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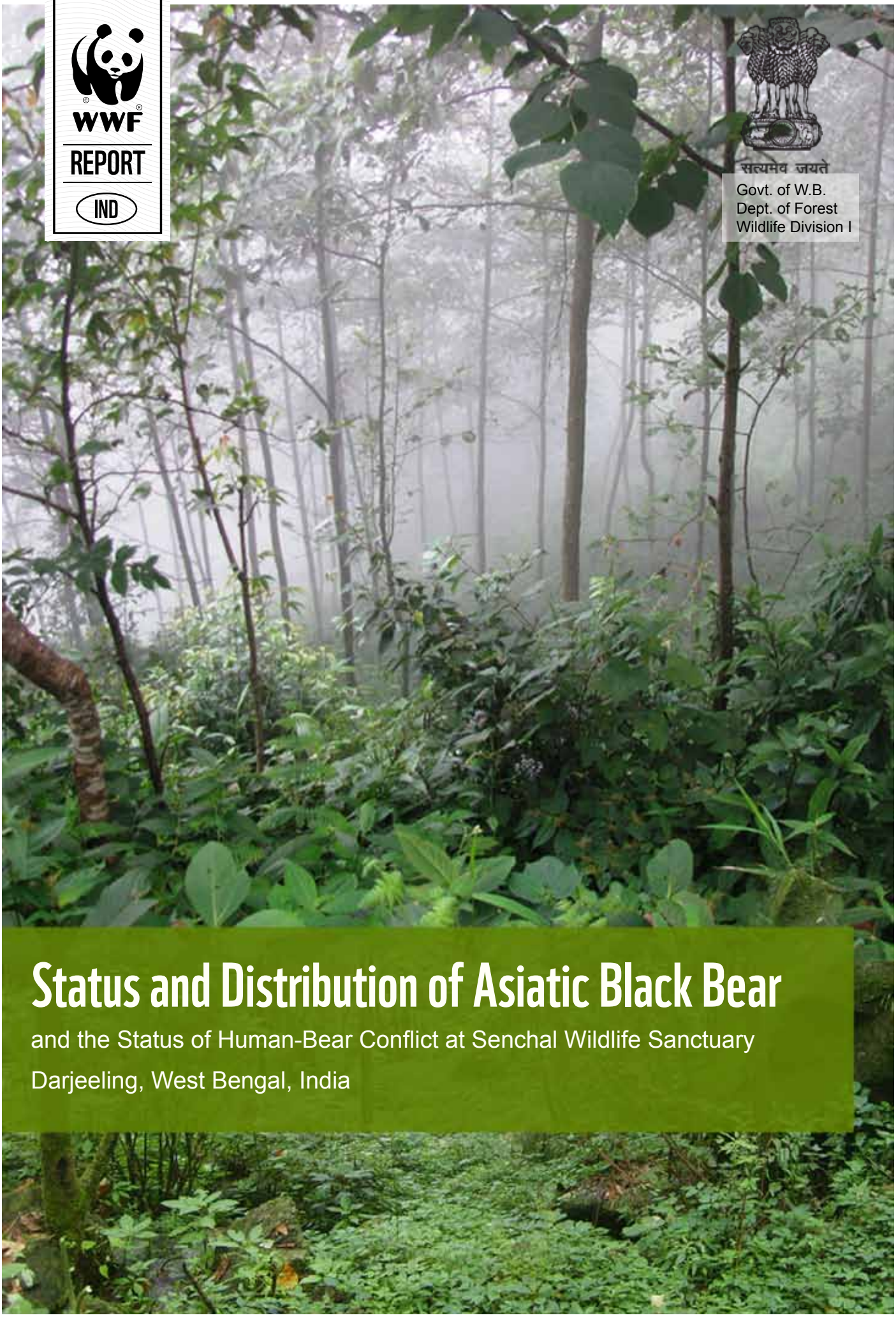

सत्यमेव जयते

Govt. of W.B.
Dept. of Forest
Wildlife Division I

Status and Distribution of Asiatic Black Bear

and the Status of Human-Bear Conflict at Senchal Wildlife Sanctuary Darjeeling, West Bengal, India

Published in October 2012 by WWF-India and West Bengal Forest Department, Wildlife Division I.

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Darjeeling, West Bengal, India

Report by:

WWF-India, Khangchendzonga Landscape Programme, Darjeeling and Sikkim
and
West Bengal Forest Department, Wildlife Division l,
Government of West Bengal, India

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WWF-India
Khangchendzonga Landscape Programme
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Foreword

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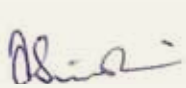
Asiatic black bear (*Ursus thibetanus*) is the largest mammal of Senchal Wildlife Sanctuary (WLS). Though there was some information on the tentative black bear numbers in Senchal, no scientific study had been undertaken until now to assess the present status of bears in the sanctuary, and even little was known on the habitat conditions available to the species. Moreover, the presence of 18 human settlements along the periphery as well as within the sanctuary increased the potential of human-black bear conflict. However, there was hardly any information available on this aspect.

This survey, undertaken jointly by the West Bengal Forest Department and WWF-India, presented an opportunity to come up with a more scientific assessment on the present status of black bears in Senchal WLS. At the same time, it will also enable a proper evaluation of the human and wildlife conflict situation from the human settlements adjacent to and within the sanctuary. The study shall also help wildlife managers to draft a suitable management plan which would not only help in securing the Asiatic black bear population of Senchal and adjacent areas but would also help to appropriately deal with the potential human-black bear conflict in future.

I would like to take this opportunity to congratulate the team members of WWF-India and the field staff of Senchal Wildlife Sanctuary for successfully completing the survey on the Asiatic black bear at Senchal Wildlife Sanctuary.



Dr. V. K. Sood, IFS

Executive Summary

Asiatic black bear (*Ursus thibetanus*) is one of the largest carnivores of Senchal Wildlife Sanctuary (WLS). This 38.97 km² sanctuary is known to have 19 villages along its periphery and inside it and incidents of human wildlife conflict in these villages is common. However, information on conflict related to Asiatic black bear is very less. Further, little information is available on ecology of Asiatic black bear from this sanctuary. With this background, this present study was initiated at Senchal WLS, in collaboration with West Bengal Forest Department, to understand the status and distribution of Asiatic black bears and simultaneously to understand the human-wildlife conflict situation in the sanctuary and the role of Asiatic black bear in it. Data on occurrence and distribution of Asiatic black bear and other associated animals were collected through sign surveys and camera trapping throughout the sanctuary. Conflict information was obtained through interviews with villagers using predesigned datasheets. Asiatic black bear was recorded in 7 out of 31 blocks at Senchal Wildlife Sanctuary indicating a sign of healthy distribution in both the East and West ranges of the sanctuary. Asiatic black bear emerged as the third most frequently captured species with the highest amount of activity around midnight. The ordination analysis showed that occurrence of black bear peaked at high vegetation density, tree cover and distance to human settlements. The fact that their distribution peaked with nearness to human habitation could be an indicator for future conflict issues. However, at present, their involvement in conflict with local communities around the sanctuary is minimal as they have emerged as one of the lowest ranking conflict animals in this survey.

Introduction

Asiatic black bear (*Ursus thibetanus*) is one of the four bear species found in India. It has been recorded from 18 countries throughout southern and eastern Asia (Garshelis and Steinmetz 2008). This carnivore is known to inhabit tropical, sub-tropical, temperate broadleaved and conifer forests. Altitudinal range of Asiatic black bears may extend up to 4300 m and on rare occasions they may venture into alpine meadows, beyond the tree line. Individual bears, however, are known to change their habitats and altitude seasonally (Izumiyama and Shiraishi 2004; Yiqing and Xiaomin 1998; Sathyakumar 1998, 2001; Hazumi 1998; Garshelis and Steinmetz 2008). In India, it is found in Jammu and Kashmir (except Ladakh), Himachal Pradesh, Uttar Pradesh, Sikkim, Arunachal Pradesh and other north-eastern states and in the foothills and hills of West Bengal (Sathyakumar 1998). Asiatic black bear has been recorded from 83 Protected Areas in India and the Senchal Wildlife Sanctuary (Darjeeling District, West Bengal) is one of them. However, information on their status from the sanctuary is patchy.

Over the years different range countries have proposed tentative estimates on population and density for Asiatic black bears. For India, the tentative population estimate for the species is 7000-9000 individuals (Sathyakumar 2006; Garshelis and Steinmetz 2008) and the tentative density estimate, only for Dachigam, is about 1.3 to 1.8 bear/km² (Sathyakumar 1998). However, Asiatic black bears face considerable stress in the wild from constant loss of habitat and also from regular poaching to fulfil the demand for its body parts for use in traditional medicinal practices (Mills and Servheen 1994; Yiqing and Xiaomin 1998; Sathyakumar 1998; Shepherd 2006). Considering this, it may be assumed that the population and density estimates proposed for different countries need a proper review (Garshelis and Steinmetz 2008). But in spite of this constraint, it is evident that global population of Asiatic black bears is showing signs of decline over the years and this has

led IUCN to include this species under the globally vulnerable species category (Garshelis and Steinmetz 2008).

In India, Asiatic black bear is protected under the Schedule I of Indian Wildlife (Protection) Act 1972 (amended in 2006). Though this species is highly threatened globally and also in India, very few studies on its population status and threats have been undertaken and they are mostly restricted to western Himalayas (Sathyakumar 1999, 2001, 2006; Sathyakumar and Viswanath 2003; Sathyakumar and Choudhury 2008). Information on the Asiatic black bears for West Bengal, and more so from Senchal Wildlife Sanctuary hardly exists, though a census undertaken by the West Bengal Forest Department indicates a presence of about 20 Asiatic black bears (Anon. 2008). This presumption, however, requires a scientific validation.

Humans and wildlife have existed harmoniously since time immemorial, but intermittent negative interactions between the two are not uncommon either. The frequency of such interactions has increased manifold in recent times. This, to a great extent, is related to increased levels of human activities in wildlife areas (Chauhan 2003; Graham et al. 2005; Bulte and Rondeau 2005; Charoo et al. 2009). The situation is similar for Asiatic black bears.

