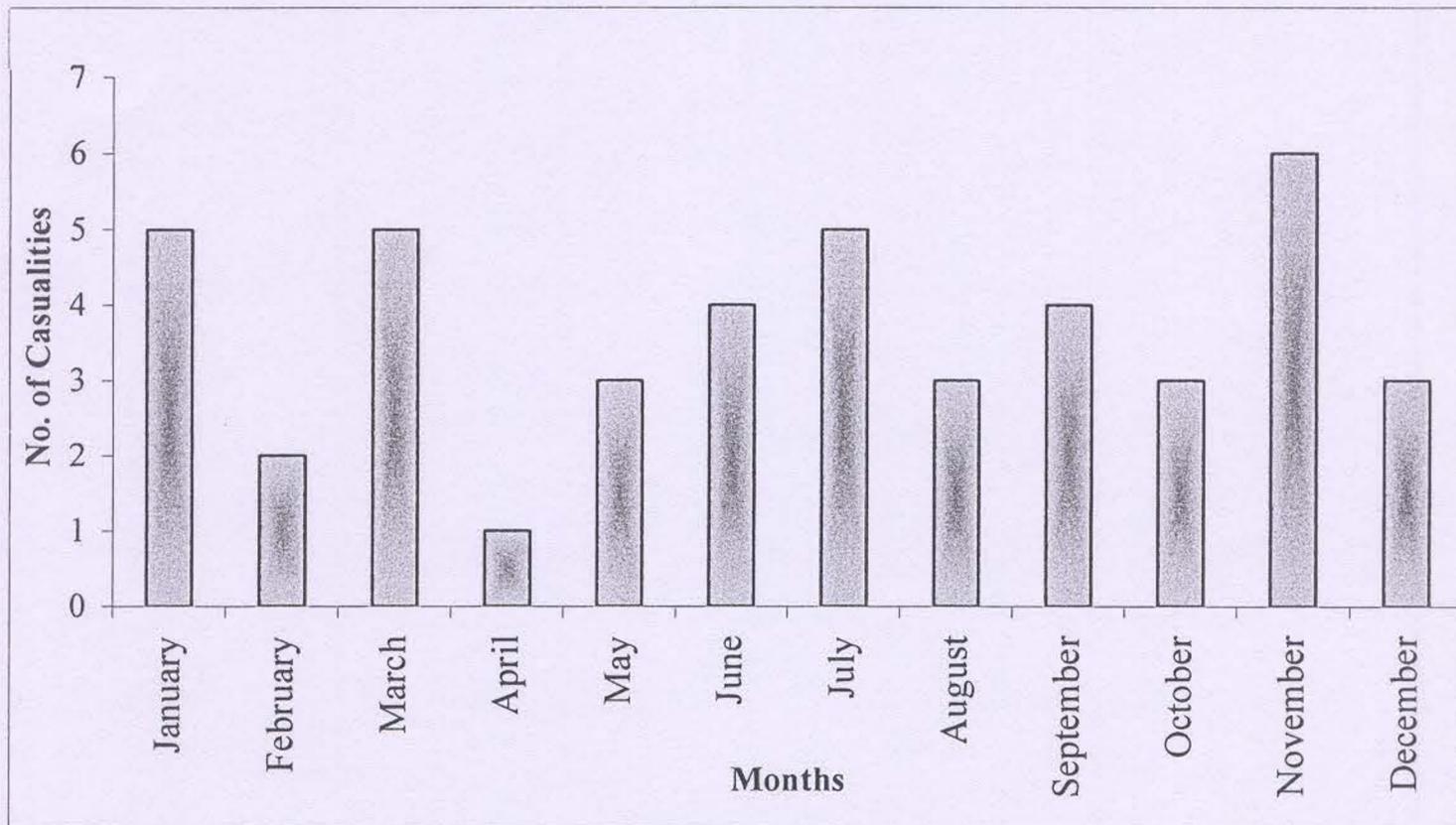
Table 4. Seasonal variation in human casualties in MWLS

Season	No. of cases
Winter	16
Summer	13
Monsoon	15
Total	44

**Figure 6. Seasonal variation in human casualties in MWLS.**

Diurnal pattern of occurrence of human casualties showed considerable variation **(Table 5)**. Most of the cases occurred in evening time. In MWLS, maximum casualties were reported between 1500-2000h (66%), followed by incidences occurred between 2000-0100h (14%), 0500-1000h (11%) and 1000-1500h (9%). Maximum cases occurred in the age group of 21-30 years (23%), followed by age group of 31-40 years (20%) and 10-20 years and, 41-50 years (16%) **(Figure 7)**.

Table 5. Time of human casualties by sloth bear in MWLS.

| Time	No. of attacks (%)
0500 – 1000 h	5 (11%)
1000 – 1500 h	4 (9%)
1500 – 2000 h	29 (66%)
2000 – 0100 h	6 (14%)
Total	**44**

Figure 7. Age group of victims in MWLS.
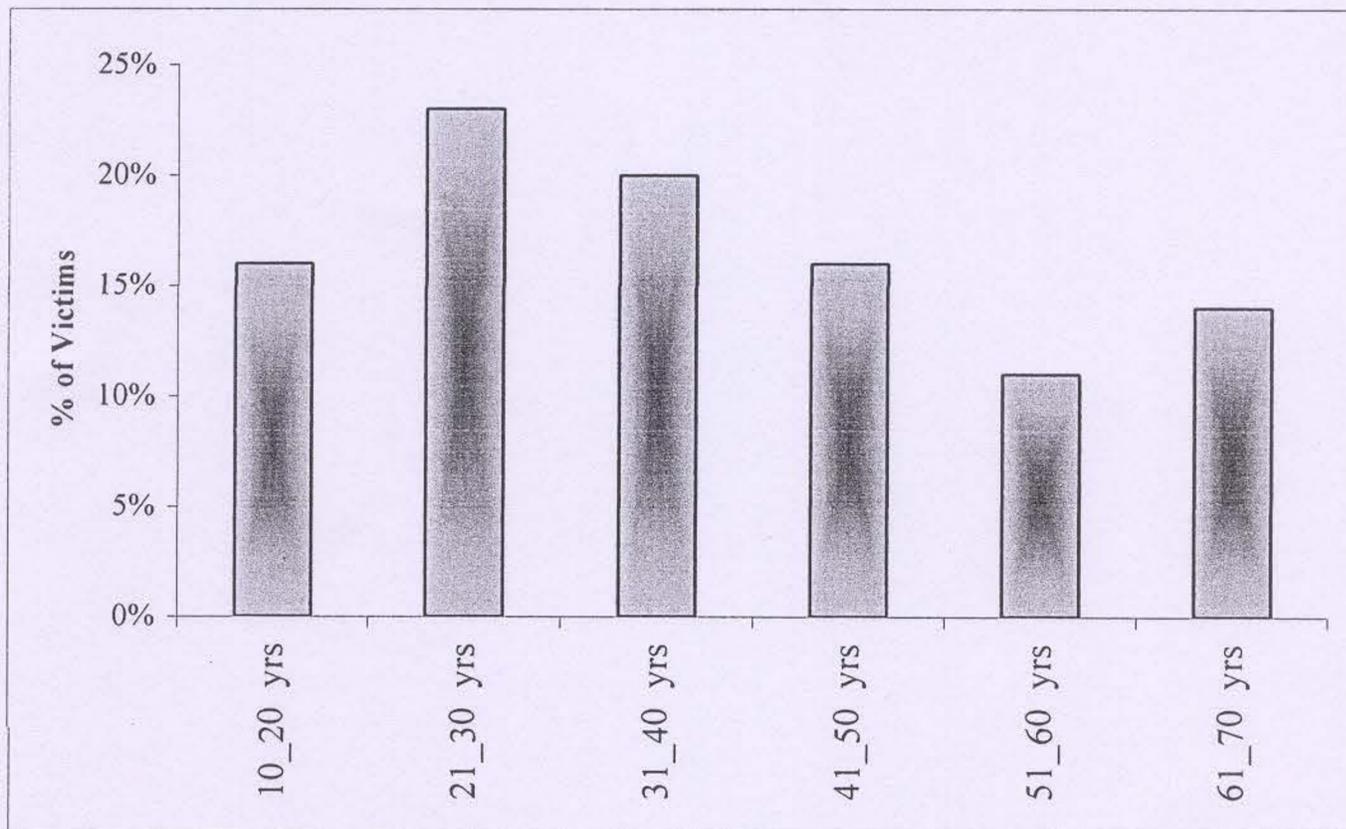
Out of 44 human casualties, 69% (n=30) cases occurred in forest area followed by crop field (n=9, 20%) and villages (n=5, 11%) **(Table 6, Figure 8)**. Single bear (52%) was responsible in most of the incidences of casualties in MWLS. Group of two and three bears were responsible for 27% and 16% attacks respectively. There were only 2 cases in MWLS when group of four was encountered **(Table 7)**.

Table 6. Place of human casualties by sloth bear in MWLS.

Place of casualties	No.
Forest	30
Crop field	9
Villages	5
Total	**44**

26

Figure 8. Place of human casualties by sloth bear in MWLS.
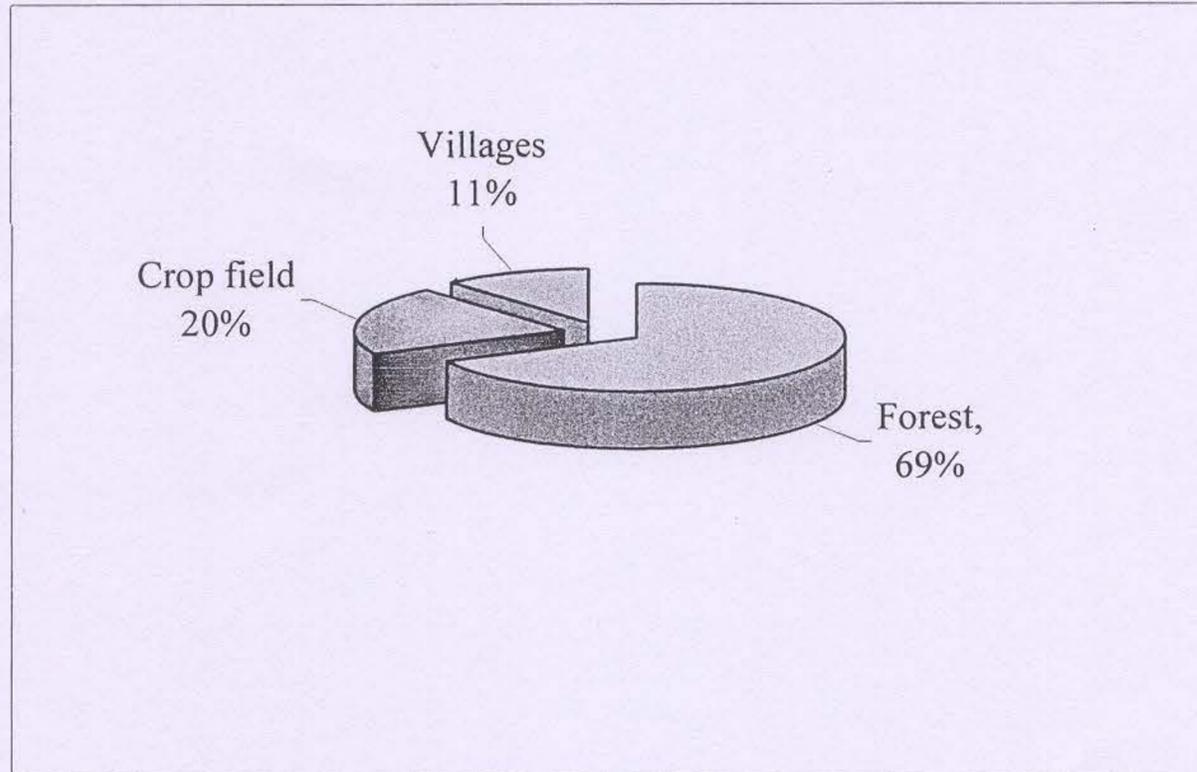
Table 7. Number of bears during attacks in MWLS.

| No. of bears	No. of cases (%)
One	23 (52%)
Two	12 (27%)
Three	7 (16%)
Four	2 (5%)
Total	**44**

Jessore wildlife sanctuary

Based on village interviews, 20 out of the 25 surveyed villages were found to be affected from sloth bear menace in JWLS. During the study period, there were 31 human casualties reported from 1997 to 2008. Incidences of male mauling were higher (65%) than those of females (29%) and children (6%) **(Table 8, Figure 9).** Monthly occurrence of human casualties showed some variation. In JWLS, incidences of human mauling steadily increased from February (n=1) to May (n=5), and then there was one casualty in June and August months each. In September, there were 4 cases, and October and December, there were three cases in each month **(Figure 10).**
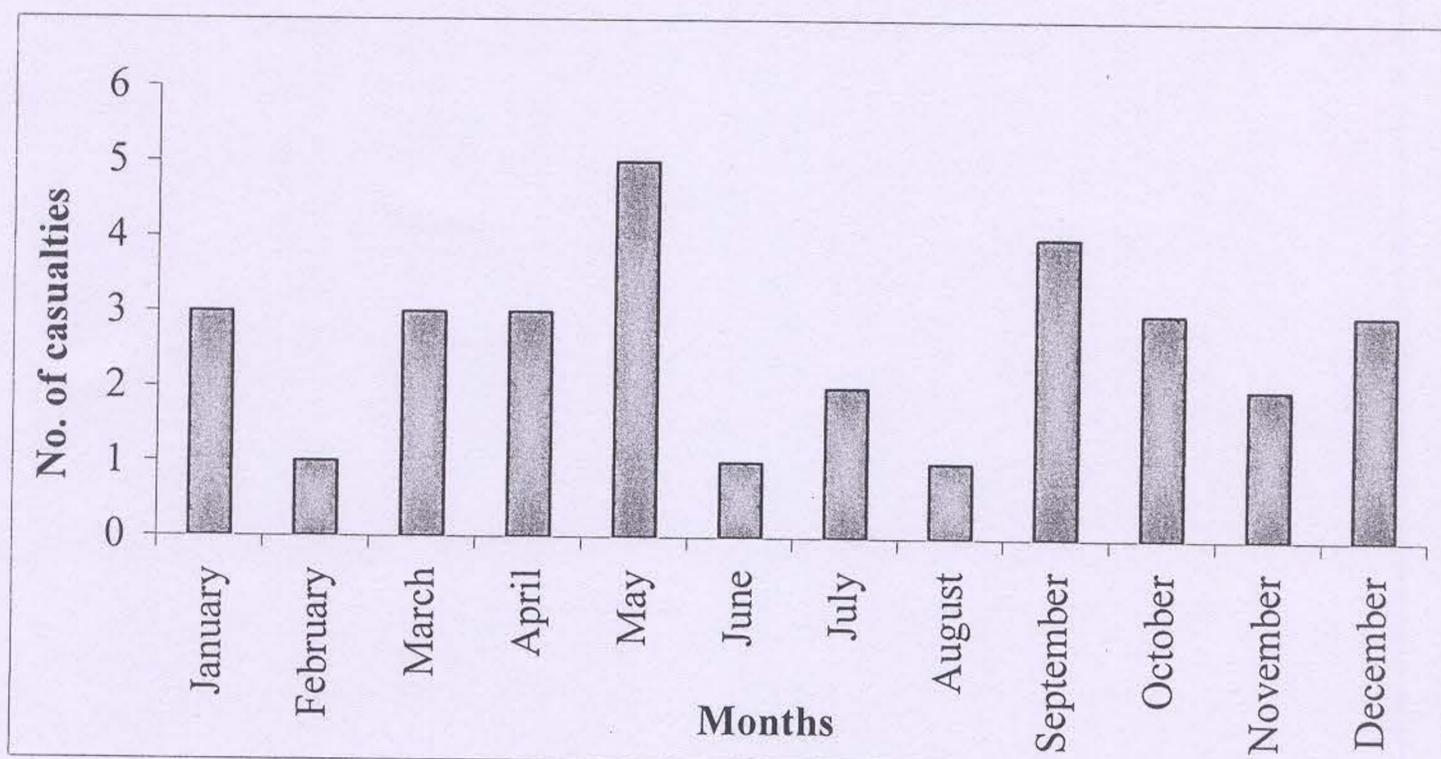
Table 8. Human casualties by sloth bear in JWLS.