Asiatic black bears have a wide home range that varies between 3 km² to 158 km² (Charoo et al. 2009; Sharma et al. 2010; Huang et al. 2010; Dr. S. Sathyakumar, personal comments), and occasionally they wander into human territory. As a result black bear end up competing with human beings, directly or indirectly, for food and other resources within its probable home range in a given locality. This has been the prime cause behind the conflicts associated with black bears throughout its range. Depredation of crops, killing of livestock and in extreme cases fatal attacks on humans are the main conflict issues related to this species (Chauhan 2003; Choudhury et al. 2008; Sathyakumar and Choudhury 2008; Charoo et al. 2009). As a matter of fact, instances of human-bear conflict have increased considerably in the last three years around forest areas of Sikkim with frequent reports of bears coming to the crop fields and getting involved in conflicts with the villagers (Department of Forest, Environment and Wildlife Management, Government of Sikkim records, unpublished). Such incidents at times have led to retribution killing of this species in some parts of its range (Stubblefield and Shrestha, 2007).

Observations from Sikkim have shown that the incidents of human-black bear conflict usually increase towards the end of autumn, which incidentally coincides with the pre-hibernation fattening season of the bears. During this season the bears are highly active and tend to travel long distances in search of food. However, if there is a shortage of wild fruits, especially oak (Hwang et al. 2010), they may walk into nearby human settlements looking for food leading to conflict. Here, it may be stated that Asiatic black bears feed on succulent vegetation during spring, insects and a variety of tree and shrub-borne fruits in summer and favour nuts and acorns in autumn. At times, their diet may contain a good proportion of meat (which they either kill or scavenge) (Bromlei 1965; Reid et al. 1991; Hwang et al. 2002; Huygens et al. 2003; Hwang et al. 2010).

Senchal Wildlife Sanctuary, with an area of about 38.97 km², has 18 villages within it and along its fringes. If the probable number of bears residing here is around 20 (Anon. 2008), chances of potential conflicts cannot be ruled out. Further, the bear habitat extends much beyond the Senchal WLS and includes the adjoining forests under the management of Cinchona Directorate and Kurseong Division and cases of human-bear conflict from villages adjoining the Bagora Range are also common (CWLW, West Bengal pers. comm.). Though some information regarding conflict exists, a detailed investigation was necessary on this aspect to develop a proper plan to reduce the negative impacts of the human-black bear interactions. Further, a proper understanding of the food habit, feeding patterns and periodicity of food production in the wild may also help in improving the strategy to reduce cases of conflict.

The Himalayan region is one of the four global ecological hotspots that occur in India and by many measures of diversity this region stands out as a globally important one. Asiatic black bear is one of the key mammals of the Himalayan forests and shares its home with a great diversity of other species, both plants and animals. Situation at Senchal Wildlife Sanctuary is no exception from the general trend. Although a floral and faunal inventory for the sanctuary exists with West Bengal Forest Department, no systematic surveys have been conducted on the presence of different mammalian species that share the habitat with the Asiatic black bear. A better understanding regarding occurrence of other species would help in devising a management plan that would not only ensure safety of the black bears but would also help in conserving other associated species properly.

With this background, the present collaborative study was conducted by WWF-India and West Bengal Forest Department to understand the distribution of Asiatic black bear and status of conflict issues related to the species in Senchal Wildlife Sanctuary. Based on the outcome of the study, a proper management plan will be developed in collaboration with the communities to conserve the Asiatic black bears in the sanctuary.

Study Objectives

The study at Senchal Wildlife Sanctuary was conducted with the following major objectives:

1. To ascertain the distribution and population density of the Asiatic black bear in the Senchal WLS and its adjoining areas.

2. To ascertain the inter-relationship of Asiatic black bears and their habitat characteristics in the Senchal WLS.

3. To document the scale and scope of human-bear conflict and poaching of bears in and around the Senchal WLS.

4. To develop a participatory approach for conservation of Asiatic black bears in and around the Senchal WLS.

In addition to this, an assessment on the distribution of other mammals using the same habitat as that of the Asiatic black bear was also made.

Methodology

1. Study Area

Senchal Wildlife Sanctuary (38.97 km²) was established in 1915 and is situated at a distance of 11 km from Darjeeling town. It is one of the five important Protected Areas of Darjeeling district (Figure 1). Altitudinally, the sanctuary ranges between 1500 -2600 m and broadly houses sub-tropical and temperate oak forests. Approximately 380-400 flowering plants can be found in Senchal Wildlife Sanctuary. The Sanctuary is home to various species of Rhododendron, Michelia, Oak, Pine and Birch. A large number of Hydrangeas, Orchids, Daphne and Mahonia can also be found (ICIMOD 2008). There are 19 major settlements within as well as in areas adjoining the forest, with Ghoom-Jore Bungalow being the largest among them. The Sanctuary has 19 blocks under two ranges (Figure 2).

Figure 1. Senchal Wildlife Sanctuary

2. Study Methods

i. Village consultations

Village level consultation meetings were organised in 11 out of 19 villages around Senchal Wildlife Sanctuary to collect information on occurrence of Asiatic black bear in the forest and to understand the conflict status associated with the bear species. These meetings were attended by community members, Eco Development Committee members and personnel from the West Bengal Forest Department.

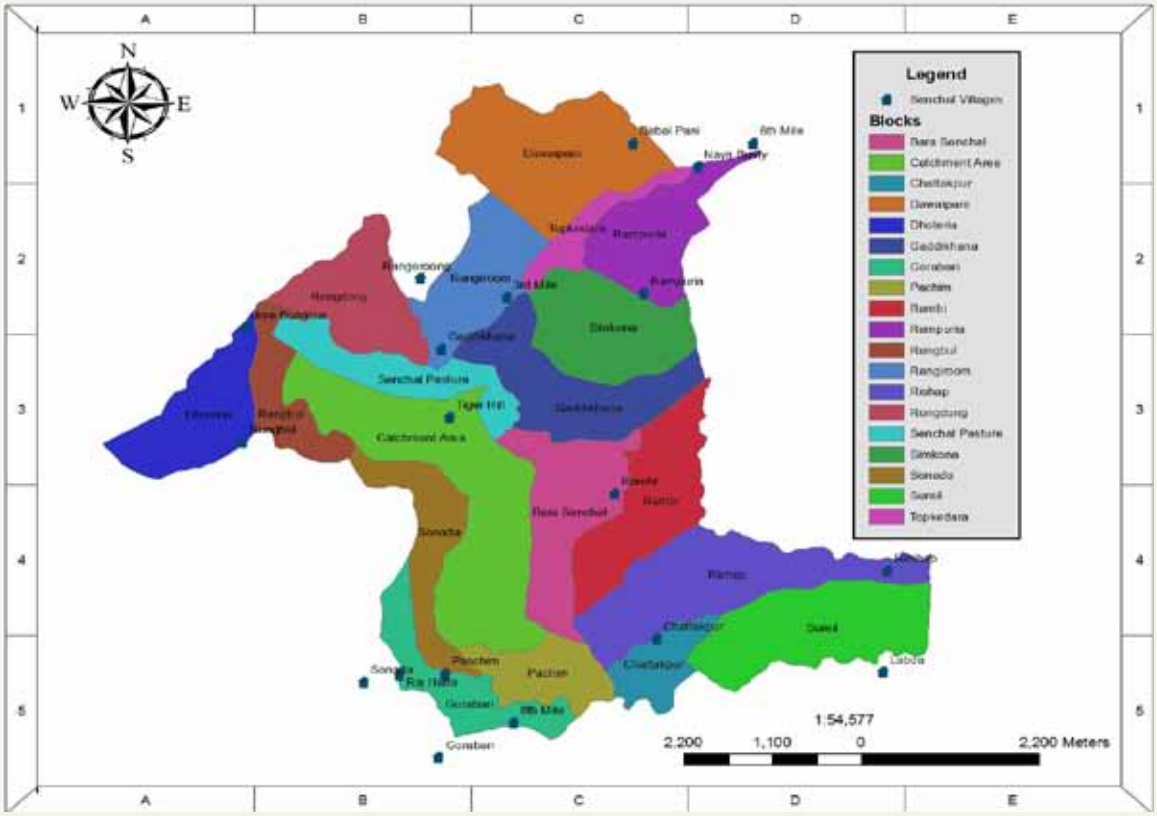


Figure 2. Map of Senchal Wildlife Sanctuary

The objectives of the project were also shared with the stakeholders and logistical and manpower requirements were discussed. Additionally, personnel were distributed into teams for fieldwork in different parts of the sanctuary.

ii. Assessment of human-animal conflict related to Asiatic black bear

Negative interactions between Asiatic black bears and humans are not uncommon in and around Senchal Wildlife Sanctuary. Further, since a black bear's habitat usage may range between 3 – 158 km², there is a possibility that its habitat may extend much beyond the boundaries of Senchal WLS. Incidentally, there are regular reports of black bear invasion from the adjoining forests under the management of Cinchona Directorate and Kurseong Division and complaints of human-bear conflict from villages adjoining the Bagora Range. To manage the conflict situations, it was essential to understand the human-wildlife conflict status at Senchal WLS, identify the most vulnerable villages and subsequently develop a proper management plan to tackle the situation.

To assess the human-animal conflict status, with special reference to bears and also other animals, data were collected through consultation with villagers, using pre-designed datasheets, at 10 villages in and around the sanctuary during post camera trapping period. Information on type of crops and livestock damaged, quantum of damage caused to different crops and livestock and the time of the year when maximum damage occurs, was collected through one-on-one interviews with the villagers. The animals were ranked based on the percentage of occasions they were reported during the survey.

Geographic Information System was used to identify the villages most vulnerable to Asiatic black bear invasion. For this analysis, points where the Asiatic black bear was recorded during the camera trapping exercise, were selected and plotted using ArcMap 9.3 (ESRI Inc. 2008). Three buffers were drawn around the black bear points using the buffer tool. The smallest buffer was of 3 km² representing the smallest recorded home range; the largest buffer had an area of 28 km²; and the third buffer covered an area of 12.5 km², which represented an average of all the home ranges recorded till now (Charoo et al. 2009; Sharma et al. 2010; Huang et al. 2010). Though the maximum published home range for Asiatic black bears is 117 km² (Huang et al. 2010), a maximum home range of only 28 km² (Charoo et al. 2009) was chosen because there were no reported cases of bear conflict beyond that zone in recent times. All the buffers for individual points were merged to create three different zones – one for 3 km² range, one for 12.5 km²range and one for the 28 km². Villages falling within the 3 km² zone were considered the most vulnerable villages and are prone to maximum conflict cases; those falling within 12.5 km² zone as moderately vulnerable villages to bear conflict; and ones falling within 28 km² zone are less vulnerable villages.