	No. of cases
Male	20
Female	9
Child	2
Total	**31**

Figure 9. Human casualties by sloth bear in JWLS.
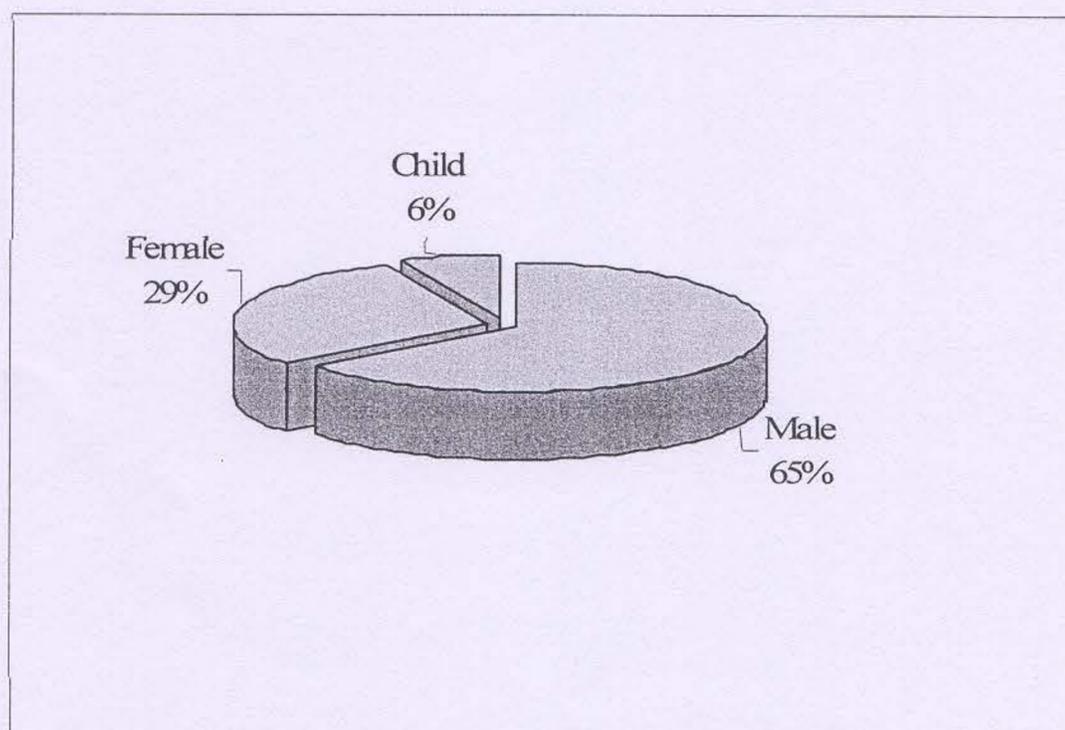
Figure 10. Monthly variations in human casualties from 1997 to 2008 in JWLS.


Number of incidences of human casualties varied in different seasons. Maximum incidences were reported during summer season (39%, n=12). During monsoon and winter seasons, there were 32% (n=10) and 29% (n=9) cases respectively **(Table 9, Figure 11)**. In JWLS, maximum casualties were reported between 1500-2000h (42%), followed by incidences occurred between 0500-1000h (39%), and 2000-0100h (19%) **(Table 10)**. It was also observed that the human mauling cases varied in different age groups. Maximum cases occurred in the age group of 21-30 years (28%), followed by age group of 31-40 years and 10-20 years (23%), 41-50 years and 51-60 years (10%) **(Figure 12)**. As the age group increased, human casualties were found to be less and children with growing age were more vulnerable to bear attack.

Table 9. Seasonal variations in human casualties by sloth bear in JWLS.

Season	No. of attacks
Summer	12
Monsoon	10
Winter	9
Total	**31**

29

Figure 11. Seasonal variations in human casualties by sloth bear in JWLS.

Winter 29%

Summer 39%

Monsoon 32%
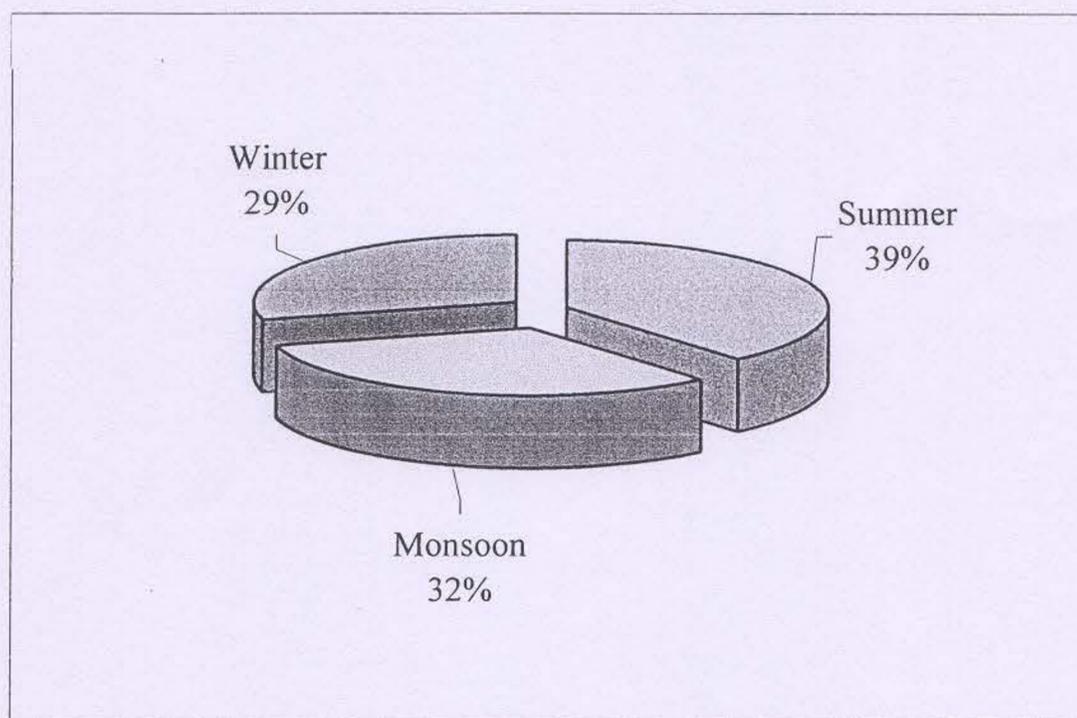
Table 10. Time of human casualties by sloth bear in JWLS.

Time	No. of attacks (%)
0500 – 1000 h	12 (39%)
1500 – 2000 h	13 (42%)
2000 – 0100 h	6 (19%)
Total	31

Out of 31 human casualties, 16 (52%) occurred in forest area, followed by crop field (n= 9, 20%) and villages (n = 5, 11%) **(Table 11, Figure 13)**. During attack on human beings, single bear or more than one bear in a group was responsible for the incidence in both sanctuaries. Out of total 31 incidence casualties most of the incidences occurred when only one bear was encountered. In JWLS single bear was encounter 75%. Group of two and three bears were responsible for 19% and 6% attacks respectively **(Table 12)**.
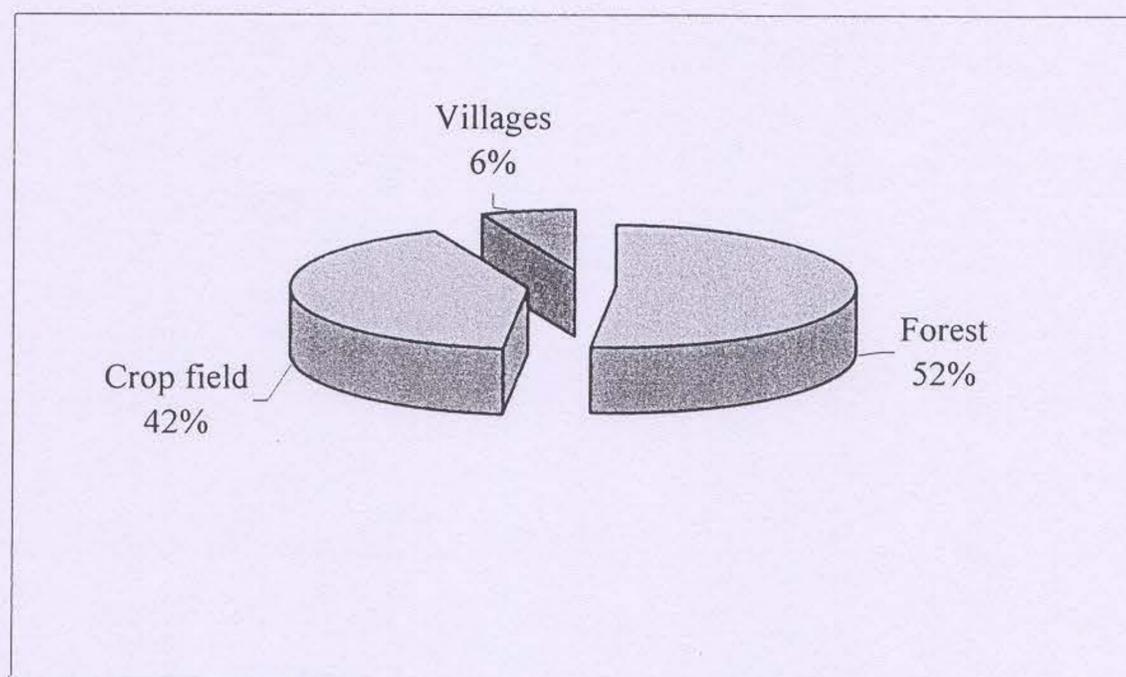
Figure 12. Age groups of victims in JWLS.
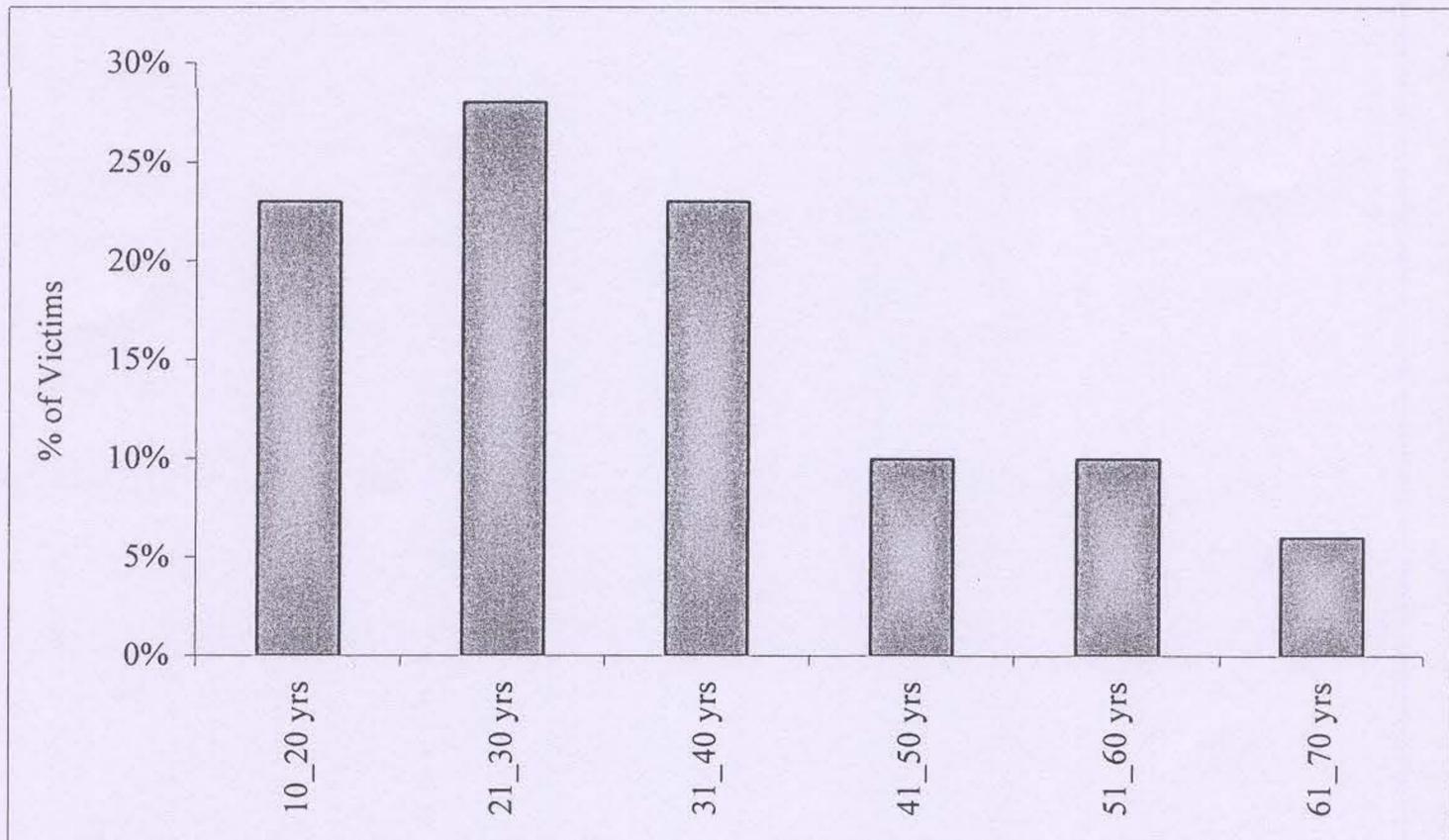
Table 11. Place of human casualties by sloth bear in JWLS.