3. Camera Trapping

i. Introduction to camera trapping

Camera trapping is widely recognized as a very effective tool in the investigation of presence, morphology, behaviour and movements of individuals and populations of animals (De Luca and Mpunga 2005). It is a cost effective way of detecting presence of fauna in an area. Also, for some nocturnal or retiring species, it provides an edge in non-intrusive detection. Similar studies at subtropical and temperate broadleaved forests in Arunachal Pradesh (Datta et al. 2008), montane forest habitats in Peru (Jimenez et al. 2010) and in the semi-urbanized landscape of coastal Southern China (Jai-Chyi Pei et al. 2010) have provided encouraging results. Though estimating the results within a capture-recapture framework in the present case is not possible due to the non-cryptic nature of the focal species, camera traps still provide a good means of quantifying data through the analysis of results per unit effort. Not only can this indicate a relative index of abundance, but it can also help to highlight more significant areas or provide an approximation of relative index of abundance per site (De Luca and Mpunga 2005). Most commonly used, Photo Capture Rate, a measure of unit effort per site for capturing each species, can be comparable to relative abundance of the focal species in the area, termed Relative Abundance Index (RAI) (Jenks et al. 2011). Additionally, camera trap photos are also an effective way to engage local communities and potentially foster stewardship for wildlife conservation on their properties (Kays and Slauson 2008).

ii. Sign survey and site selection for camera traps

Based on the information availed through village consultation, a sign survey was conducted from June to August 2010 using randomly selected animal and human trails throughout the sanctuary (Figure 4). This survey not only provided information on the tentative distribution of Asiatic black bears but also allowed identification of potential camera trap locations. Locations were marked using GPS (Garmin GPS 72). Additionally, areas which showed a good abundance of black bears were identified and approximate proximity to human settlements noted.

Three factors were considered while selecting a location for camera trap placement. They were:

- Signs of animal usage (scats/pellets/scratch marks/footprints/feeding signs)
- Proximity to water sources
- Overall coverage of the area

Upon completion of the survey, the locations were plotted on the sanctuary's map using ArcMap 9.3 and final consultations were held with field personnel from the Forest Department. The landscape was then divided into 62 1 km^2 grids that housed at least some portion of the sanctuary. Out of these 62 grids, 33 were chosen for camera trapping exercise based on the distribution of black bear evidence and through consultation with the villagers and Forest Department officials. Further, while selecting the grids for camera trapping it was also made sure that none of the grids included degraded habitats, dense settlement areas, tea gardens and forest roads.

Figure 3. Survey team from Forest Department and WWF-India

Figure 4. Bear scratch mark on tree bark at Rambi recorded during sign survey

Figure 5. Camera trap being set up by Forest Department and WWF-India staff

iii. Camera trapping schedule

Due to logistical constraints, camera trapping was done in two phases, the first during September 2010 and the second during October 2010. The entire study area was divided into 33 grids and the trapping was conducted in these pre-defined grids. The details of each phase and the number of cameras engaged are given in the following table:

Table 1: Details of camera- trapping schedule

Phase	Commencement	Completion	No of cameras	Effective trap nights
Phase I	06/09/2010	07/10/2010	17	442
Phase II	20/10/2010	26/11/2010	16	544
Total			33	986

iv. Field methods

In each location, camera traps were installed singly, near the trails and water sources, tied on trees or placed with rocks, 30-45 cms above ground on an average (Figure 5). Camera placement and angles were finalized after assuming the position of the animal on the trail. The camera traps of choice were Cuddeback Capture (Cuddeback Inc, USA), sensitive to both heat and motion and powered by D batteries. All camera traps were numbered serially and their locations marked on the GPS.

The camera traps were checked every 7-10 days and batteries replaced, if needed. The storage medium, a digital SD storage device, did not need to be changed in any of the cameras for the duration of the individual phases. After the completion of the schedule, all photos were downloaded and stored in individual folders, corresponding with the serial number and location of the camera traps.

4. Habitat Data

At each camera-centred plot, the team measured the habitat characteristics using the quadrat method (Bullock 2006). Physical features such as altitude, slope aspect, and slope angle; and habitat features like canopy cover, tree species, tree height, girth at breast height (GBH), number of individuals per tree species and their regeneration patterns and details of bamboo thickets such as - density, height, number of stems per cluster and cover were measured within 10m × 10m quadrats. Number, cover and height of the shrub species and whether they are flowering or fruiting were measured within 3m × 3m quadrat inside the 100 m^2 tree quadrats. Herb species present, herb cover, height, whether they are flowering or fruiting was recorded by demarcating 1 m × 1 m plots within the 9 m^2 shrub quadrate (Ghose et al. 2011).

Information on tree species across the study grids was used to calculate relative density, relative frequency and relative dominance following Curtis (1959). The three components were then added to generate Importance Value Index (IVI) of tree species.

5. Analysis

i. Camera trap data analysis

a. Interval of independent capture

Depending on the focal species, purpose of trapping and the habitat, different studies have used various interval lengths between consecutive photographs in a camera trap to ensure non replication and independent capture events, from 5 minutes (Araujo and Chirello 2005) to 1 hour (Jimenez et al. 2010). For the present purpose, an interval of 30 minutes (i.e., two consecutive photos will be considered independent events only if their interval is 30 minutes or greater) was used following Jenks et al.(2011).

b. Photo capture rate

In case of absence of individual identification of animals and a capture-recapture framework, studies worldwide have explored use of a quantitative measure of capture rate of each camera, described in various ways in different literature, from photographic rate (no of trap days/photo) (Carbone et at. 2001), camera trap rate (no. of photos/total trap days) (Bowkett

et al. 2007) and photo capture rate (no. of photos/total trap nights×100) (Kawanishi et al. 1999; Dutta et al. 2008 ; Li et al. 2009; Jenks et al. 2011).

For the present study, photo capture rate or Relative Abundance Index (RAI) was

$$\text{Relative Abundance Index (RAI)} = \frac{\text{Total no. of photos captured of a species}}{\text{Total trap nights}} \times 100$$

Thus, all the captured photos of a species were sorted following the intervals and details were recorded using Microsoft Excel.

c. Activity pattern

To understand the activity pattern of the focal species, based on their time of capture, the day was divided into 12 two-hour periods and the number of photos in each interval was noted. A Daily Activity Index (DAI) was estimated following Li et al.(2009), as

$$\text{DAI} = \frac{\text{No. of photos in a duration}}{\text{Total no. of photos captured of a species}} \times 100$$

The DAI's were plotted against each duration graphically to approximate activity patterns for each species.

d. Calculation of density

Asiatic black bears have a uniform black coat colour and lack any major marking over their bodies, except for the white V-mark on the chest, which may allow identification of two different individuals of the same species. DNA hybridization is used globally for population estimation of bears, including Asiatic black bears. However, it was out of the scope of the present study. Further, the number of captures of black bears were far too less to perform other calculations to assess the populations with more conviction.

However, if it is considered that bears that were captured by independent camera traps at least once are separate individuals, then a crude density of black bear individual forest blocks may be calculated as

$$\text{Block wise density (crude)} = \frac{\text{ABB captured at least once by the camera in a block}}{\text{Area of the block in which camera has been set up}}$$

where ABB = Asiatic Black Bear. During the survey, camera trap were set up in 13 blocks. The six blocks that were excluded are Rampuria, Rangbul, Rongdong, Sonada, Gorabari and Bara Senchal, and hence they have been excluded from future analyses.

However, one needs to remember that an Asiatic black bear may have a minimum home range of around 3 km^2. Considering this, it may be said that two captures made on adjacent cameras could be of the same animal. Keeping this in mind, one needs to understand that the present assessments are very crude and caution should be taken in interpreting the information. A scientifically reliable inference regarding the population can be proposed only after more robust data have been generated through repeated surveys in future.

e. Data Reduction

Data reduction was conducted by fitting 17 habitat data, qualitative and quantitative, identified during the field study in the Principal Component Analysis (PCA) domain. The main objective of this analysis was to extract major variables from this set that may have significant impact on wildlife distribution in Senchal WLS, summarising maximum variance of the original set of variables. The factor matrix was rotated using Varimax method (Shankar Raman et al. 1998) to help interpretation and representation. The analysis was conducted using SPSS 17.0 (SPSS Inc. 2008).

f. Ordination analyses

A sequential ordination analyses was conducted to select the suitable analysis that could be used to test how habitat

variables impact the wildlife distribution in Senchal Wildlife Sanctuary using Canoco 4.5 (terBraak 1986; Leps and Šmilauer 2003). Significance of relationship between the species occurrence and habitat variables was tested using Monte Carlo randomization test (199 permutations). The results were considered significant if $P < 0.05$.

Crop damaged by an Asiatic black bear

Results

1.Vegetation information

Senchal has a rich assemblage of trees, shrubs and herbs belonging to the temperate broadleaved habitat. Overall, a total of 45 species of trees were detected in the study plots (N= 33). Among the 45 species recorded, *Symplocos theifolia* emerged as the most dominant species followed by *Eurya japonica* and *Cryptomeria japonica* (Table 2).

Table 2. Table showing eight most dominant tree species recorded at the individual camera trap points (Ghose *et. al.* 2011)

Species	No of individuals	Frequency in plots (N= 33)	Relative frequency	Relative density	Basal Area (m^2/ha)	Relative dominance	IVI
Cryptomeria japonica	25	11	0.33	0.11	2.91	0.45	0.89
Symplocos theifolia	76	16	0.5	0.34	0.45	0.07	0.89
Castanopsis sp	23	10	0.3	0.1	1.79	0.28	0.68
Eurya japonica	35	15	0.45	0.16	0.17	0.03	0.63
Quercus lineata	28	8	0.24	0.12	0.57	0.09	0.45
Cinnamonu sp	13	10	0.30	0.06	0.18	0.03	0.38
Michelia catcarthii	10	4	0.12	0.05	0.08	0.01	0.17

Total of 14 shrub species were recorded from the study plots. *Viburnum erubescens* was the most dominant shrub, followed by *Rubus* and *Daphne* (Figure 6).

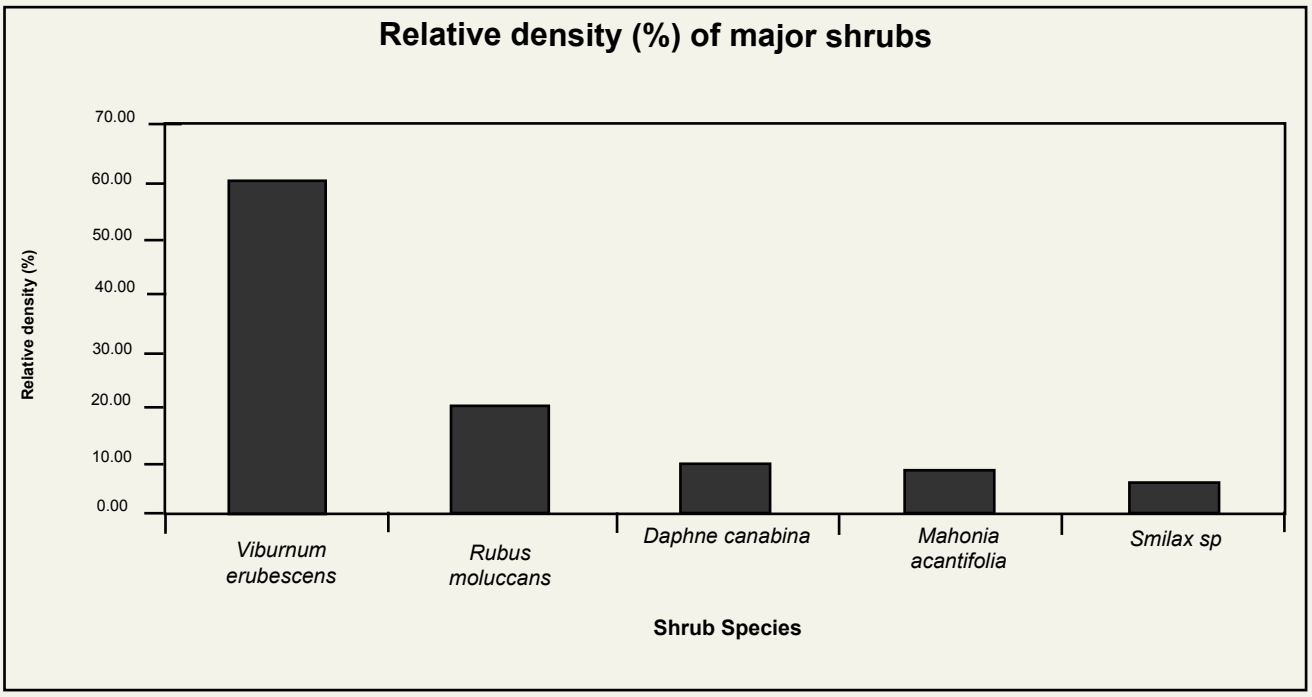


Figure 6. Graph showing the five most dominant shrub species recorded at the 33 sample points.

A total of 31 species were recorded across the study area. Ferns were recorded in high frequency. However, individual species of this group could not be segregated according to their species. Second most frequently occurring herb species was *Cissus* sp., followed by *Elastostema* sp. and *Oplismenus* sp. (Figure 7).

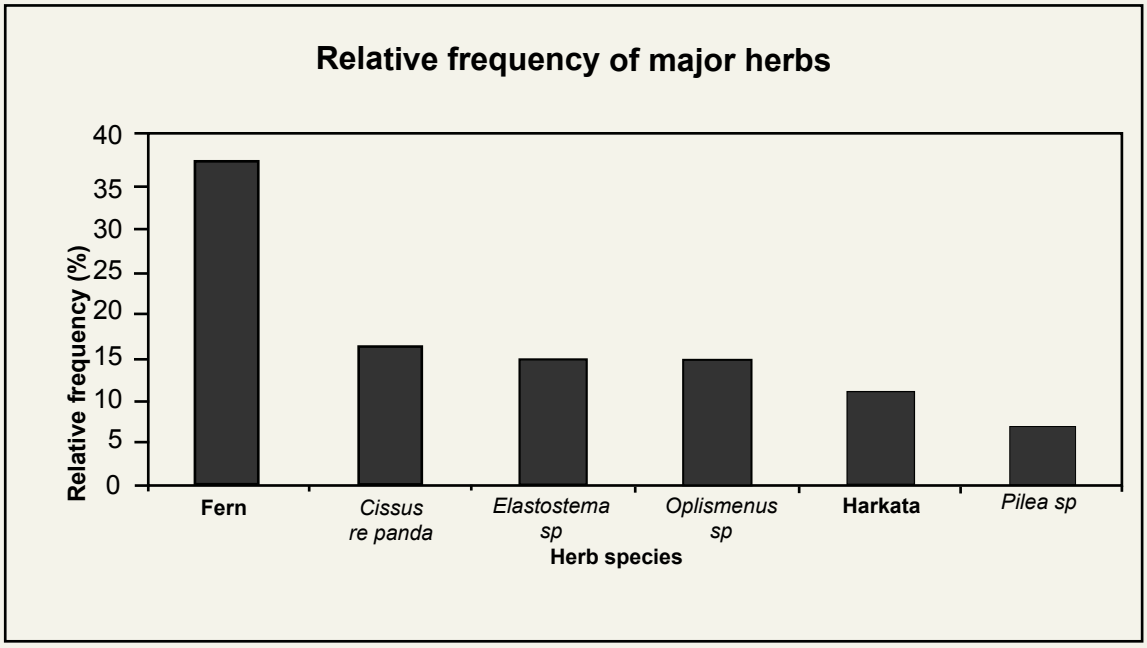


Figure 7. Main herb species recorded during the survey at Senchal Widlife Sanctuary

2. Sign Survey and Camera trapping for Distribution

Sign surveys were conducted at 10 locations within as well as in areas adjacent to Senchal Wildlife Sanctuary. These 10 locations were selected in such a way so that it allowed maximum area coverage within and around the sanctuary during the sign survey (Figure 8). Highest abundance of evidence was recorded at Chattakpur followed by Dabaipani. No evidence was recorded from Surrel and Paschim. Though no bear sign was recorded from Pachim, pre-sign survey consultation meetings indicated its presence here. Based on the outcome of the sign survey, the study area was divided into 33 grids and one camera trap was placed at each grid.

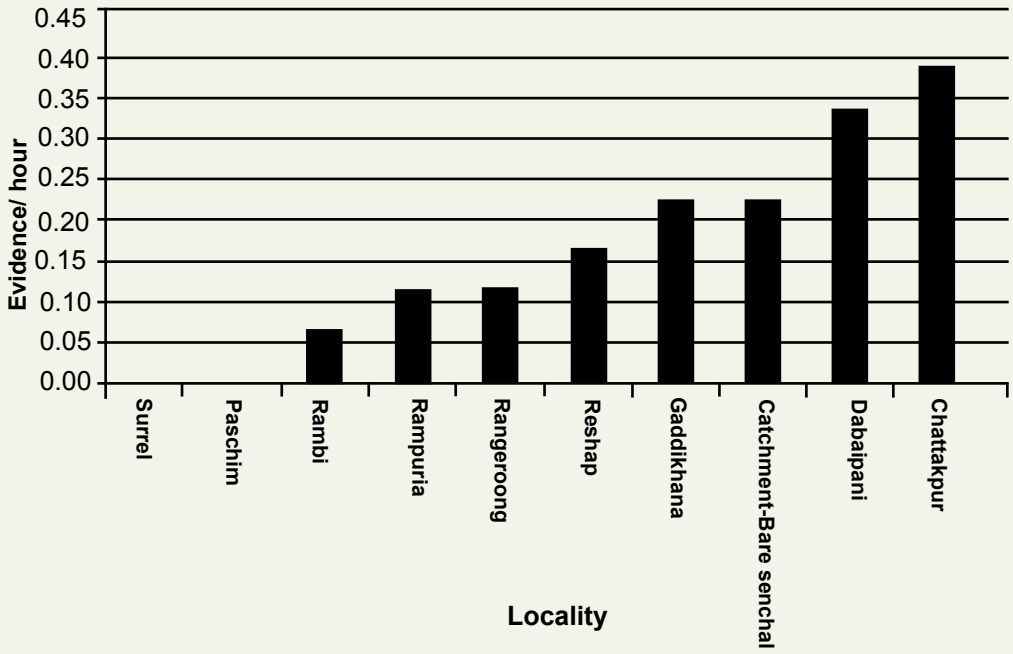


Figure 8. Locality of sign abundance of Asiatic black bear recorded during pre-camera trapping sign survey.

The camera trapping exercise was performed in two cycles. Asiatic black bear was captured at 9 (27%) out of 33 grids where the cameras were set up (Figure 9). Most of the captures happened around areas where the sign abundance was comparatively higher.