Place of casualties	No. of cases
Forest	16
Crop field	13
Villages	2
Total	**31**

Figure 13. Place of human casualties by sloth bear in JWLS.

Table 12. Number of bears during attacks in JWLS.

No. of bears	No. of cases (%)
One	23 (75%)
Two	6 (19%)
Three	2 (6%)
Total	**31**

During village surveys, it was found that villagers were collecting 24 NTFP items in different seasons from in and around JWLS and MWLS for their economy and sustenance **(Table 13)**. Based on the responses from the villagers, there was no specific time for collection of NTFP; it could be anytime during the day. Plates I to IV show injuries to victims caused by sloth bear attack and Plate V shows NTFP collection by villagers.

Table 13. List of NTFP collected by villagers.

| S. No.	Common name	Scientfic name
1	Aam	*Mangifera indica*
2	Adulsa	*Adhatoda vasaca / Justicia adhatoda*
3	Amaltas / Indian Laburnum	*Cassia fistula*
4	Aritha	*Sapindus emarginatus*
5	Avla	*Phyllanthus emblica*
6	Behda	*Terminalia belerica*
7	Bel	*Aegle marmelos*
8	Ber	*Zizyphus mauritiana*
9	Goras imli	*Pithecellobium dulce*
10	Gugal	*Comiphora species*
11	Gunda	*Cordia dicotoma*
12	Jamun	*Syzygium cumini*
13	Karvanda	*Carissa congesta*
14	Kessu / Flame of Forest	*Butea monosperma*
15	Khatti imli	*Tamarindus indicus*
16	Mahua, Mahuda	*Madhuca indica*
17	Mardasing / Murudsheng	*Helicteris isora*
18	Rayan	*Manilkara hexandra*
19	Safed musli	*Chlorophytum borivalianum / tuberose*
20	Salai	*Boswellia serrata*
21	Sitaphal	*Annona squamosa*
22	Timru	*Diospyros melanoxylon*
23	Gum	
24	Honey	

Crop damage by sloth bear

Human-wildlife conflict (HWC) is a growing problem for communities located at the borders of protected areas. Such conflicts commonly take place as crop-raiding events by wild animals, among other forms (Ogra and Badola 2008). Wild animals often destroy standing crops, causing economic losses to farmers. Crop and wildlife damage are becoming serious for many Indian protected areas. Sloth bears subsist primarily on termites, ants, and fruits. This is the only species of bear adapted specifically for myrmecophagy (ant and termite-eating; Garshelis *et al.* 1999*b*, Sacco and Van Valkenburgh 2004). The ratio of insects to fruits in the diet varies seasonally and geographically (Baskaran *et al.* 1997, Joshi *et al.* 1997, Bargali *et al.* 2004, Sreekumar and Balakrishnan 2002). Studies in Nepal and Sri Lanka suggest that sloth bears avoid areas where human disturbance is high, so crop depredation by sloth bears is typically rare (Joshi *et al.* 1995, Ratnayeke 2007). Conversely, in some parts of India, sloth bears routinely raid peanut, maize, and fruit crops etc. (Chhangani 2002). Chauhan (2006) suggests that such crop depredations may occur because these habitats are severely affected by human exploitation, including the extraction of several food sources for bears. During the work on sloth bear in North Bilaspur forest division the presence of groundnut and corn (maize) in scats collected during the monsoon suggests crop damage by bears (Bargali *et al.* 2004). The extent and intensity of damage may vary depending upon the cropping patterns, wildlife population density and behaviour, and feed availability in wild habitats. A loss in crop productivity hurts all the inhabitants (Maikhuri *et al.* 2000a).

During a project study conducted on crop raiding by Asiatic black bear (*Ursus thibetanus*), the damage to corns by bears was investigated using video tape recording and monitoring the traces-eaten on corns in an experimental farm area of Tohoku University. The invasion of the corn field was strongly motivated during the milk-ripe stage where the nutrient requirement could be fulfilled only by corn in this stage. In New England in colonial times, black bears were serious agricultural pests and were bounties as an incentive for controlling their numbers. Black bears still cause damage to agriculture, particularly corn. Corn was not only consumed but stalks were flattened, hindering mechanical harvesting. In Wisconsin, corn damage increased from 10% (of all damage claims) from 1936 to 1954 and 65% during 1986-1990, principally due to the

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increased use of short-maturity varieties of corn. Silage corn is most commonly depredated in New England.

Methods

For assessment of crop damage, control plot and uncontrolled ones were constructed in crop fields in different villages. The control plots were laid immediately after sowing. For this 2×2 m control plots were constructed in different agricultural areas in and around the sanctuary area. These plots were constructed by fixing four wooden poles of six to seven feet each on each corner of the square plot and then wire mesh panels of six feet in height were fixed on all the sides as shown in the picture below. The uncontrolled plots were randomly laid in the same crop fields. These plots were laid just before the harvesting crop. All these control plots were monitoring periodically. Data obtained from comparison of controlled and uncontrolled plots was used to quantitatively assess the damage to agricultural crops.
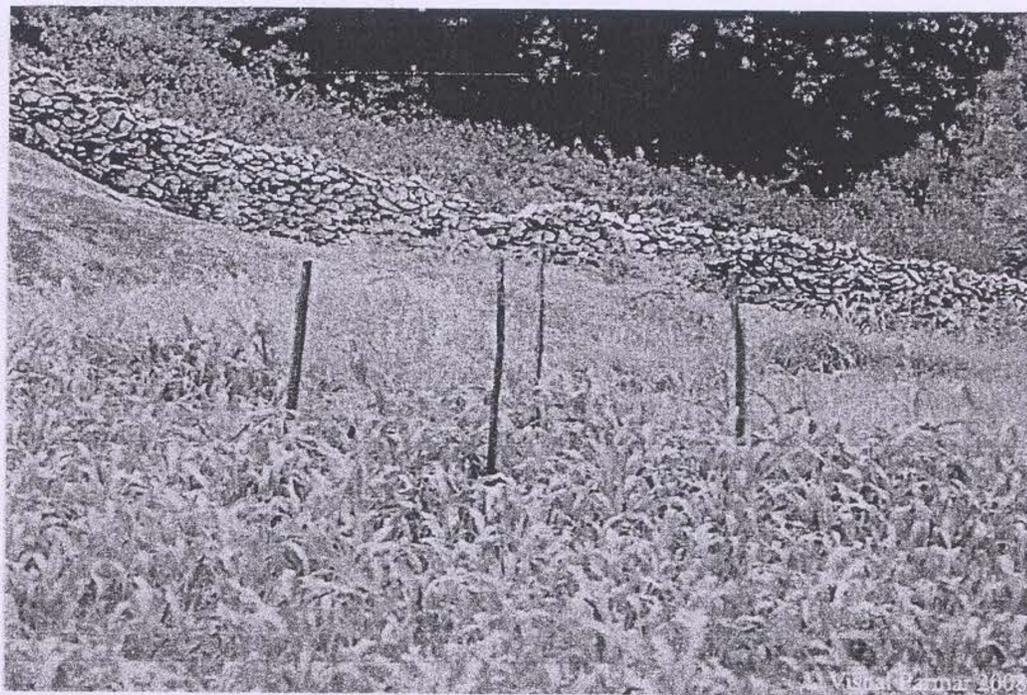
Crop damage in villages in MWLS

The study on assessment of damage to agricultural crops was conducted in villages situated in and around MWLS. Information was collected using a semi-structured questionnaire from 27 villages through interviews of more than 150 respondents and also through group discussions. Crop depredation evidently affected nearly half of the households in those villages in the vicinity of both the sanctuaries, but extent of damage varied considerably amongst villages with respect to crop grown. Crop guarding was the most popular means, followed by use of physical fences around crop fields. In spite of damage to agricultural and horticultural crops, the local people were still found to have a positive attitude towards the forest because of tangible benefits derived from the reserve in terms of fodder, seasonal fruits and fuelwood.

The principal income source of the people living around MWLS is farming and cattle rearing, the major crops grown in this area are maize, wheat, jowar, castor, kennel and seasonal vegetables. Agriculture is mainly rain fed; major irrigation sources are wells and running perennial water from Mount Abu. Some areas around Swarupganj and Rewdar were facilitated with dam water during the dry season. In Mount Abu, water often goes dry during summer due to very deep ground water levels.

Based on control and uncontrolled plot method, damage to crops was quite high in the villages of MWLS. In Oriya village, crop damage was extensive and maximum loss was 54.5%. Crop damage in Jawai and Bapuda villages was found to be 42.9% and 35.7% respectively. In Anadra and Wastanji villages, extent of damage was found up to 14.3% **(Table 14)**. Based on surveys of 27 villages and 163 respondents, the main crop grown were maize, wheat, castor, kennel, jowar, and seasonal vegetables **(Table 15)**. Out of all respondents, majority of farmers were growing maize and wheat (n=155, 28%), 74 respondents (14%) were growing seasonal vegetables, 73 farmers (13%) were planting castor, 49 respondents (9%) were also growing jowar in their seasonal crops. Forty one (8%) respondents were growing kennel **(Figure 14)**. In and around MWLS, sloth bears were found to raid crops as the scarcity of food materials might force them to invade the agricultural fields or due to the shrinking of forest areas due to increasing human habitations might.

Table 14. Assessment of damage to wheat crop in MWLS.

| Village	Area of crop field (ha)	Productivity in control plots (kg/ha)	Productivity in uncontrolled plots (kg/ha)	Loss (kg/ha)	% loss
Hetamaji	0.47	919.71	668.88	250.83	27.3
Oriya	0.47	919.71	418.05	501.66	54.5
Jawai	0.23	585.27	334.44	250.83	42.9
Delwada	0.47	1337.76	1337.76	0.00	0
Salgav	0.58	836.10	535.10	301.00	36
Nitoda	1.86	1086.10	877.91	209.03	19.2
Bhekari	1.28	1079.33	729.68.	349.64	32.4
Bapuda	0.81	668.88	429.99	238.89	35.7
Anadra	1.28	851.30	729.69	121.61	14.3
Isra	1.51	823.24	656.02	167.22	20.3
Wastanji	0.35	1170.54	1003.32	167.22	14.3
Taleti	0.23	1003.32	1003.32	0.00	0

According to 163 respondents, we found that the maximum damage the maize crop. Out of all respondents, 125 (42%) said that sloth bears were responsible for damages to maize and wheat crops. Fifty nine respondents (20%) reported damages to seasonal vegetables **(Table 16, Figure 15)**. There was no damage to castor and kennel.

Table 15. Agricultural crop grown in villages (n=163).

	Wheat	Maize	Jowar	Vegetables	Castor	Kennel
No. of respondent	154	155	49	74	73	41
%	28	28	9	14	13	8

Figure 14. Number and % of respondents growing different crops in MWLS.
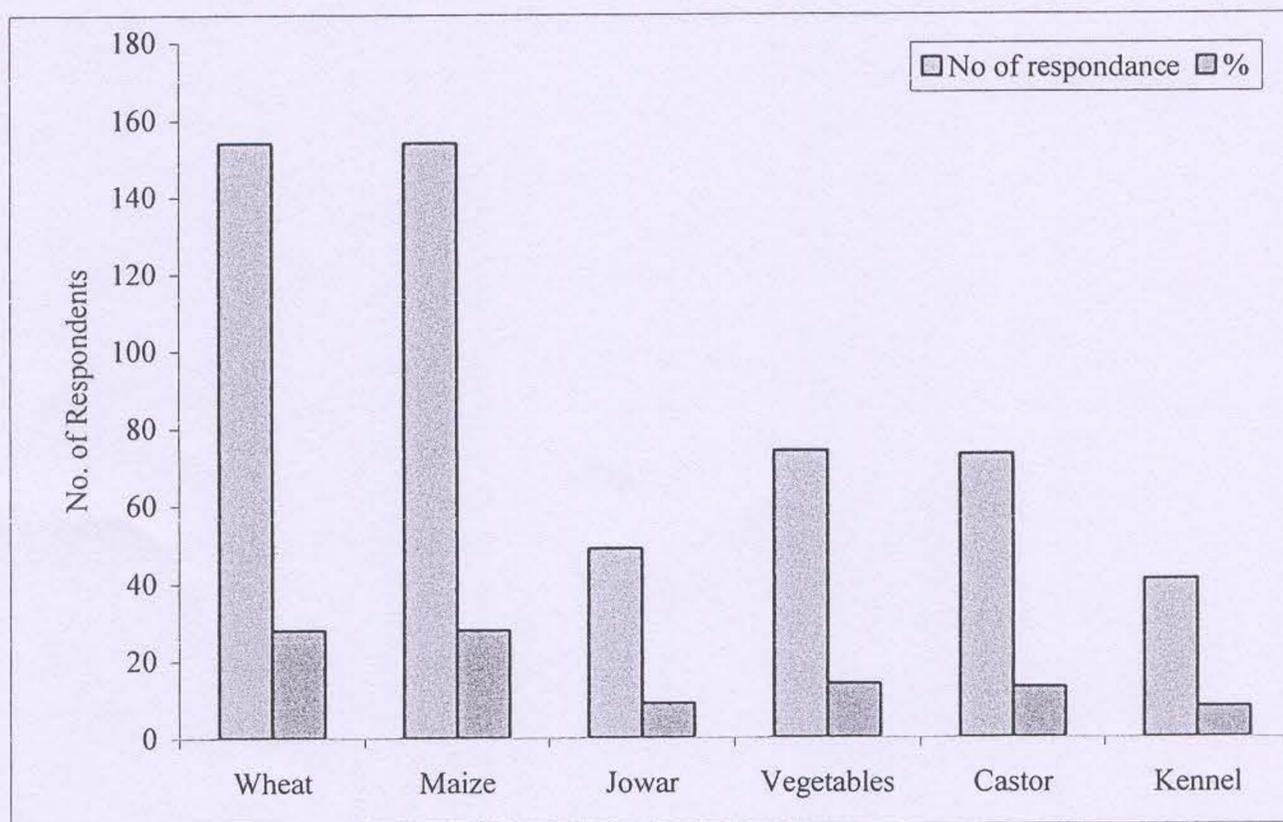
Table 16. Crop damages by sloth bear according to no. of respondent in MWLS

Crop	Wheat	Maize	Jowar	Vegetables	castor	kennel
Damage	107	125	5	59	0	0

Based on the survey information collected from 163 respondents of different villages, the extent of damage caused by sloth bear varied in different months depending on phonological stages of the crops. More than 100 respondents indicated occurrence of crop damage during the months of September to December. So during winter season, bears were mostly active in raiding maize crop fields when the crop was in growing and matured stages. According to 80 respondents, damage to wheat crop also occurred during months February, March and April **(Table 17, Figure 16).**

Figure 15. Agricultural crop damage by sloth bear in MWLS.
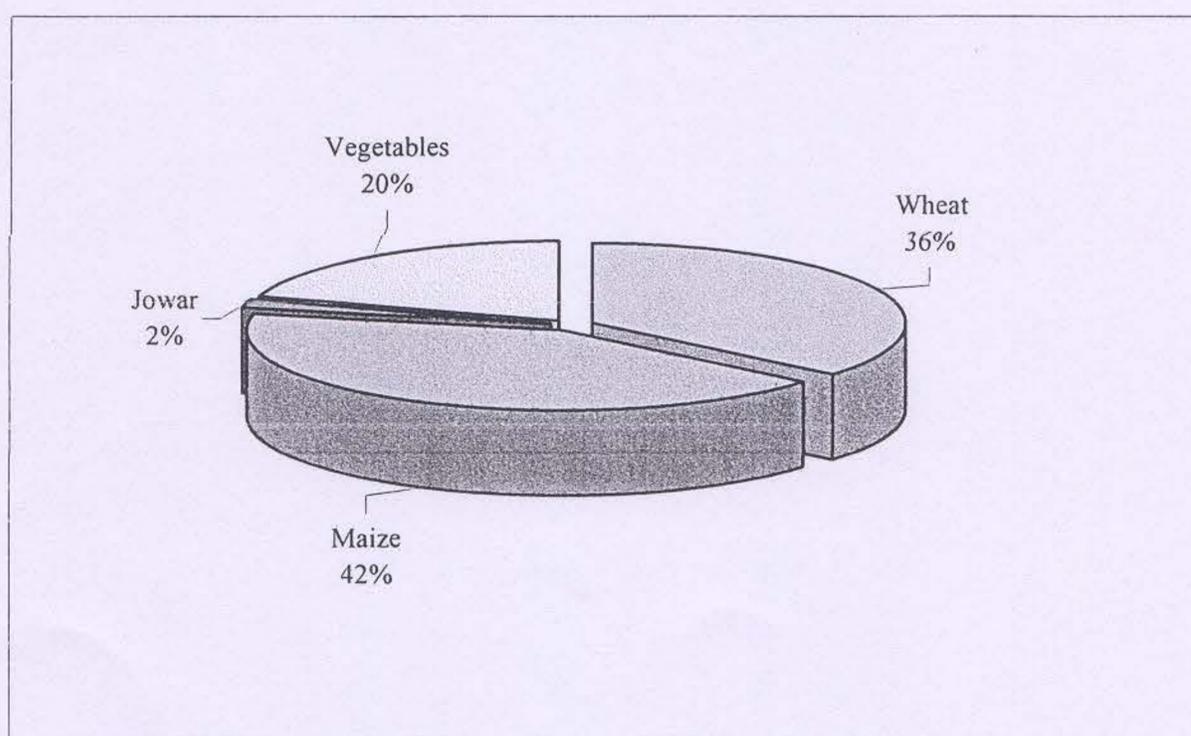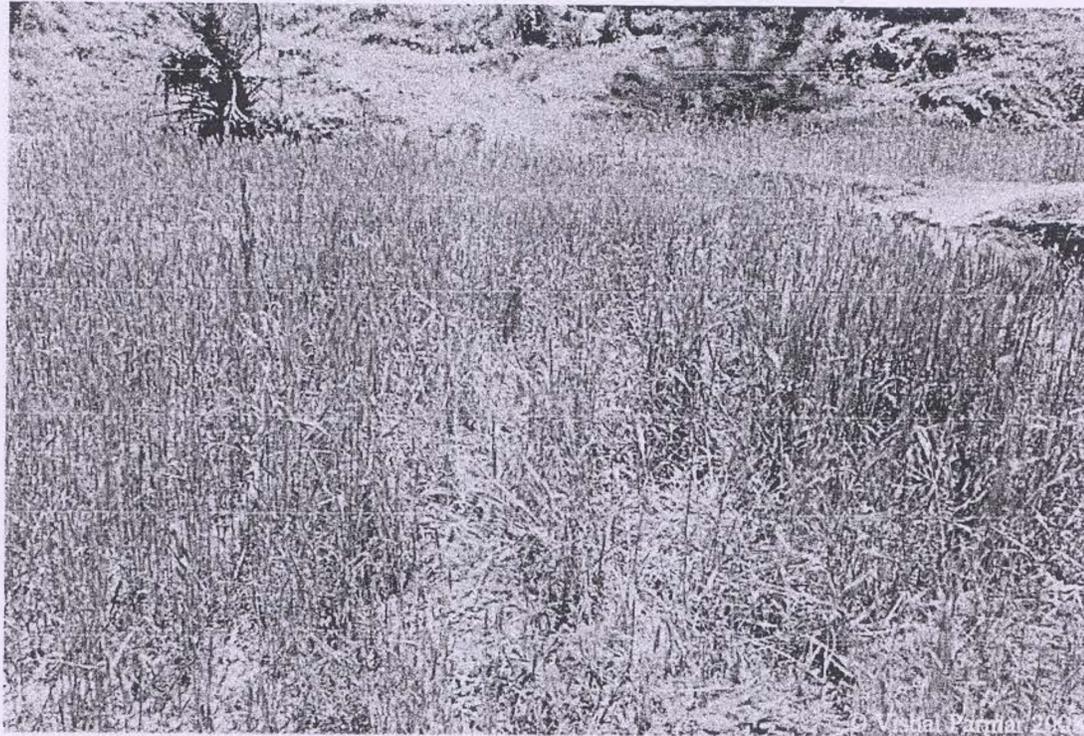
According to 163 respondents in the 27 interviewed villages, the maturation stage of maize crop was the most vulnerable to damage by sloth bears. Almost all the respondents reported the occurrence of damages during the mature stage of maize, and nearly 50 (n=163) respondents indicated occurrence of damage during the sprouting stage of corn. There was no damage during the sowing time of maize. In case of wheat, 102 (n=163) respondents indicated occurrence of damage during the matured stage before harvesting, and 84 (n=163) respondents were pointed occurrence of damage during the growing stage of crop. As vegetables were grown round the year on seasonal basis, the damages were reported all the time. Twenty seven villagers indicated occurrence of damages during early growth stage of vegetables, whereas 20 villagers indicated occurrence of damages when the vegetable were matured. Only 5 (n=163) respondents reported occurrence of damage to jowar crop especially when it was matured **(Table 18 and 19, Figure 17 and 18).**

Table 17. Monthly variation in crop damage by sloth bear according to respondents in MWLS.

%	January	February	March	April	May	June	July	August	September	October	November	December
Wheat	0	84	80	94	0	0	0	0	0	0	0	0
Maize	0	0	0	0	0	0	0	0	114	113	102	114
Castor	0	0	0	0	0	0	0	0	0	0	0	0
Kennel	0	0	0	0	0	0	0	0	0	0	0	0
Jowar	0	0	0	4	3	4	0	0	0	0	0	0
vegetables	4	10	15	7	6	17	20	39	12	13	13	9
Total	4	94	95	105	9	21	20	39	126	126	115	123

Monthly crop damage

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Figure 16. Crop damage in different months in MWLS.
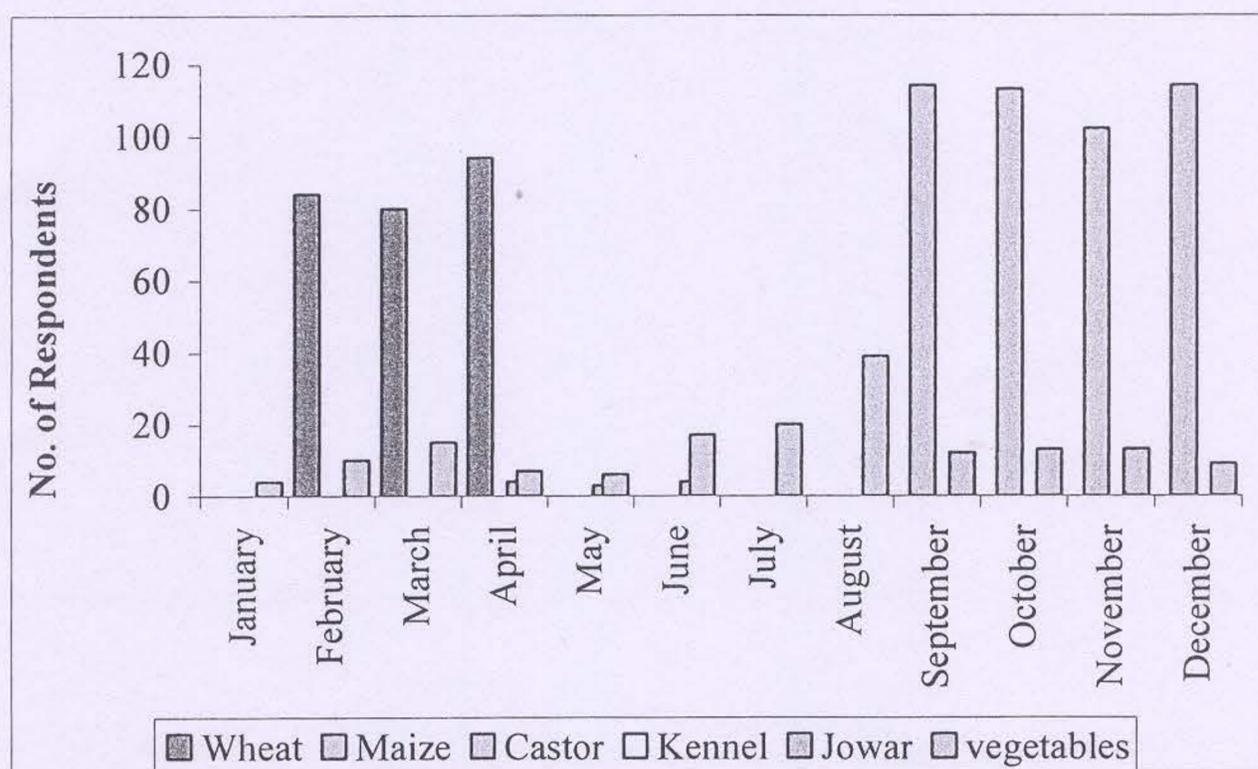
Table 18. Phenological stages of crop damage by sloth bear according to respondents.

Stages	Sown	Middle	Mature
Wheat	0	84	102
Maize	0	50	125
Jowar	0	0	5
Vegetables	27	19	20
Castor	0	0	0
Kennel	0	0	0

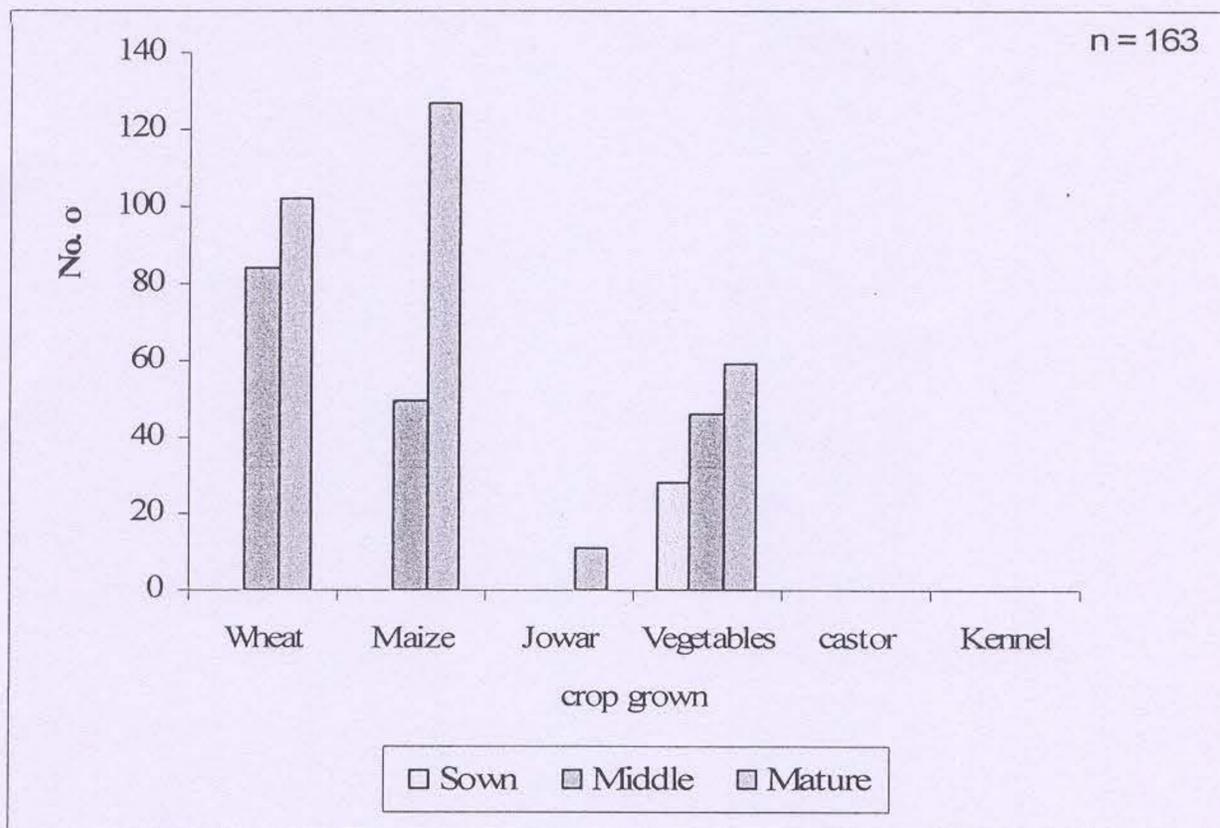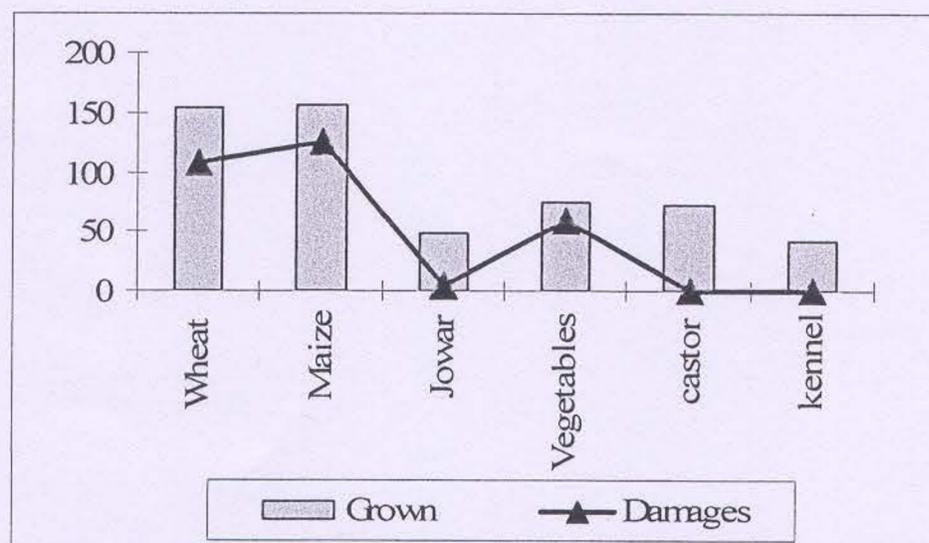**Figure 17. Damage to different phenological stages of crops.**