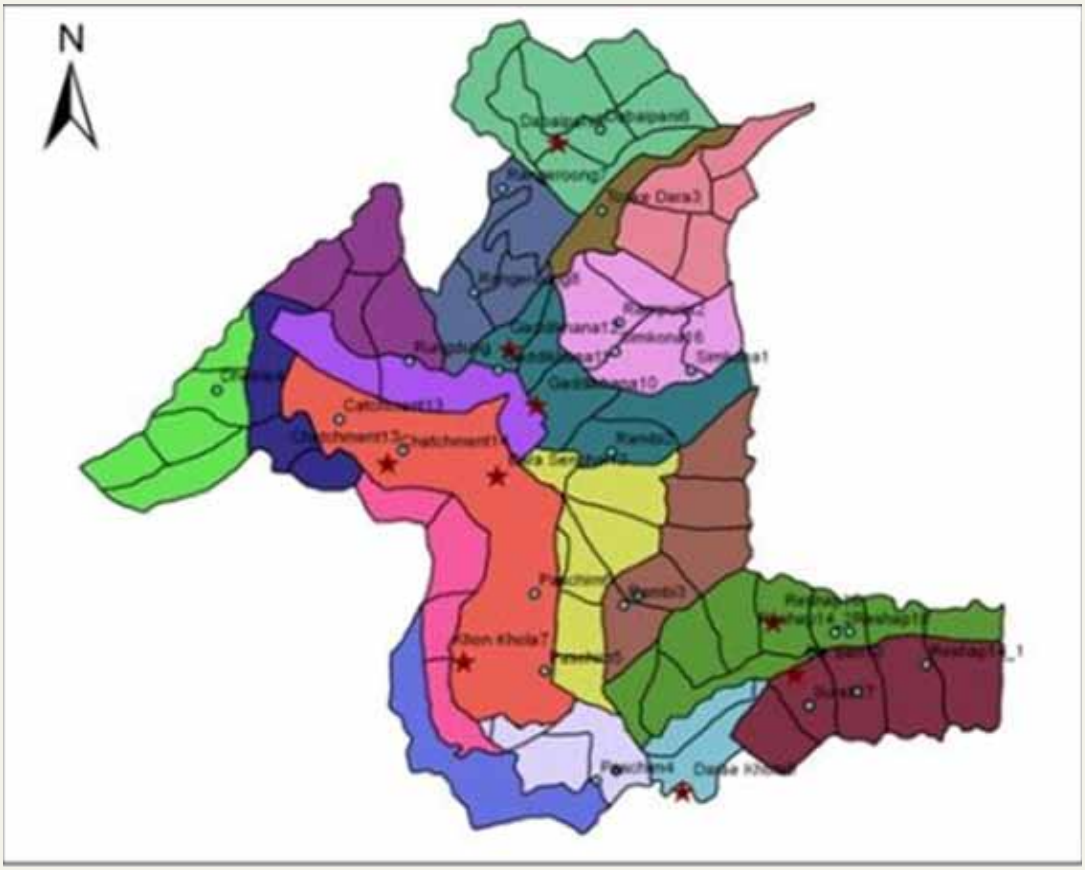


Figure 9. Map showing distribution of Asiatic black bear (purple stars) across the study area

Though no bear evidence was recorded from Surrel during sign survey or camera trapping survey, pre-survey consultation meetings with villagers from the adjoining villages indicated probable presence of Asiatic black bear in the area. Based on the sign survey and camera trap survey it may be stated that Asiatic black bear is distributed very evenly throughout the Sanctuary.

3. Assessment of density

The mean crude density estimated across the 13 forest blocks where the camera traps were set up was 1 animal per 3.55 km², with highest being measured at Chattakpur (1 animal per 0.91 km²) and lowest at Dawaipani (1 animal per 3.55 km²). With a mean density of 1 animal per 3.55 km² there could be about 11 Asiatic black bears in Senchal Wildlife Sanctuary, with a maximum of up to 15 animals and a minimum of 7 animals. However, it hsould be stressed that this interpretation is a very crude one and should be used with utmost caution and a more intensive field exercise needs to be performed to come to a more scientific inference regarding the population density of the Asiatic black bear in Senchal Wildlife Sanctuary.

4. Relative Abundance Index (RAI) and Daily Activity Index (DAI) measured for Asiatic black bear at Senchal WLS

During the survey Asiatic black bear was captured by 9 different camera traps, with 15 independent captures. The RAI measured for black bears at Senchal Wildlife Sanctuary during the study period was 1.52 (Figure 10). This measure, when compared with that of other species recorded during the survey (to be detailed later), suggested that the target carnivore was the third most regularly captured species during the camera trap study.

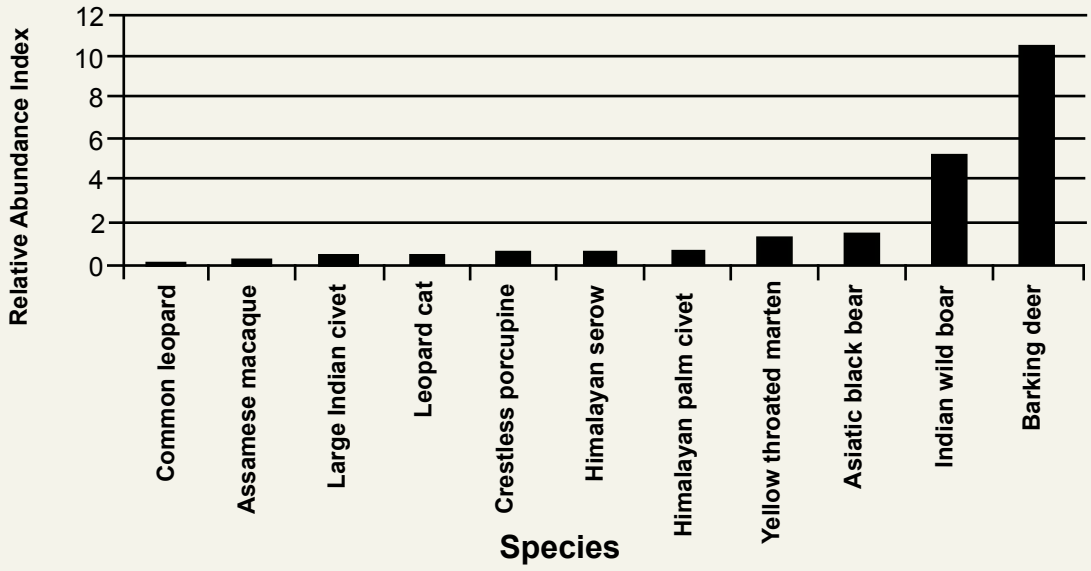


Figure 10. Details of species captured and their RAI (Relative Abundance Index)

Daily Activity Index (DAI) values indicate that the Asiatic black bear shows high levels of activity during dawn and dusk (Figure 11). But the activity level of the species peaks during midnight. However, due caution should be excercised while drawing any inference out of these observations because the study was conducted for a single season and bear activity pattern varies considerably from one season to the other.

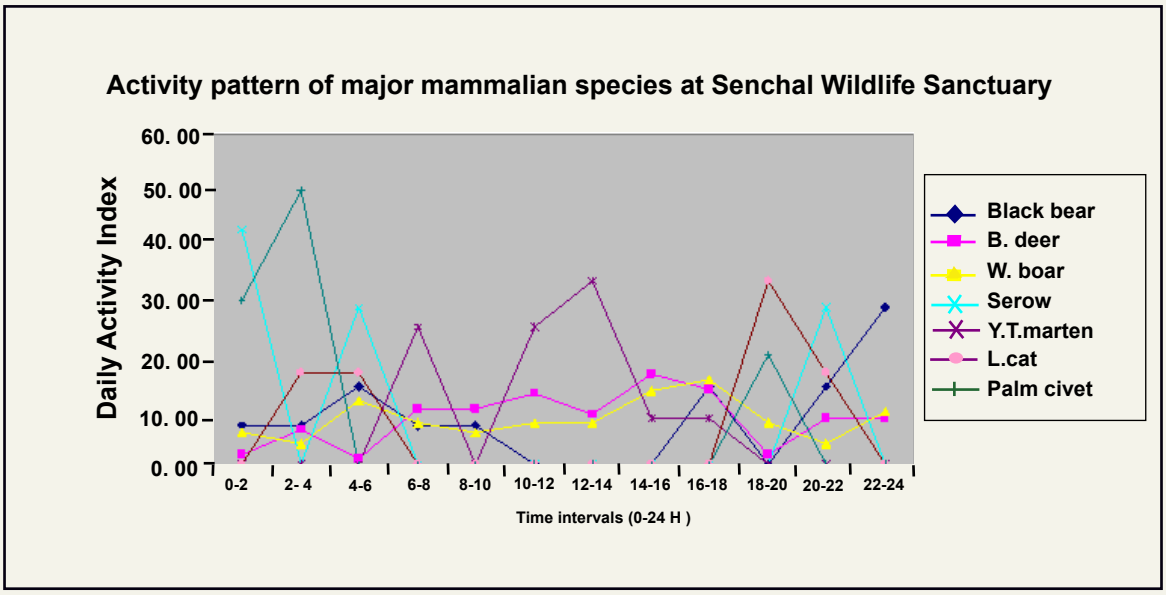


Figure 11. Daily activity patterns of different mammalian species captured by camera trap during the study

5. Observed Food Habit

During the survey an attempt was made to assess the preferred food habits of Asiatic black bears through observations in the field. Overall, fruits of *Symplocos theifolia* seemed to be most favoured by the bears at Senchal WLS followed by *Castanopsis hystrix*, *Symplocos* sp. (kholme), *Cinnamomum impressinervium* and *Quercus lineata* (Figure 12).

The study was conducted in two phases, and there was a marked increase in remains of *Q. spicata*, *Machilus edulis*, *Lithocarpus* sp., *Prunus nipalensis*, *Syzygium cumini*, *Q. lamellosa*, *Machilus odoratissima* and *Brassaiopsis hispida in* black bear faecal matter during the second phase of the study. However, since this was an ocular assessment, caution should be taken in making any definite statement on the exact food habits.

6. Other animals recorded during camera trap survey

Other species captured during the camera trap survey include barking deer (19 locations); wild boar (17 locations); yellow throated marten (six locations); serow (five locations); common leopard and Himalayan crestless porcupine (three locations each); and, Assamese macaque, Himalayan palm civet, large Indian civet and leopard cat (at two locations each) (Figures 13, 14, and 15). Highest frequency of occurrence was recorded for barking deer followed by wild boar and yellow throated marten (Figures 13, 14, 15). However, caution should be exercised in drawing conclusive remarks regarding the distribution, commonness and rarity of the individual species based on the outcome of the camera trap survey.

Most of species have wide distribution but that does not reflect properly in the camera trap exercise, because of its short study period.