Table 19. Damage to different crops by sloth bear according to respondents in MWLS.

|	Wheat	Maize	Jowar	Vegetables	castor	kennel
Grown	155	155	49	74	73	41
Damage	107	125	5	59	0	0

Figure 18. Damage to different crops by sloth bear according to respondents in MWLS.

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Crop depredation in villages of JWLS

The people residing in and around JWLS were found to be mainly dependent on cattle grazing and agriculture. The main crops grown are maize, wheat, jowar, castor, kennel, and seasonal vegetables. During the survey detail obtained from the villagers, we found that all the respondents interviewed grow maize and wheat (145) and 65 grow castor, 56 respondents grow vegetables and nearly 50 interviewers grow kennel and jowar **(Figure 19)**.

Figure 19. Crop growing pattern in JWLS.
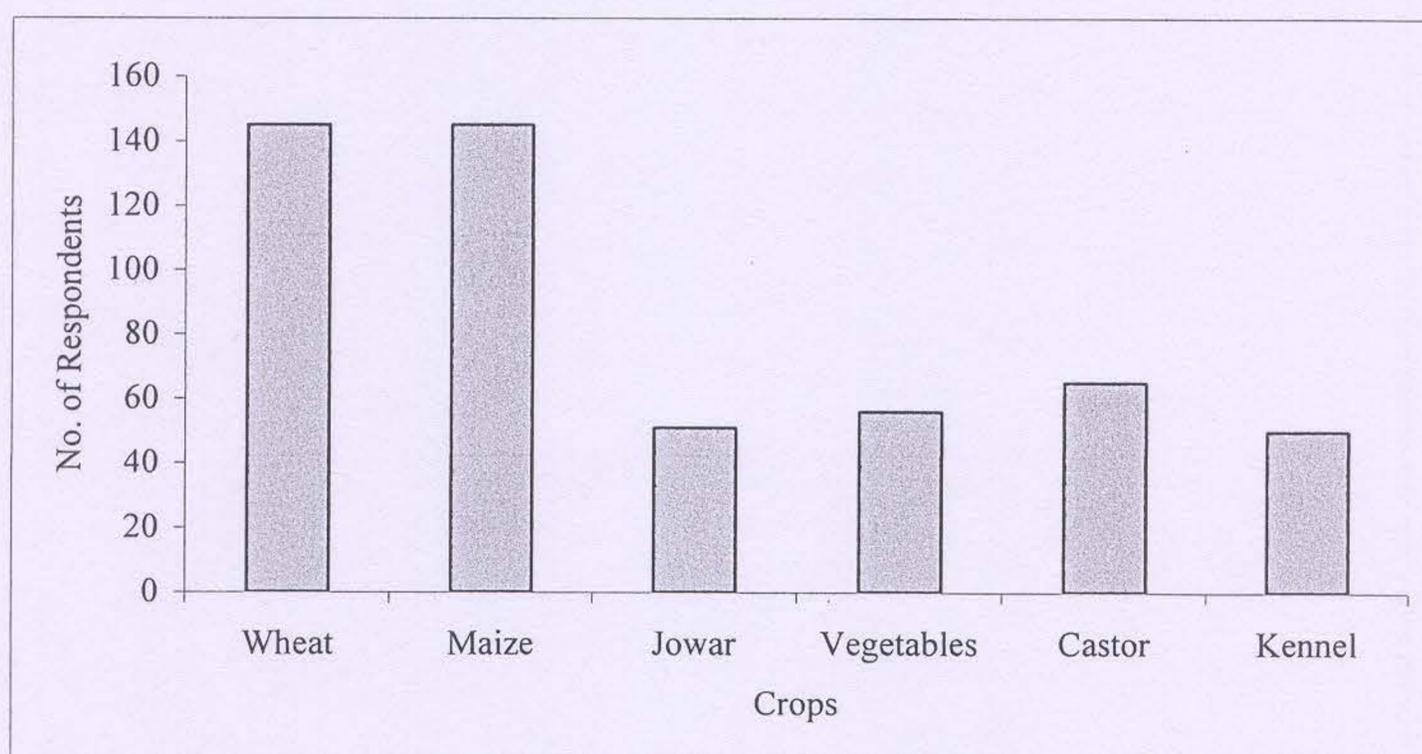
We surveyed 25 villages in and around JWLS and interviewed 145 respondents. We found that the maximum number of respondent (58, 38%) indicated the occurrence of damage to maize crop, followed by the wheat (49, 33%), jowar (21, 14%), vegetables (17, 11%), and minimum to castor (6, 4%). There was no damage to kennel crop according to the respondents. The extent of damage to maize crop was highest **(Table 20, Figure 20).** There was marked monthly variation in the extent of damage to different crops by the sloth bear. We found that in winter season from September to December, the level of damage as reported by the respondent was high nearly 48% of total damages. The maximum damage to maize crop occurred during the month of October when it was in sprouting stage. During January, the damage was very less according to only 8 respondents **(Table 21, Figure 21).**

Table 20. Crop damage by sloth bear according to respondents (n=145).

Crops	Wheat	Maize	Jowar	Vegetables	Castor	Kennel
No. of respondent	49	56	21	17	2	0
% of damage	33.79	38.62	14.48	11.72	4.14	0.00

Figure 20. Damage to different crops by sloth bear according to respondents.
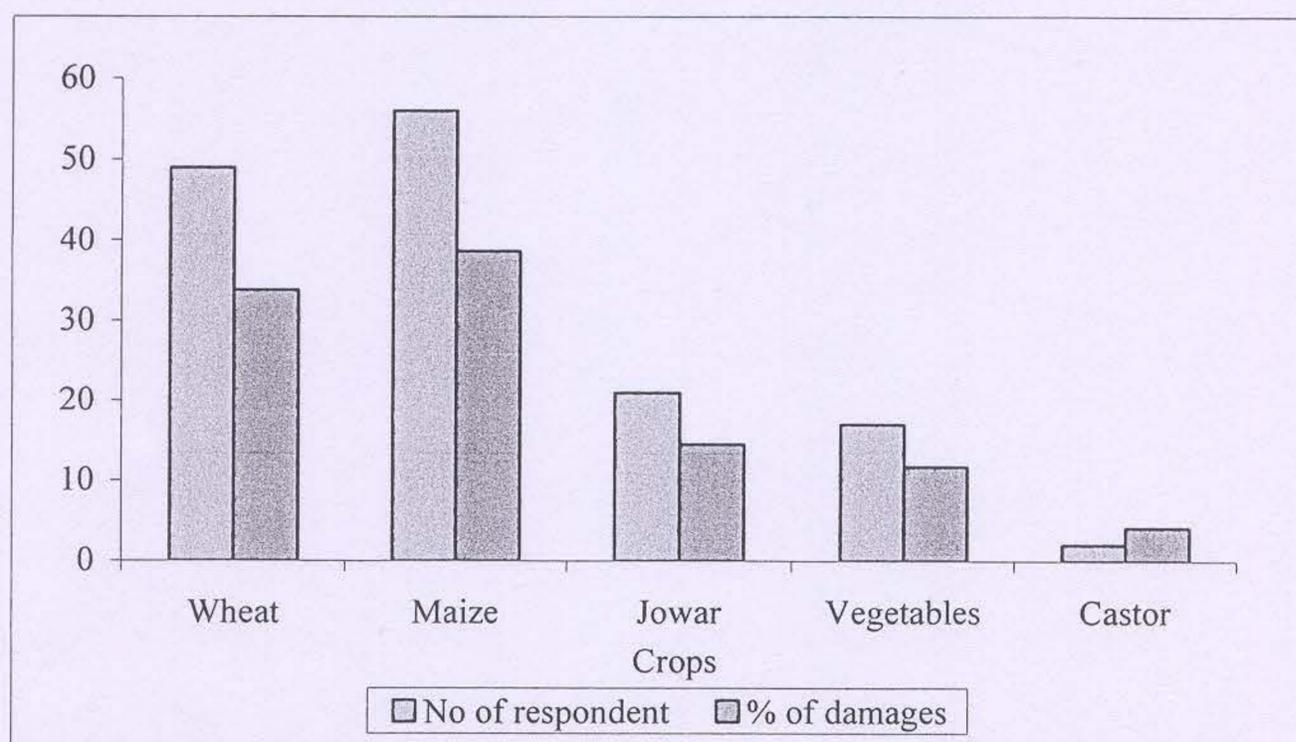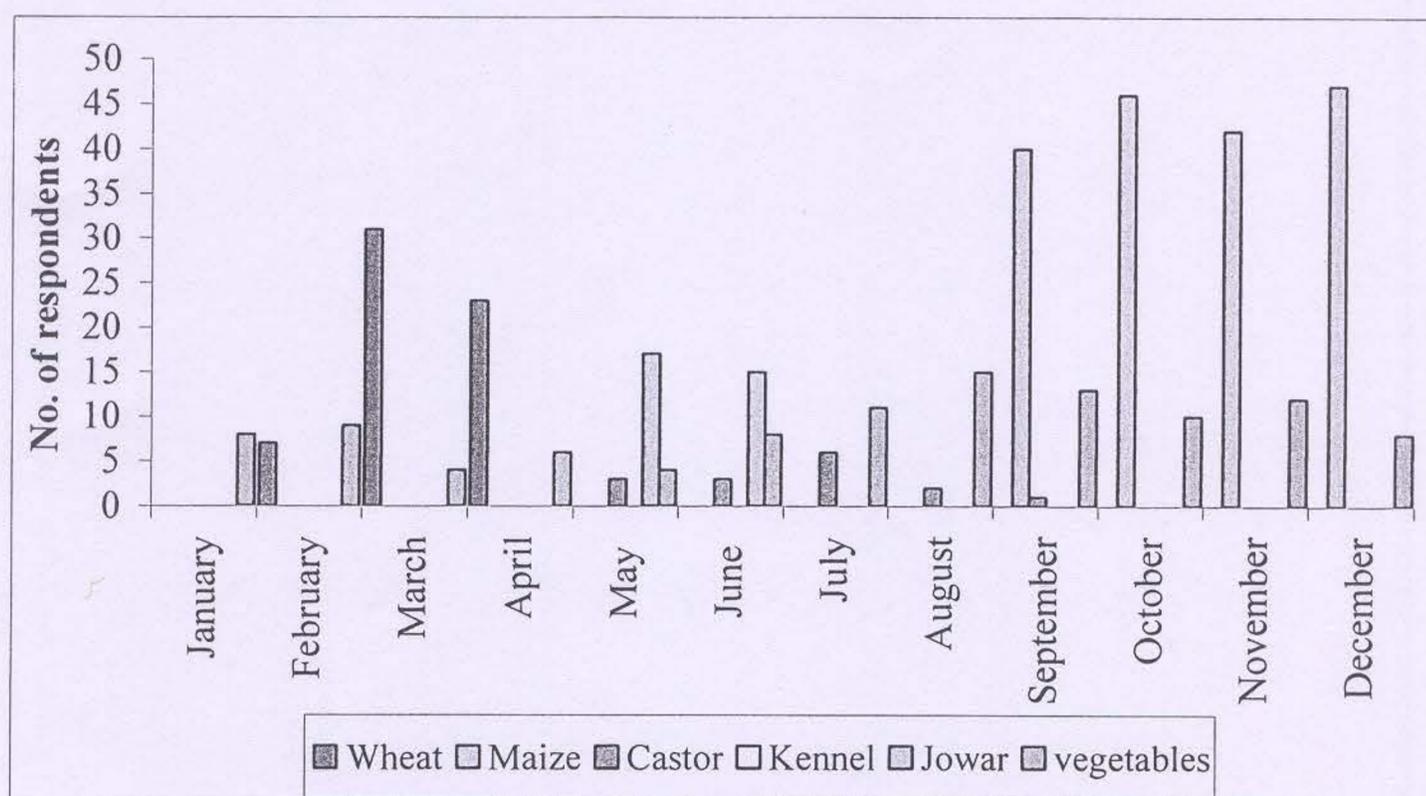
Table 21. Damage to different crops by sloth bear according to respondents (n= 145) in JWLS.