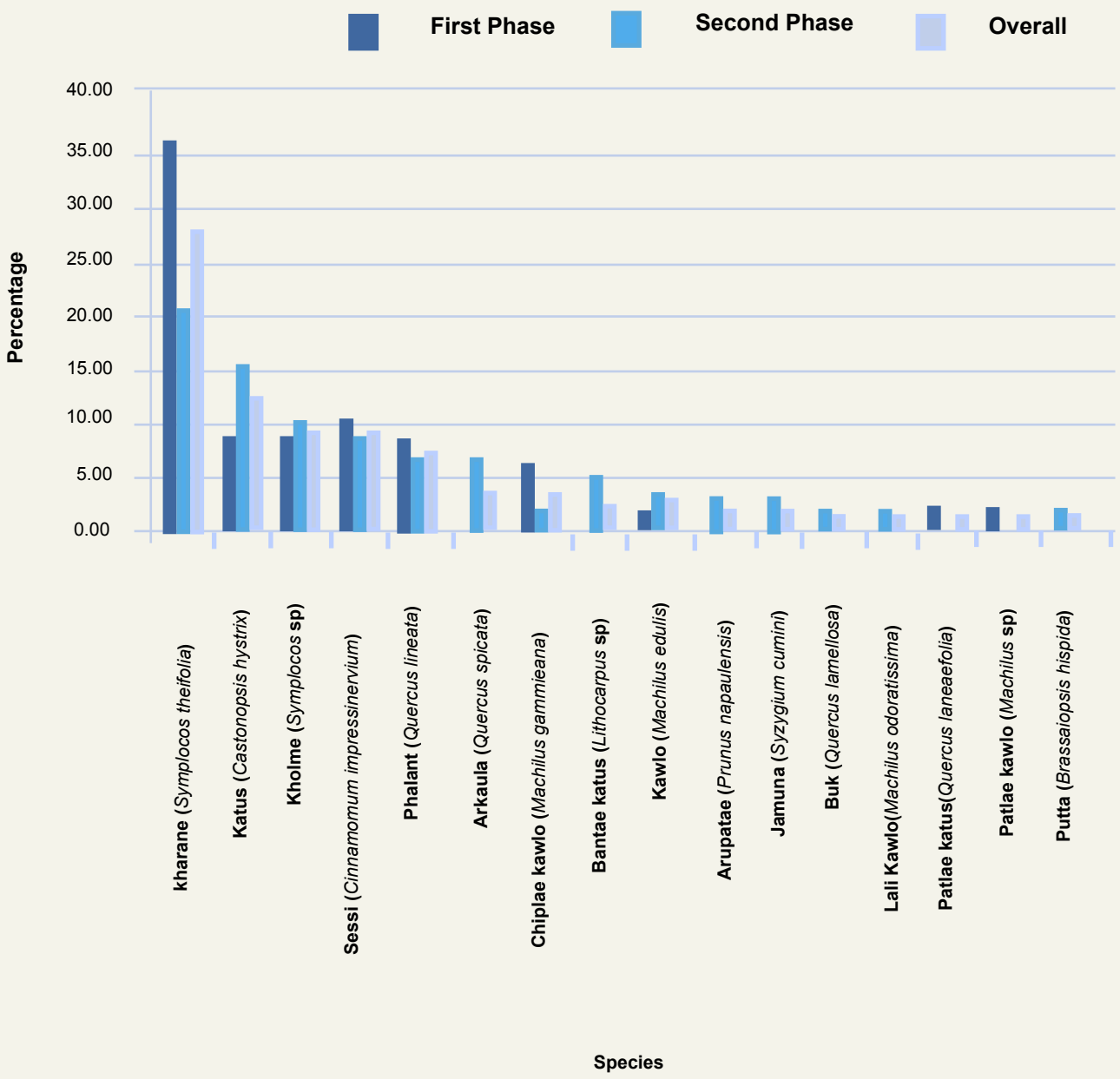


Figure 12. Most preferred food plants of Asiatic black bear at Senchal Wildlife Sanctuary

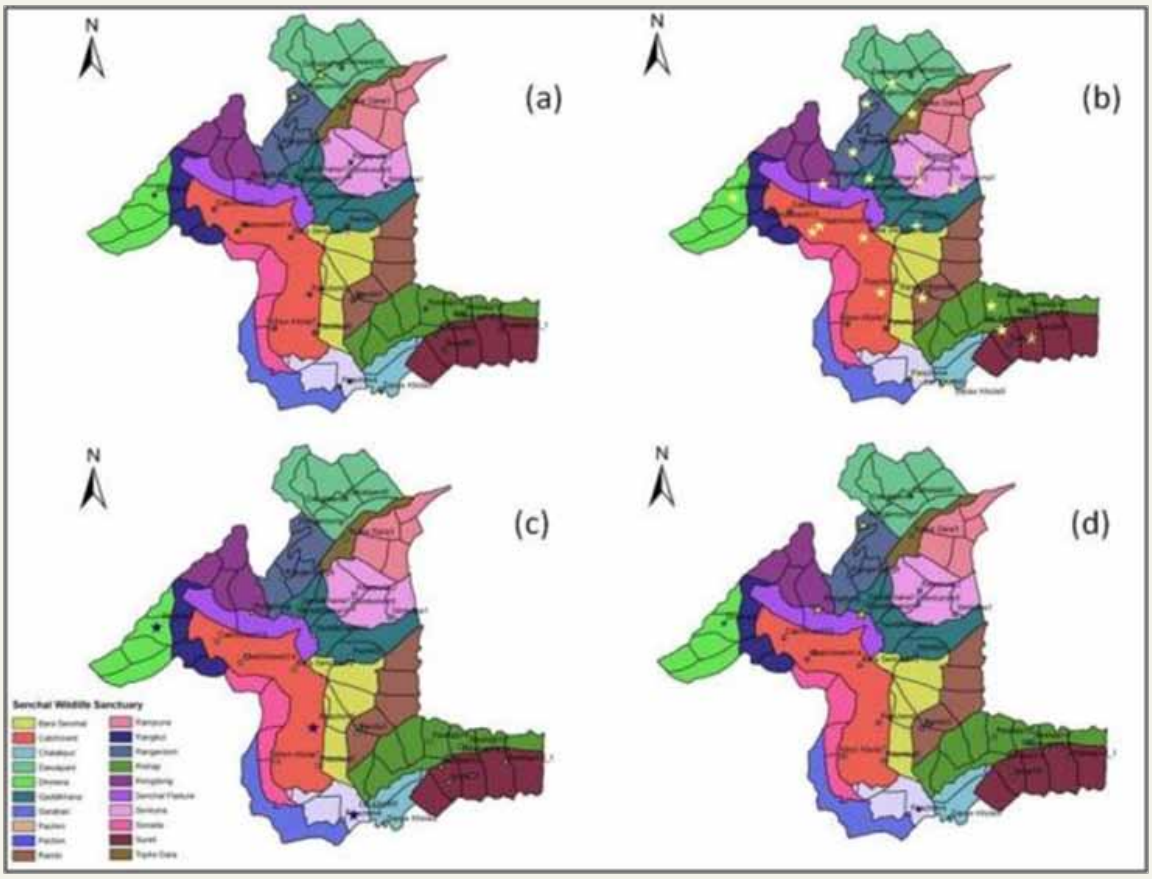


Figure 13. Distribution (marked by the stars) of Assamese macaque (a), Barking deer (b), Common leopard (c) and Himalayan crestless porcupine (d) in the study grids selected for camera trapping.

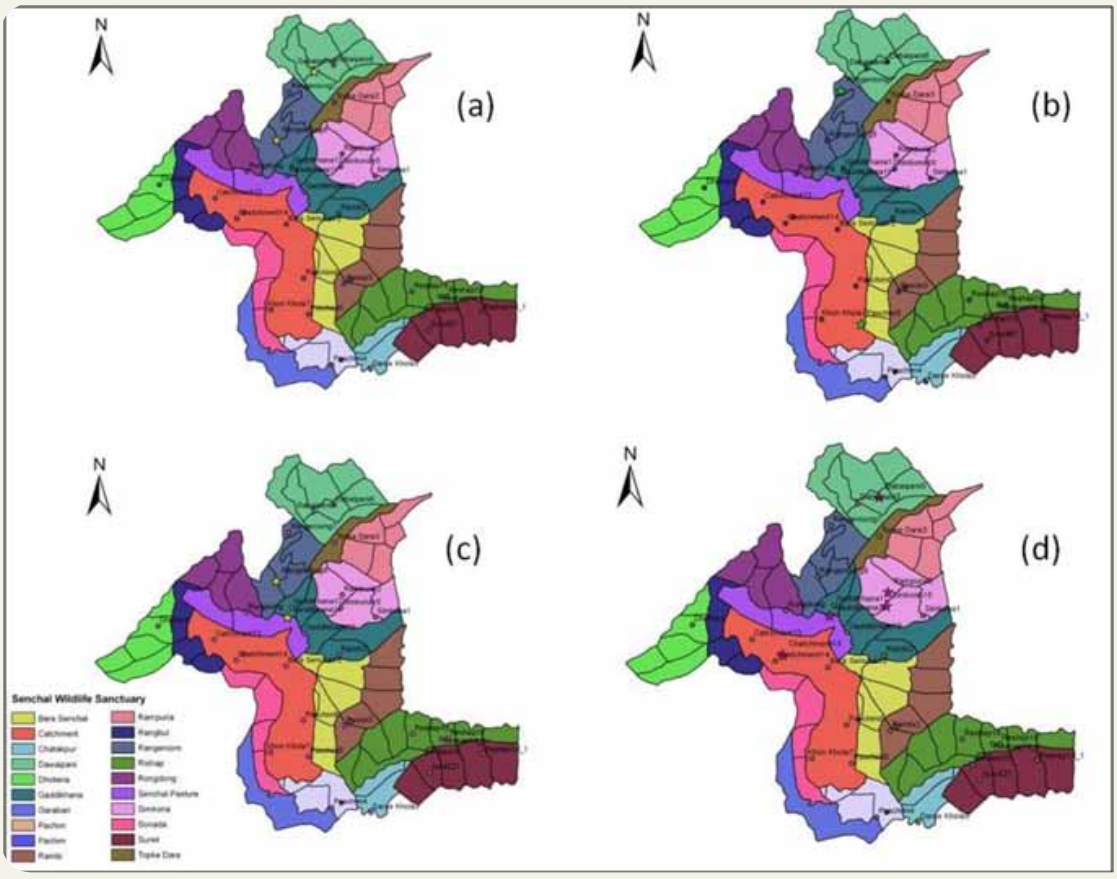


Figure 14. Distribution (marked by the stars) of Himalayan palm civet (a), large Indian civet (b), leopard cat (c) and serow (d) in the study grids selected for camera trapping.