Crop	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Wheat	0	7	31	23	0	0	0	0	0	0	0	0
Maize	0	0	0	0	0	0	0	0	40	46	42	47
Castor	0	0	0	0	3	3	6	2	1	0	0	0
Kennel	0	0	0	0	0	0	0	0	0	0	0	0
Jowar	0	0	0	0	17	15	0	0	0	0	0	0
vegetables	8	9	4	6	4	8	11	15	13	10	12	8

**Figure 21. Monthly variation in crop damage in villages of JWLS.**

By interacting with the villagers, we also collected information about the extent of damage to different phenological stages of crops. In all 145 interviews were conducted and only 20 respondents indicated the damage to phenological stages of crops by the sloth bears. In and around JWLS, damage by the sloth bear was considerably high to maize crop, followed by wheat, vegetables and jowar as per the information collected from the villagers of 25 villages. In case of wheat crop, it occurred during the growing stage, 49 respondents reported damage at the time of maturation stage of wheat by digging resting and feeding on the seeds. Whereas in maize crop, 18 respondents indicated the damages during the sprouting of maize crop and 56 persons indicated the damage during the time of ripening of corn when the crop is matured and ready to harvest, most of the losses occurred during this time. In case of jowar, damage is less as copared to other crops. Damage to vegetables was reported by only 17 respondents. According to 56 (40%) respondents, maximum damages were during the mature stage of maize crop, followed by wheat 49 (33%) during the harvest time and jowar 21 (14%) **(Figure 22)**. In case of vegetables, 17 (20%) respondents indicated occurrence of maximum damage by sloth bear during the matured stages.

Table 22. Phenological stages of crop damage according to respondent in JWLS

	Wheat	Maize	Jowar	Vegetables	Castor	Kennel
Mature	49	56	21	13	6	0
Middle	20	18	0	17	0	0
sown	0	0	0	15	5	0

Figure 22: The Phenological stage of crop damage (n= 145) in JWLS
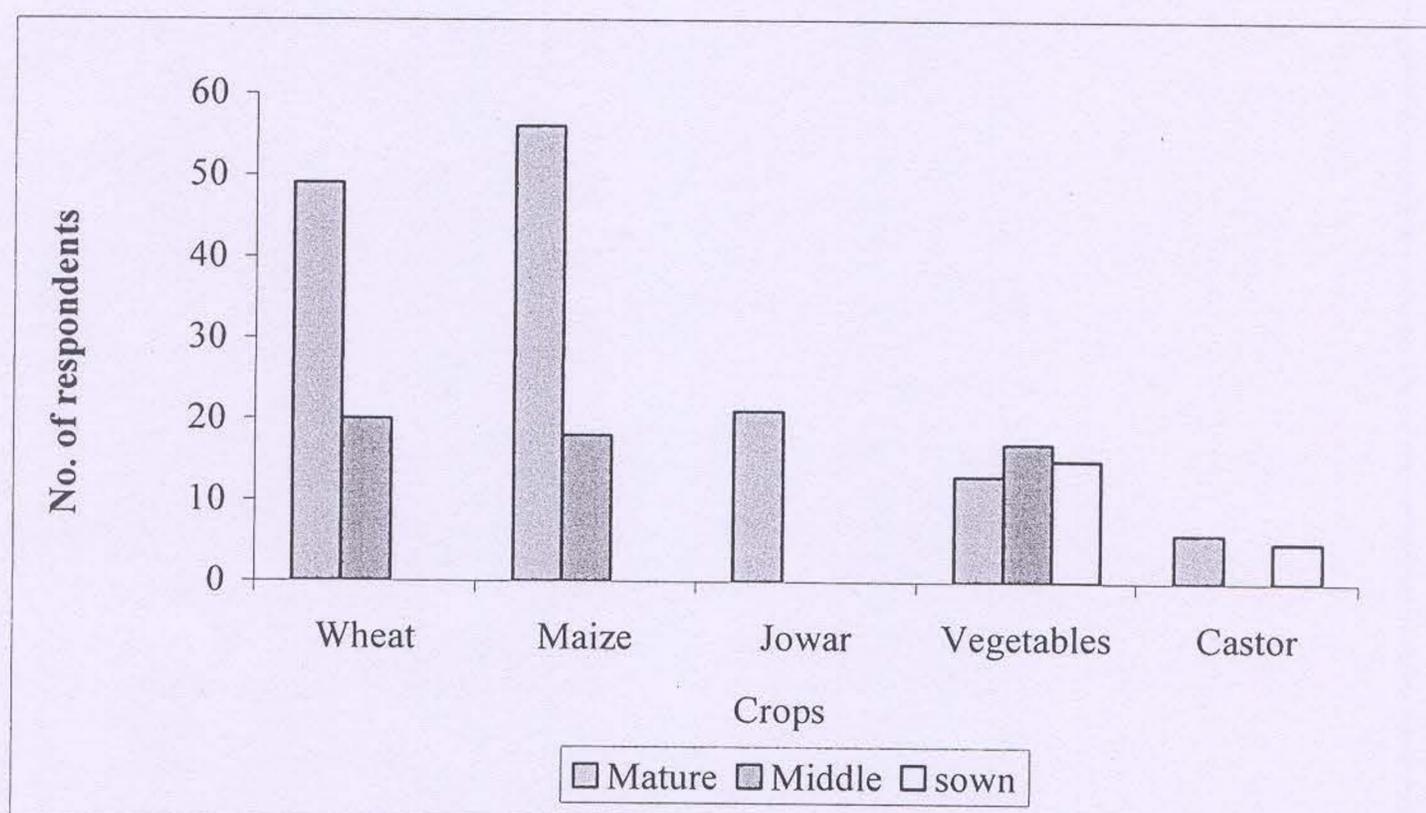
People often find damages crops due to different activities of sloth bears; damages by digging, trampling, crushing and feeding. Indirect evidences like presence of faecal matter, paw marks, claw marks indicated the activities sloth bear, and also the extent of damage. By conducting interviews in villages in and around JWLS, we could also compare the ratio of crop damages. Maximum damage was reported to growing maize crop according to 56 respondents out of 145 respondents, whereas damage to wheat crop was reported by 49 respondents out of 145 respondents (**Table 23, Figure 23**).

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Table 23. Damage by sloth bear with respect with crop grown - JWLS

	Wheat	Maize	Jowar	Vegetables	castor	kennel
Grown	145	145	51	56	65	50
Damage	49	56	21	17	6	0

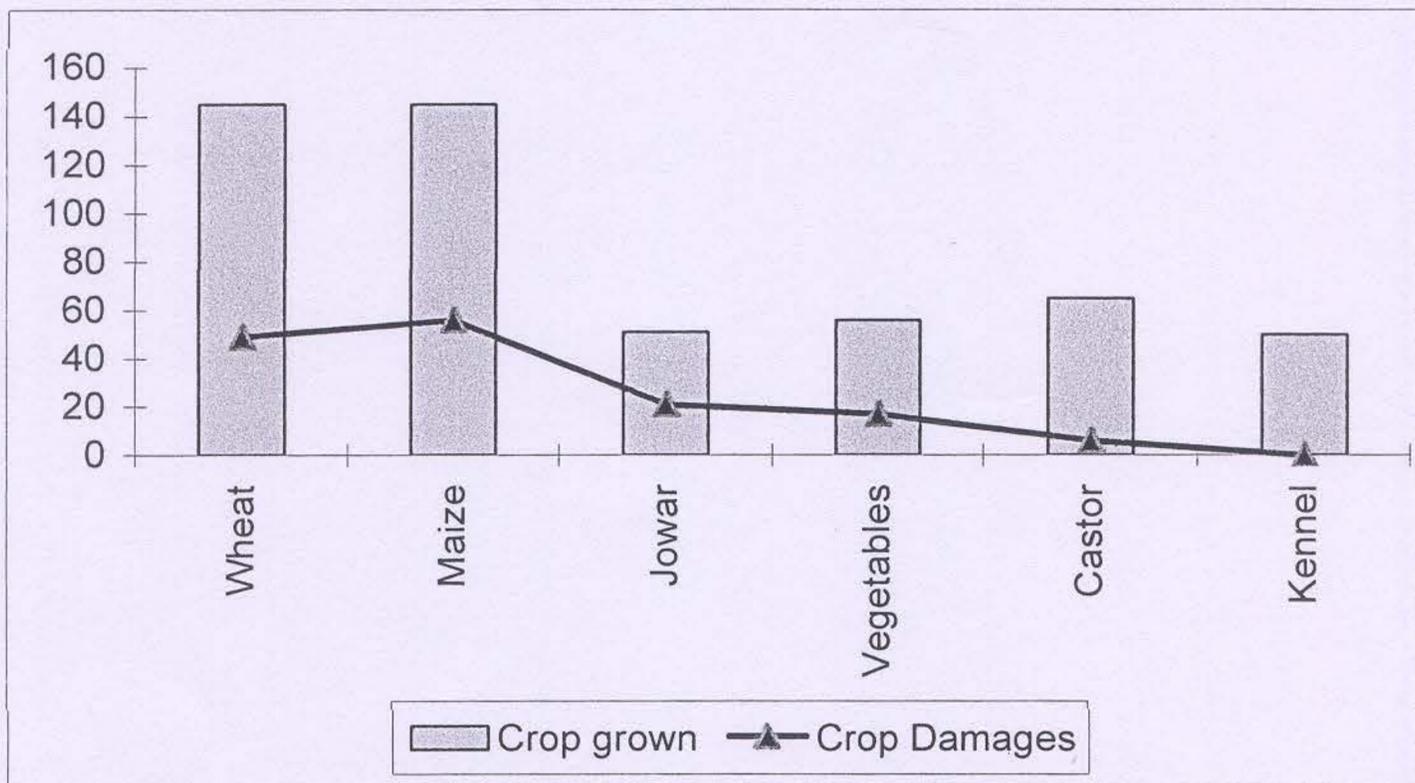**Figure 23. Damage with respect with crop grown in JWLS (Based on interviews)**

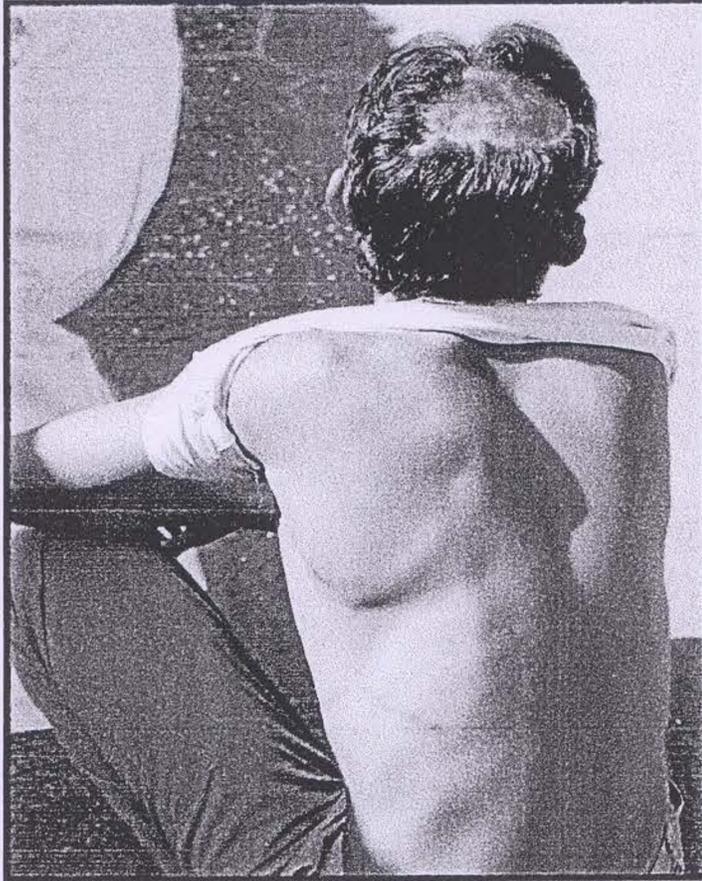**Plate - I**

Photographs of Victims of Sloth bear attacks
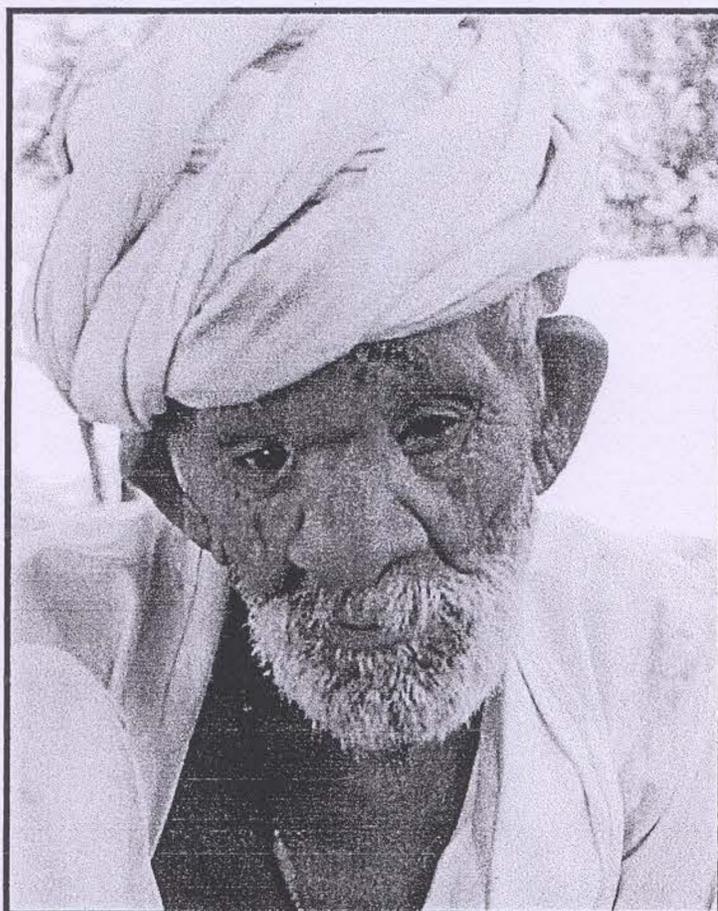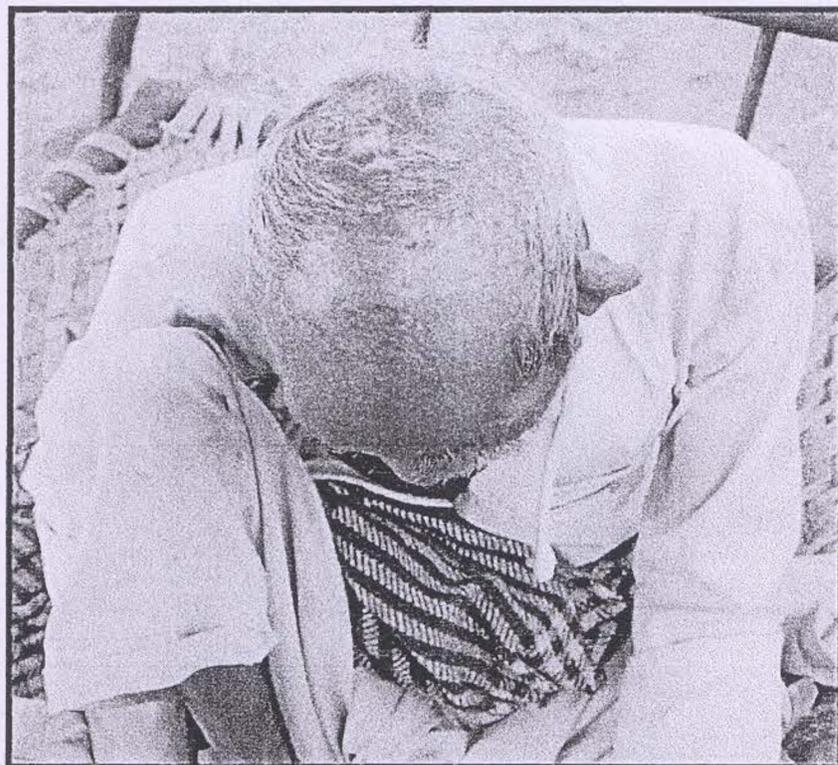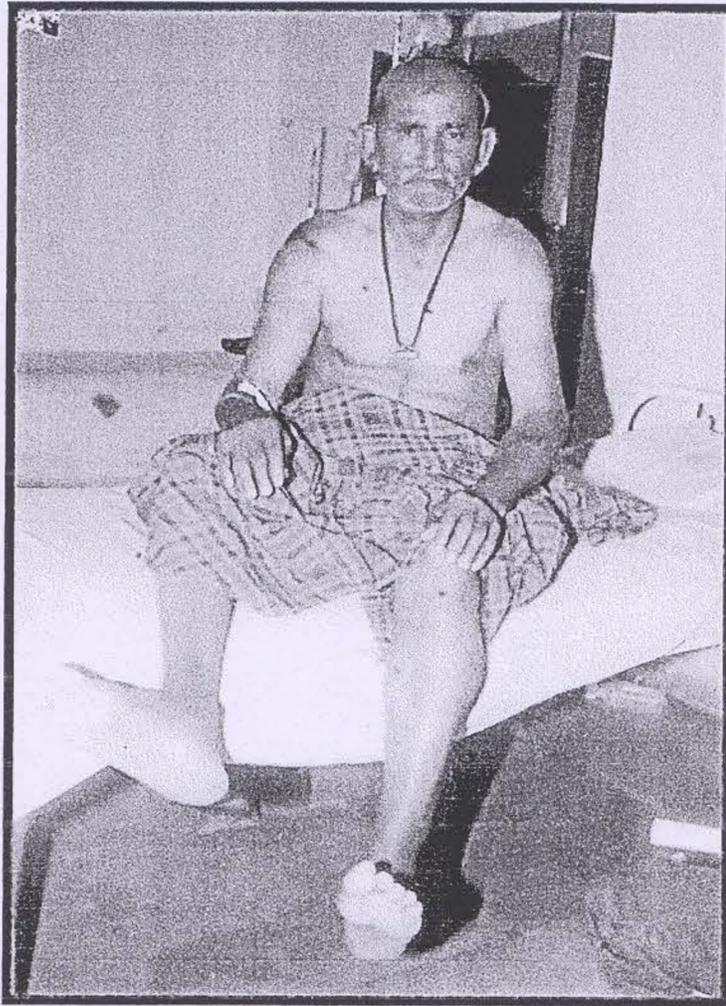
Plate - II

Plate – III

Plate - IV

Plate - V

NTFP Collection in sanctuary

Discussion

Sloth bear are widely distributed in India. But now due to the continuous habitat loss, fragmentation and degradation, and poaching, sloth bear populations have drastically declined in the wild. The increasing human population has caused alteration in forests and decline in sloth bear populations (Cowan 1972, and Schoen 1990). Sloth bear populations were reported to be declining in India, Sri Lanka and Bangladesh, and they were facing precarious future (Khan 1982, Santipillai and Santipillai 1990, and Servheen 1990). The total world population of sloth bears was reported to be roughly between 10,000-23,000. In a survey during 1993-1994, the median density of 12 bears/100 km^2 was estimated in 23 protected areas and about 5000 sloth bears estimated within the protected areas in India (Garshelis et al. 1999a).

In JWLS and MWLS occurrence of tropical dry deciduous forest, and tropical evergreen forests, dry deciduous thorn forest of south-western most part of the country appears to be optimal habitat for sloth bears. Villages in and around both sanctuaries depend on these forests, which are declining rapidly, exerting tremendous biotic pressure on both flora and wildlife. Extraction of timber and bamboo and conversion of forests to other uses have adversely impacted sloth bear habitat (Cowan 1972, and Servheen 1990). The food resources for bears have diminished because of extensive damage to its habitat (Murthy and Sankar 1995). In addition, human beings and bears have direct competition for food resources (Rajpurohit and Chauhan 1996). In search of food, bears frequently invade human habitation and cultivation areas and cause human casualties and extensive damage to agricultural and horticultural crops. Consequently, human-bear conflicts have increased to alarming levels.

In the forests of central India, the sloth bear is one of the most dangerous wild animals (Pillarisett 1993 and Rajpurohit and Chauhan 1996). They are unpredictable, especially mother with cubs; they attack humans readily if they perceive their cubs to be threatened (Prater 1980 and Pillarisett 1993). Many human casualties occur when humans enter sloth bear habitat or when sloth bears invade agricultural fields. From 1997 to 2008, there were 75 cases of human casualties in JWLS and MWLS, based on village interview records. Incidences of human casualties were slightly on the increase in past few years. There were more incidences of human

casualties in MWLS than in JWLS. These might be due to high population of sloth bears in MWLS (136 bears, Rajasthan Forest Department, 2008) than in JWLS (45 bears, Gujarat Forest Department, 2008). There are continuous hills and hillocks in MWLS, and vegetation is very dense with *Lantana* cover, which provided shelter to the bears in patchy, degraded and fragmented forests. These hillocks were surrounded by agricultural crop fields and human habitations. Whereas in JWLS, the bears traversed long distance due to scattered hills and hillocks.

Number of human injuries and deaths from bears is substantial. Sloth bears caused 47 human casualties in Bihar and 67 human casualties in Orissa from April 1990 to March 1995 (Rajpurohit and Chauhan 1996). Human-sloth bear conflicts in Madhya Pradesh were reported from 17 forest divisions and 13 protected areas. Most of the human casualties occurred in and around the protected areas in managed forests. Human injuries have been caused by grizzly bears (*Ursus arctos*) and black bears (*Ursus americanus*) in North America (McCullough 1982 and Herrero 1985).

In North America, only approximately 100 people have been killed by grizzly bears in the past 100 years (Herrero 1985). Other reports from North America indicate that in 17 National Parks from 1969 through 1978, black bears caused 263 and grizzly bears caused 36 injuries to humans. In Yellowstone National Park, 1,927 injuries from black bears and 75 from grizzlies occurred between 1930 and 1978. In Glacier National Park, the ratio of deaths to injuries from grizzly attacks was even greater: between 1939 and 1980 there were 24 injuries and 6 deaths. Conversely, there was only one death from a black bear in Yellowstone Park and none in Glacier Park from 1939 to 1978 (McCullough 1982).

The males were more vulnerable to attacks than the females in both the sanctuaries; number of mauling cases of males was comparatively high than the females and children. This might be due to fact that men were mostly active and increasingly involved in the collection of NTFP from forests, moving to markets or other villages crossing forests or den sites for purchases or selling of the NTFP and agricultural products and labor work. There were more mauling cases as in most of the cases, bear attacked people only for their self defense and ran away. The death cases

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occurred when victims succumbed to serious injuries. The females and children were mostly move in groups or with some men.

In both sanctuaries, there was marked monthly variation in the human casualties from 1997 to 2008. In JWLS most of the cases occurred in the summer, followed by monsoon season and least cases during winter. During summer season, bears left their dens early in the evenings and they were mostly dependent on fruiting trees for their food, and thus frequently invaded the villages and forest areas. During this time, there were no crops in the field, and people were venturing into forests for the collection of NTFP. All these factors contributed for occurrence of more attacks on human beings. Whereas during winter season, generally bears emerged from their dens after it became dark, and people ceased their activity. Bears were most active during crepuscular time when people were least active. Whereas is MWLS most of the cases occurred in the winter, followed by monsoon and summer season. After a very hot and dry summer season when it rained in the monsoon season, there was a sudden bloom in the vegetation and people started their agricultural practices. Bear signs of feeding on termites and ants in crop fields and raiding maize crop were high. More and more conflict cases at this time were due to presence of people in crop fields for farming and protection etc. and increased cattle grazing in the forests only. All this added to the disturbance to the bears and there were more cases of human casualties.

For giving some relief to victims or their families, although the forest department started the compensation, but even then all the cases were not reported due to cumbersome procedure of payment of compensation. In many of the villages, people were not even aware of such scheme. Within the village, victims were treated for their injuries by providing some local herbal medicines. In both sanctuaries, villages and cultivation areas were interspersed with forests, and people increasingly invaded forests for cattle grazing and NTFP collection. While going from one village to another or going to market, they had to cross the forests, crop fields and villages. This would have led to occurrence of more human casualties in the forests. Many of the human casualties also occurred in crop fields and villages. As bears invaded crop fields and villages in search of food or crossed villages to reach to other forest areas, possibility of encounters with people active in farming activity or cattle grazing was enhanced. Villagers going out for toilet in

the morning and evening were vulnerable to bear attacks. The mauling incidences in the vicinity of villages indicated the presence of bear in and around the villages. Such incidences were also associated with the movement of people between the villages.

At the time of human casualties, the victims were engaged in different activities like defecation, walking, and collection of NTFP, farming, cattle grazing and moving in the vicinity of houses. In crop fields, incidences occurred mainly when the victims were active in farming activities, moving from one place to another or crossing fields, defecation, and cattle grazing. In forests, incidences of mauling were highest when the victims were engaged in cattle grazing, moving from one place to another, defecation and NTFP collection. Villagers were taking their livestock to forest areas daily, and spending lots of time for NTFP collection. For their sustenance, they were dependent on forests directly or indirectly through cattle grazing, collection of NTFP for their use or selling in the market to get some other commodity. There was some variation in occurrence of human casualties associated with different activities of the victims in JWLS and Mount WLS. This was mainly attributed to the extent of forest cover and den distribution, availability of food resources, competition for food items in the two sanctuaries.

Most of the cases occurred early in the morning during defecation in nearby forest patches or crop fields. Coincided with this time, bears returned to their den sites after the whole night foraging on ants and termites and other food items in forests, crop fields and in the vicinity of villages. This increased the chances of more and more encounters with people out in these areas for defecation and other activities. Most of the cases of human mauling occurred early in the morning hours; highest number of incidences took place between 1500 – 2000h when bears were active and villagers set out for field areas. At this time, bears returned to den sites and people were out in the crop fields or forest areas for toilet or farming, or NTFP collection or other works. In such situation, there were increased chances of encounters of bears with villagers that led to more and more attacks by bears. Sometimes bears were late to return to their den sites, and during encounters with men they were chased by the people. In self defense, bears increasingly attacked on people. A few times, bears hanged around and stayed temporarily in bushes, depressions or crop fields, and attacked on people. In the evening time, human casualties occurred when people returned from the forests or other villages or markets. Bear had to cross

the villages to invade forest areas and crop fields close to the human habitation. Early in the morning when people went for defecation or NTFP collection or passing by or moving around dens, then there were sudden encounters with bear.

People of the age group of 21-30 years suffered most from bear attacks. Mostly the people of this age group were engaged in carrying out different works such as NTFP collection, fuelwood collection, cattle grazing and labor etc., which increasingly exposed them to face bear encounters. People of above this age group were involved less and less in carrying out different works so they got comparatively less exposed to bear attacks. People of very old age and children mostly stayed at homes or restricted their activities in crop fields or cattle grazing, and as a result, there were only few victims of these age groups. Most of the attacks were caused by a single bear, and there were comparatively few cases when bear were in group of two or three. Only two casualty were caused by a group of four bears. Irrespective of group size, majority of the attacks were caused by a single bear from the group. Rarely two or three bears together attacked the person most of by the mother bear with cub. In most of the cases, bear approached the victims running and attacked by striking them hard with its fore head and muzzle, and as a result the victims fell down and got mauled by bears. During sudden attack, bear had also attacked the victims while standing on its hind legs. In majority of the cases, bear left to the victims after mauling. In several other cases, bear left the victims when he or she shouted for the help and people ran towards the attacking bear and the victim. In a few cases, cattle and dogs were helpful in chasing away the attacking bear to save the victims, his master. (Bargali 2004)

Most humans mauled by sloth bears were severely disfigured, particularly on the face, scalp, eyes, ears, and leg and arm muscles. Similar injuries have been observed in human mauling by grizzly bears (*Ursus arctos*) and black bears (*Ursus americanus*) in North America (McCullough 1982, and Herrero 1985). In both sanctuaries, bears caused multiple injuries to the victims in majority of the cases. In many attacks, the victims got injuries in their legs, followed by injuries in hands or chest and head. At the time of attacks, the victims fell down and bear injured thigh or hips, back or abdomen or other body parts. Injury to hands was mainly caused in self defense by struggling with the bear. The other affected parts from high to low are head, chest, hips, back, stomach and hand in order. Being a very hot region of the western India and lack of irrigation

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facility, people were mainly dependent on the monsoon for agricultural practices. During non-cropping season, people were engaged in different works for their livelihood, but they were mainly dependent on the NTFP collection for their use and economy. Consequently NTFP collection by the people not only disturbed bears and the habitat but also encountered bears due to competition for resource sharing.