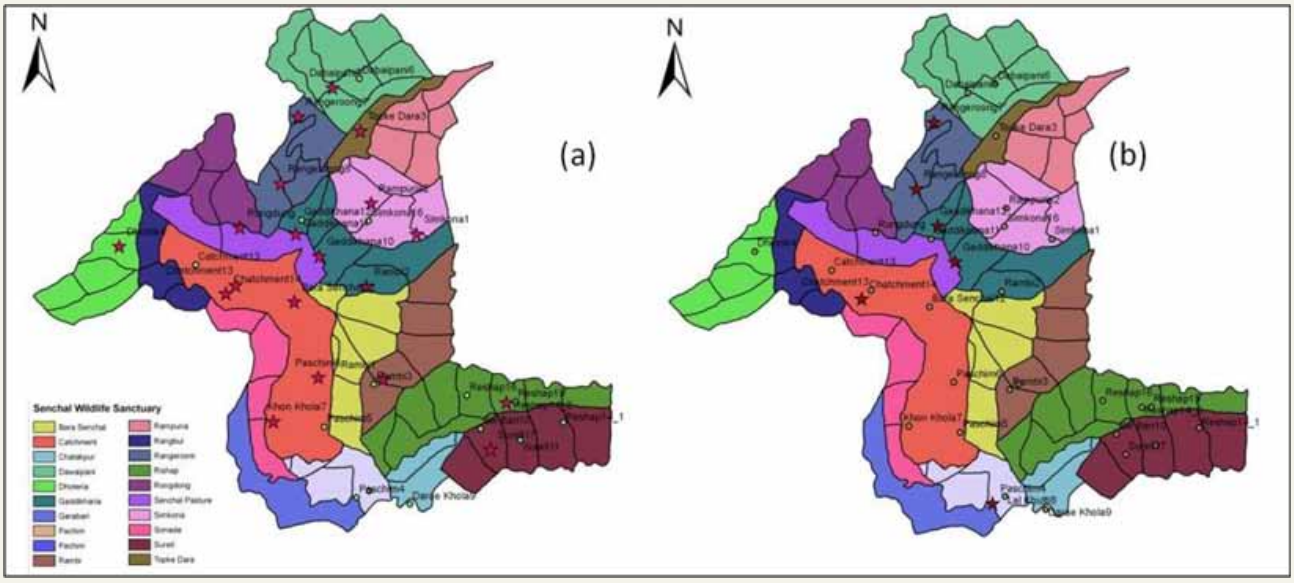


Figure 15. Distribution (marked by the stars) of Wild boar (a) and Yellow throated marten (b) in the study grids selected for camera trapping.

7. Human-wildlife conflict in and around Senchal Wildlife Sanctuary

i. Conflict associated with Asiatic black bears

Asiatic black bear emerged as the fifth most damage causing animal to crops and vegetables and ranked third among the animals causing damage to the livestock at the 10 villages where the survey was conducted (Figure 16 and Figure 17). However, they were not actively involved in conflict cases involving the villagers at the villages where the study was undertaken. At Rajahatta and Upper Johnson Hatta it has emerged as a crop damaging agent and at Chattakpur and Rambi it has been associated with livestock damage alone. However, at Lhabda and Rampuria, the Asiatic black bear has emerged both as a crop and livestock depredation agent.

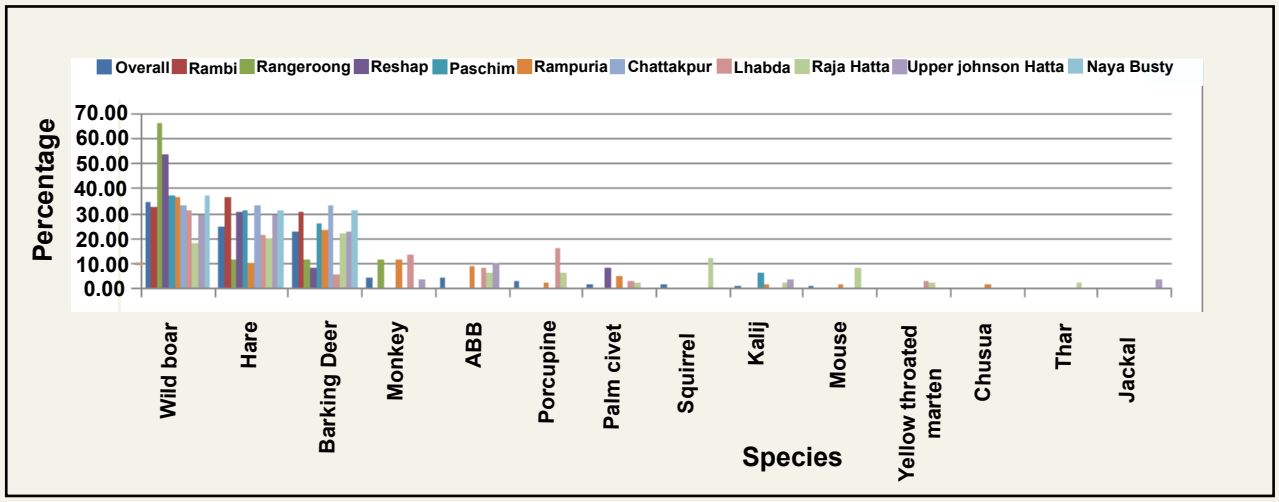


Figure 16. Major conflict causing animals from Senchal Wildlife Sanctuary that are associated with crop depredation (ABB = Asiatic black bear)

Buffer analysis suggested that out of 19 villages and settlements that occur within and adjacent to Senchal Wildlife Sanctuary, 11 fall within the highly vulnerable zone and are likely to be more susceptible to bear encounters (Figure 18). Out of these 11 villages, bear occurrence has already been confirmed from 5 villages. Among these 11 settlements, 3rd Mile, Gaddikhana, Jore Bungalow and Rangbul are comparatively larger and densely populated. Six settlements fall within the moderately vulnerable zone, of which 3 have confirmed reports of Asiatic black bear. All these villages, however, have a very close proximity to the forest.

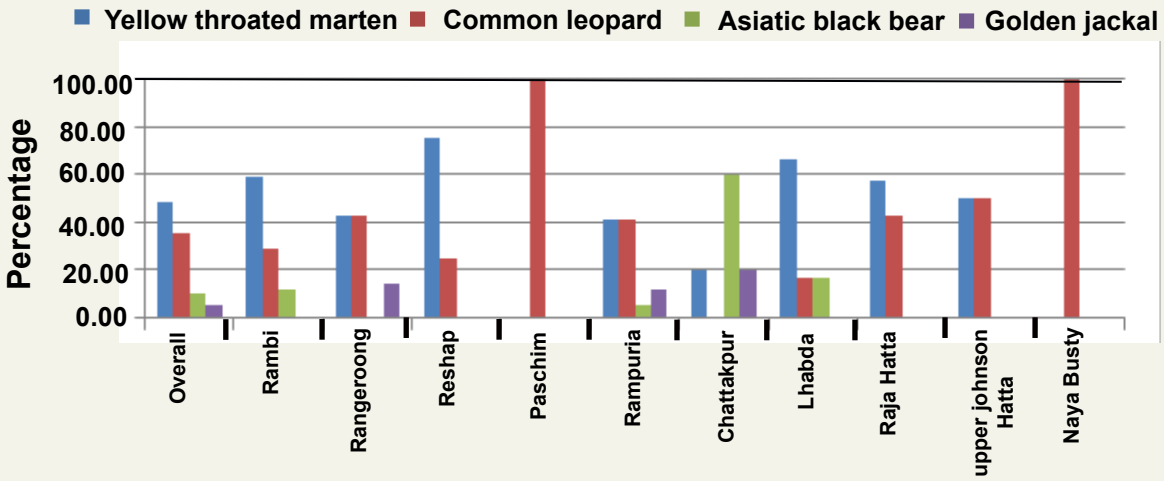


Figure 17. Major conflict causing animals from Senchal Wildlife Sanctuary that are associated with livestock damage

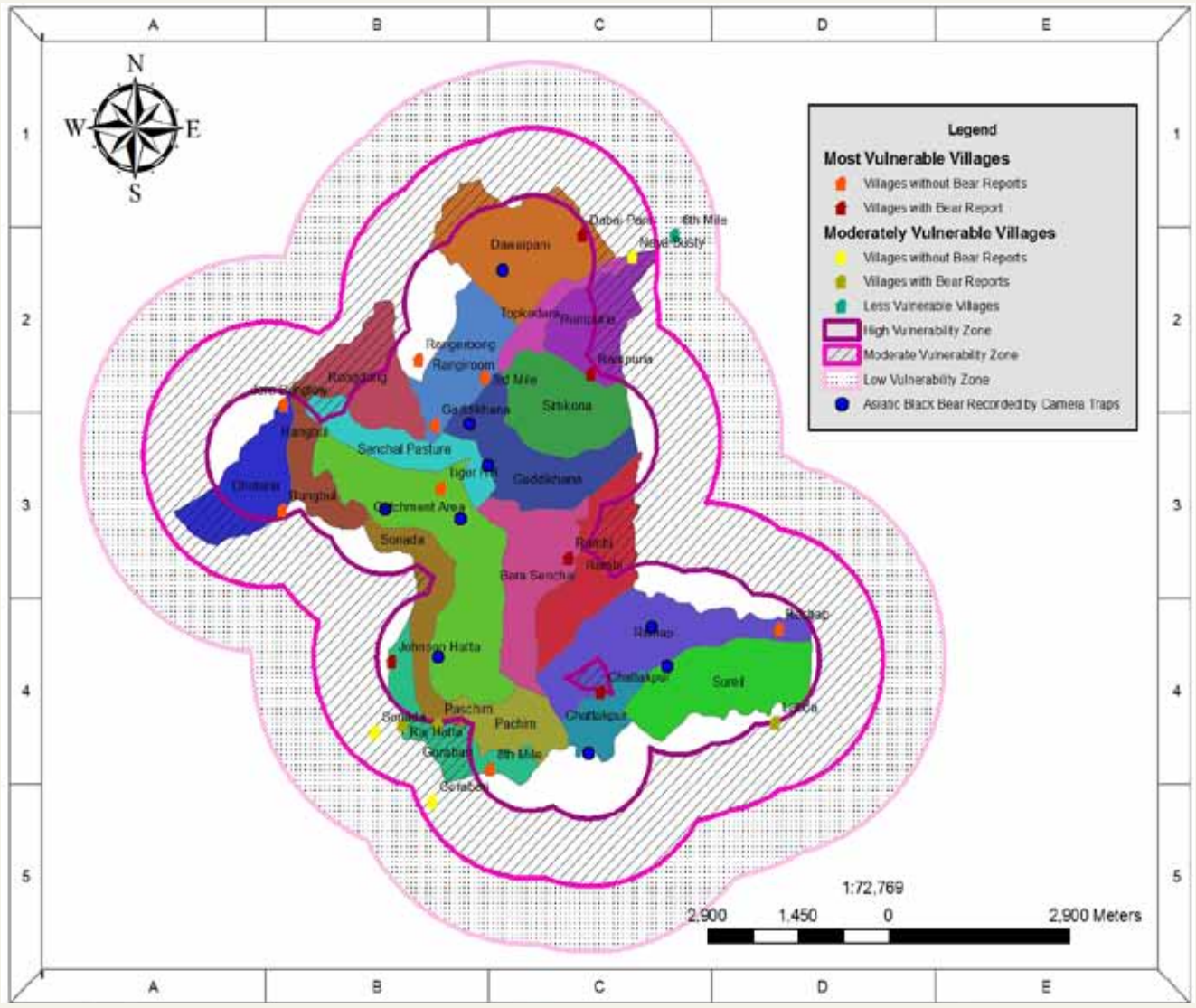


Figure 18. Map showing villages that are highly vulnerable, moderately vulnerable and least vulnerable to potential human-bear conflicts.