Although sloth bears have large and widely distributed food resources, availability of food items was low (Rajpurohi and Chauhan 1996). This was mainly because many important food items such as jamun, ber, tendu, bel, karvanda, mango and gunda; mahua flowers, shoots of bamboo, tubers and root and honey from the rock bee (*Apis dorsata*) and smaller forest bee (*Apis indica*) were also collected by the villagers as NTFP. Bears were found to raid different crops, including maize, wheat, vegetables sweet potato. In JWLS and MWLS, we find that local people also collect most of the above food items and thus develop intense competition with the bears for resource sharing. Also sloth bears increasingly raid crop fields to feed on different crops. Thus due to increased resource sharing between humans and bears, and crop damage pattern, there are more and more encounters that result in severe human-sloth bear conflicts. The NTFP collection by the villagers was done especially during early in the morning and again in the evening. The collection time was also coincided with the time when bears were foraging or returned to their den sites. As a result, people had more and more encounters with bears, and led to increasing mauling cases. Likewise in the evening time, encounters took place when people returned to their villages from forest areas and bears were out in search of food. Thus most of the villages located close to den sites were severely affected due to crop raiding and human casualties by bears in the sanctuaries. As the distance of villages increased from boundary of forest, the bear menace was of lesser magnitude. Although the number of human casualties and extent of crop damage by bear seemed to be high in villages located far from dens, but it was apparently due to cumulative extent of damage in large number of villages in this category.

Crop damage by sloth bear

Based on the interviews and assessment of crop damage in control and uncontrolled plots, a comparison of crop losses was made. It was found that due to crop raiding by sloth bear, loss of upto one fourth of total crop yield has been found. Here they have no strong background and majority of people are associated with agriculture for their livelihood. When we compared the results of control and uncontrolled plots crop yields, there was 167 kg to 350 kg damage to wheat crop per hector. If we calculate this loss in term of economy loss, there was total loss of minimum Rs. 2505 per hector. This loss is quite significant as far as their economy and livelihood concerned. As a result, these people resorted to other alternative activities like selling of NTFP collection which include selling of fruits, fodder, fuelwood, honey and timber. For this, they frequently visit the forest areas and bear habitats in forest. There was also competition with sloth bear for food resources like fruits, honey etc. Because of all these activities, there were more chances of encounter with sloth bear.

The study conducted in both MWLS and JWLS revealed that majority people grow wheat, maize, different vegetable. Maximum damages reported to wheat and maize crop during the crop maturation time. Damage to wheat and maize crops was maximum during seed formation stage when corn spikes were developed. Maize and wheat plants were trampled more that eaten. In other crops like castor, jowar and kennel, damage was less. Vegetable like potatoes, and pulses were damaged during the sowing time i.e. April-May and during the seed or tuber formation stage i.e. September-October. During the time of wheat maturation coinciding summer season, there was less availability of food resource and water in forest area. So sloth bear increasingly moved towards easily available food like wheat in crop fields and chances of encounter with human was more when people were in crop fields for farming activities.

Mitigation strategies

Public education and awareness

For wildlife conservation, involvement of local people and their support is necessary. Through education and awareness programmes, conservation ethics can be included among these local people. So the education and awareness programs about ecosystem, conservation, natural history of slot bear, bear habits, feeding habits, behavior, activity pattern, human-sloth bear interaction and safety measures are important for the local community. Constitution of village committees would help in confidence building and creation of awareness among the people of the affected areas through the outreach programmes. This will greatly help conservation of sloth bears in JWLS and MWLS. Villagers should be motivated to grow trees of economics importance in their crop field to reduce their dependency on the forest, and to keep a few high yielding cattle, and dispense with large number of local breeds.

Conservation recommendations

- We need to verify and updates the information on the distribution across their range and develop a database on bears existing bear habited areas need to be identified and mapped. Intensive surveys should be carried out to asses the status and distribution of bear in both sanctuaries for bear density and abundances. A realistic sloth bear distribution range map to be developed.
- Slot bear habitat need to be quantified and mapped on broad scale land use maps so that necessary steps could be taken to protect and restore such habitats.
- Factor leading to degradation and fragmentation of slot bear habitats should be identified area-wise in sanctuaries and strategies should be developed to remove these threats. Cattle grazing, illicit cutting, and lopping should be completely banned in both sanctuaries.

- Local people venture into forest anytime of the day to collect non-timber forest produce, which may be of bear interest i.e. food plants. So there should be restriction on collection of these of these forest produce from the bear areas. Villagers should be discouraged for collecting bear food items from the forest.

- To reduce crop damage by sloth bears, vulnerable stages of crops, especially at the maturation time, should be protected by using crackers, fires and other scare sounds to keep away bears from the fields. Change in the crop pattern may be useful. To avoid casualties, people should move in groups, especially at morning and evening time.

References

Akhtar, N., H. S. Bargali, and N. P. S. Chauhan. (2004). Sloth bear habitat use in disturbed and unprotected areas of Madhya Pradesh, India. Ursus 15:203-211.

Bargali, H. S. (2004). The ecology of the problematic sloth bear (*Melursus ursinus*) and mitigation of human sloth bear conflicts in Bilaspur Forrest Division, Madhya Pradesh. Ph. D. thesis, Wildlife Institute of India, Dehradun, India

Bargali, H. S., Akhtar, N. and Chauhan, N. P. S. (2004). Feeding ecology of sloth bears in a disturbed area in central India. Ursus 15:212–217.

Bunnell, F.E., and Tait, D.E.N. (1980). Bears in models and reality – implications to management. Int. Conf. Bear Res. and Manage. 4:15–23.

Chauhan, N. P. S. (2006). The status of sloth bears in India. In: Understanding Asian bears to secure their future. pp: 26-34 Japan Bear Network, Ibaraki, Japan.

Chauhan, N. P. S., Bargali, H. S., and Akhtar, N. (2003). Ecology and management of problematic sloth bear in North Bilaspur Forrest Division, Madhya Pradesh. A project report - Wildlife Institute of India, Dehradun, India

Chhangani, A.K. (2002). Food and feeding of sloth bear (Melursus ursinus) in Aravalli Hills of Rajasthan, India. Tigerpaper 29(2):1-6.

Conover, M.R., and Decker, D.J. (1991). Wildlife damage to crops: perceptions of agricultural and wildlife professionals in 1957 and 1987. *Wildlife Society Bulletin,* 19: 46-52.

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

Desai, A. A., Baskaran, N., and Venkatesh, S. (1997). Behavioural ecology of the sloth bear in Mudumalai Wildlife Sanctuary and National Park, Tamil Nadu. Report . A collaborative Project between Bombay Natural History Society and Tamil Nadu Forest Department.

Garshelis, D. L., A. R. Joshi, J. L. D. Smith, and C. G. Rice. (1999b). Sloth bear conservation action plan. In: C. Servheen, S. Herrero, and B. Peyton (eds). Bears: status survey and conservation action plan. pp: 225-240. IUCN/SSC Bear and Polar Bear Specialist Groups, Gland, Switzerland and Cambridge, U.K.

Garshelis, D.L., Joshi, A.R., Smith, J.L.D., and Rice, C.G. (1999a). Sloth Bear Conservation Action Plan. 225-240 in Bears: Status Survey and Conservation Action Plan. Servheen *et al.* (eds), op.cit.

Ghimire, B.K., Pimbert, M.P (1997). Social change and conservation: an overview of issues and concepts. In: Krishna, P.G., Michel, P.P. (Eds.), Social Change and Conservation. Earthscan Publications Limited, London, pp. 1–45.

Herrero, S. (1985). Bear attacks: their causes and avoidance. Winchester, Piscataway, New Jersey, USA.

Iswariah, V. (1984). Status survey report and recommendations for conservation of the sloth bear in Ramnagaram Taluk, Karnataka. WWF-India, unpublished report, Banglore. 34 pp.

Johnsingh, A.J.T. (1981). Ecology and behaviour of the dhole or Indian wild dog Cuon lpinus Pallas 1811, with special reference to predator-prey relations at Bandipur. Ph.D. dissertation., Madurai University, India. 306 pp.

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 59:204–213.

Karanth, K.U. and Karanth, K.K., 2007. Free to move: conservation and resettlement in the Western Ghats of Karnataka, India, In: Redford, K.H., Fearn, E., (Eds), Protected Areas and Human Displacement: A conservation perspective, working paper 29. Wildlife Conservation Society, New York, pp. 48-59.

Kemf, E., Wilson, A., and Servheen, C. (1999). Bears in the Wild. 1999 WWF Species Status Report. World Wide Fund For Nature, Gland, Switzerland.

Kenneth, A. (1954). *Nine Man-Eaters and One Rogue*. pp. 251.

Khan, M.A.R. (1982).Wildlife of Bangladesh. University of Dhaka, Dhaka. 173 pp.

Krishnan, M. (1972). An ecological survey of the larger mammals of peninsular India. *Journal of Bombay Natural History Society*. 69: 26-54.

Kutty, R. and Kothari, A. 2001. Protected areas in India: A profile. Kalpvriksh Publications, New Delhi.

Laurie, A., and Seidensticker, J. (1977). Behavioural ecology of the sloth bear (*Melursus ursinus*). *Journal of Zoology* . 182:187-204.

Maikhuri, R.K., Nautiyal, S., Rao, K.S., Chandrasekhar, K., Ravali, R. and Saxena, K.G. (2000a). Analysis and resolution of protected area-people conflicts in Nanda Devi Biosphere Reserve, India. Environmental Conservation 27, 43-53

McCullough, D.R. (1982). Behavior, bears, and humans. *Wildlife Society Bulletin*. 10: 27-33

Miller, S.D. (1990). Population management of bears in North America. Int. Conf. Bear Res. and Manage. 8:357–373.

Mills, J.A. and Servheen, C. (1991). The Asian trade in bears and bear parts. TRAFFIC USA/WWF. Washington D.C. 131 pp.

Murthy, R.S. and Sankar, K. (1995). Assessment of bear-man conflict in North Bilaspur Forest Division, Bilaspur, M. P., Wildlife Institute of India, Dehradun.

Nowak, R., and Paradiso, J. (1983). Walker's mammals of the world, Vol. II. 1363 pp. Johns Hopkins Univ. Press, Baltimore.

Ogra, M. and Badola, R. (2008). Compensating Human–Wildlife Conflict in Protected AreaCommunities: Ground-Level Perspectives from Uttarakhand, India. Human Ecology, 36 (5), pp 717-729.

Peyton, B. (1980). Ecology, distribution, and food habits of spectacled bears, *Tremarctos ornatus*, in Peru. *Journal of Mammalogy*. 61: 639-652.

Pillarisett, A.M. (1993). Are sloth bear man marauders? Pages 41-46 in M.G. Gogate and P.J. Thorse, editors. Two decades of project tiger, Melghat (1973-1993). Melghat Tiger Reserve, Melghat, India.

Porter, G., Clemencon, R., Ofosu-Amaah, W., Philips, M. (1998). Study of GEFs overall performance. World Bank, Washington, DC.

Prater, S. H. (1980). The book of Indian animals. Bombay Natural History Society, Bombay, India

Rajpurohit, K.S., and Chauhan, N.P.S. (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.

Rajpurohit, K.S., and Krausman, P.R. (2000). Human sloth bear conflicts in Madhya Pradesh, India.*Wildlife Society Bulletin*. 28(2): 393-399

Rangaranjan, M. and Shahabuddin, G., 2006. Displacement and relocation from protected areas: Towards a biological and historical synthesis. Conservation and Society 4, 359-378.

Ratnayeke, S., van Manen, F.T. & Padmalal, U.K.G.K. (2007). Home ranges and habitat use of sloth bears *Melursus ursinus inornatus* in Wasgomuwa National Park, Sri Lanka. - Wildl. Biol. 13: 272-284.

Read, B.E. (1982). Chinese materia medica: animal drugs. Southern Materials Center, Inc., Taipei. 281 pp.

Reid, D., Jiang, M., Teng, Q., Qin, Z., and Hu, J. (1991). Ecology of Asiatic black bear (*Ursus thibetanus*) in Sichuan, China. *Mammalia*. 55: 221-237.

Sacco, T., and B. Van Valkenburgh. (2004). Ecomorphological indicators of feeding behaviour in the bears (Carnivora: Ursidae). Journal of Zoology, London 263:41-54.

Santiapillai, A., and Santiapillai, C. (1990). Status, distribution and conservation of the sloth bear (*Melursus ursinus*) in Sri Lanka. *Tiger Paper*. 17(1):13-15.

Sathyakumar, S. (1999a). Status and Management of the Himalayan Brown Bear in India. Pp. 125-128 in Bears: Status Survey and Conservation Action Plan. Servheen *et al.* (eds), op.cit.

Sathyakumar, S. (1999b). Status and Management of the Asiatic Black Bear in India. Pp. 202-207 in Bears: Status Survey and Conservation Action Plan. Servheen *et al.* (eds), op.cit.

Schoen, J.W. (1990). Forest management and bear conservation. *International Congress of Ecology*. 5:1-7.

Servheen, C. (1990). The Status and conservation of the bears of the world. *International Conference on Bear Research and Management* Monograph, 2. 32 pp.

Shahabuddin, G, Kumar R, Shrivastava M. (2005). 'Forgotten Villages: A People's Perspective on Village Displacement from Sariska Tiger Reserve', Technical Report, Council for Social Development and National Foundation for India.

Shahabuddin, G. and A. Shah. (2003). Relocation of people from wildlife areas: Socio-economic and ecological issues. *Economic and Political Weekly,* 38(47): 4945-4946.

Sharma, A. (2003). Displacement from wildlife protected areas: Implications for conservation and livelihoods. The case of Kuno Wildlife Sanctuary, Madhya Pradesh. Social Change 33, 89-114.

Singhal, R.M., Kumar, S. and Jeeva, V., (2003). Forest and forestry research in India. *Trop. Ecology*, 44, 55-61.

Soule, M E and Terborgh, J. (1999). Continental Conservation, Island Press, Washington DC and Covelo, California.

Stearman, A.M. and Redford, K.H. (1992). Commercial hunting by subsistence hunters: Siriono Indians and Paraguayan Caiman in lowland Bolivia. *Human Org.*, 71, 235-244.

Stowell, L.R., and Willging, R.C. (1992). Bear damage to agriculture in Wisconsin. Proceeding of Eastern Wildlife Damage Control Conference. 5: 96-104.

Sunquist, M.E. (1982). Movements and habitat use of a sloth bear. Mammalia, 46:545-547.

Vaughan, M.R., Scanlon, P.F., Mersmann, S.E.P., and Martin, D.D. (1989). Black bear damage in Virginia. Proceeding Eastern Wildlife Damage Control Conference, 4:147-154.

Waits, L.P., J. Sullivan, S.J. O'Brien and R.H. Ward. (1999). Rapid radiation events in the family Ursidae indicated by likelihood phylogenetic estimation from multiple fragments of mtDNA . Molecular Phylogenetics and Evoilution, 13(1): 82-92.

Western, D. and Wright, R.M. (1994). Natural Connections: Perspectives in Community-based Conservation. Washington (DC): Island Press.