ii. Other conflict causing animals

As part of the study, an assessment of other conflict causing animals was also made. Wild boar emerged as the top crop damaging animal at villages in and around Senchal Wildlife Sanctuary and was closely followed by hare (*Lepus sp.*) and barking deer. Among the livestock depredating species, yellow throated marten occupied the first spot. However, at Paschim and Naya Busty, leopard emerged as the sole problem causing species.

8. Influence of habitat factors on animal distribution

During the survey, 18 habitat variables were recorded at the individual plots where the camera traps were set up. Principal Component Analysis (PCA) was used to identify most significant variables among the group that may have significant influence on animal distribution in the sanctuary. The PCA generated seven principal components of which the first three components PC1, PC2 and PC3 accounted for over 64% variance among the data. Among these, PC1 characterizes the habitat with respect to elevation (ELEV), tree cover (TCOVER), bamboo cover (BCOVER), and scrub forest type (SCRUB); PC2 on the other hand characterizes the survey points on the basis of distance of the survey points from the nearest water source; and PC3 characterizes the study plots based on the slope angle of the locality. The habitat variables showing very high correlation (>0.6) with the first three PC axes were selected and were used to test their influence on the animal distribution.

Information related to animal distribution and seven variables showing high correlation with the first three components (PC1, PC2 and PC3) was fitted into CANOCO 4.5 and a Detrended Correspondence Analysis (DCA) was conducted. DCA gradients longer than 4 suggests that the data set has high amount of heterogeneity indicating necessity to conduct indirect gradient analysis to understand the animal distribution patterns with respect to habitat conditions. Canonical Correspondence Analysis (CCA) was used for this purpose. None of the permutations with different habitat variables show significant relation with the animal distribution. This may be due to limited number of observations during the study period.

When the habitat variables were plotted (Figure 19) against animal distribution it was seen that the probability of black bear distribution peaked with increase in vegetation density, tree cover and distance to human settlement. Similar response was also seen in case of yellow-throated marten and wild boar. Distribution possibilities of mainland serow and palm civet peaked with occurrence of water source and that of common leopard and large Indian civet show greater dependence with scrub forest and bamboo cover. No species attains any optimum against elevation. The Assamese macaque, crestless porcupine and leopard cat, however, plots on the opposite direction to elevation.

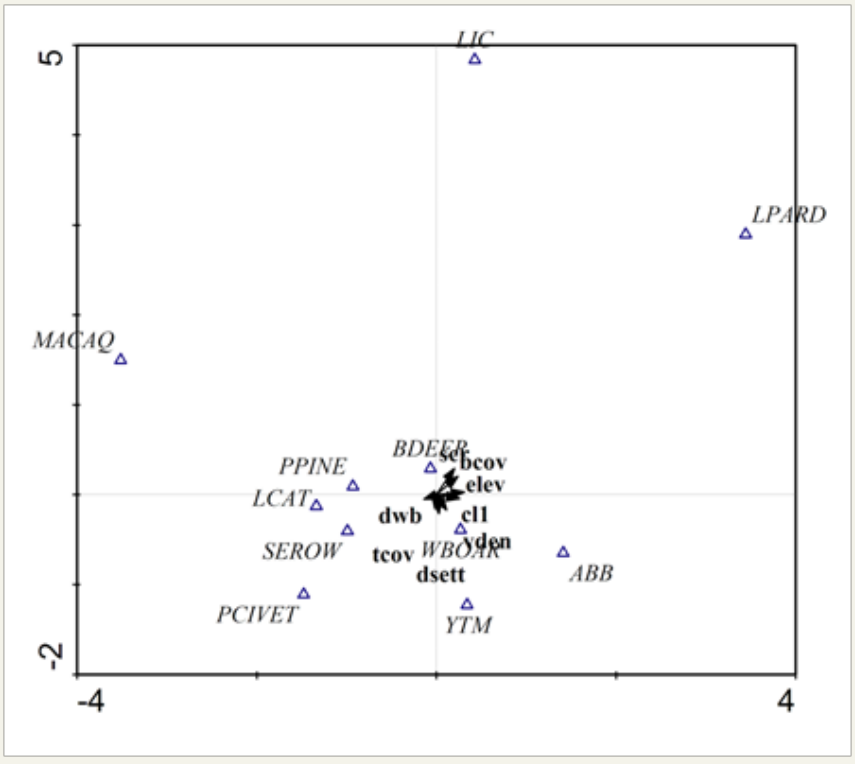


Figure 19. Mammalian distribution at Senchal Wildlife Sanctuary with respect to habitat conditions

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Discussion

Asiatic black bear is one of the key carnivore species of the subtropical and temperate forests and plays a critical role as an indicator of health of the forest. The Asiatic black bear carries a reputation of being one of the major conflict causing animals throughout its range. It is incidentally the largest mammal of Senchal Wildlife Sanctuary, one of the oldest Protected Areas of eastern India. However, little information is available on its status and incidents of human wildlife conflict associated with this species from the sanctuary.

During the present survey, it was recorded from about 27% of the grids and shows an even distribution throughout the sanctuary. It has emerged as the third most abundant species in the camera trap study and shows a tentative density of about 1 animal per 3.55 km². This estimate, however, is much lower than that of Dachigam National Park, Jammu and Kashmir (Sathyakumar 1998). One has to remember that Dachigam NP has the highest density of Asiatic black bears in India. Low density of black bear has also been reported by Hazumi and Maruyama (1983, 1986) and Reid et al. (1991). The probable number of bears calculated for the Sanctuary is about 11 individuals with a highest probable number of about 15 individuals. Both these numbers are much lower than the 20 individuals reported in 2002 (Anon. 2002). However, the present number is a crude estimate and a more detailed analysis is necessary to predict a more scientifically accurate population estimate. In spite of this, one cannot deny the fact that even a population of 10-15 individuals can be considered as a comparatively healthy population of bears for a 38.97 km² sanctuary.

Frequencies of human wildlife interactions have increased manifold in recent times. This to a great extent is related to the increased levels of human activities in wildlife areas (Chauhan 2003; Graham et al. 2005; Bulte and Rondeau 2005; Charoo et al. 2009). The situation is no different for Asiatic black bears. Recent experiences from a similar habitat in Sikkim have shown that the incidents of human-black bear conflict have increased considerably over the past few years and in 2009 alone there were at least 13 cases of human-black bear conflict (Department of Forest, Environment and Wildlife management, Government of Sikkim records; Dr. S. Sathyakumar, personal comments). Considering the size of the sanctuary and the number of settlements (19 in total) that occur within and around the sanctuary, even with a reduced count of 11 – 15 individuals, the villages are highly vulnerable to potential human-bear conflict and though there are only occasional reports of bear conflict from the sanctuary, increase in intensity in future of such incidents cannot be ruled out.

Assessments indicate that at least 17 out of 19 settlements occur within highly vulnerable and moderately vulnerable zones and are more susceptible to black bear related conflict. Field surveys and village consultations revealed that almost 50% (n = 8) of these 17 settlements have confirmed reports of black bear incidents, providing support to our assumption. Among these 17 settlements, 3rd Mile, Gaddikhana, Jore Bungalow, Rangbul, Sonada and Gorabari are large and populated settlements and the risk of negative interactions between bears and humans may be comparatively less. However, experiences from Sikkim have shown that during specific seasons black bears often wander into villages and in November 2009 one black bear even walked into the state capital, Gangtok, and seriously injured three Forest Department officials during the rescue operation. Considering this, it may be suggested that though settlements like 3rd Mile, Gaddikhana, Jore Bungalow, Rangbul, Sonada and Gorabari may have lower risk compared to the other 11 villages falling within the high and moderately vulnerable zones, possibilities of bear invasion at these settlements cannot be ruled out.

Observations from Sikkim also indicate that most of the invasions usually happen during the pre-hibernation fattening season. During this period, the bears are active even during the day and are known to travel great distances in search of food. Such incidents happen more often on occasions when food production is less in the wild. In doing so, they repeatedly end up outside forest areas. Research from other parts of its range shows that such situations happen when there is a low production of acorn and hard fruit like chestnut with high nutritious value in the wild during autumn (Hwang and Garshelis 2007; Hwang et al. 2010). Extensive surveys during the present study were done only for two months, September and October 2010 (late monsoon and early autumn), and observations indicate high content of nut, acorns and berries in the faecal residues indicating a probable intake of highly nutritious food items leading to hibernation period. Reportedly, during 2010, there was a high production of wild fruits but such high production does not occur every year. In case of Senchal Wildlife Sanctuary where there are a large number of settlements around the park, such lean seasons can lead to regular conflict, at least in the years when the food production in the forest is less. Therefore, it is essential that suitable measures be put in place so that conflict situations can be minimised.

Here it might be emphasised that Asiatic black bear has emerged as the fifth most crop damaging and third most livestock damaging animal. The animals that rank higher than black bears include wild boar, barking deer, yellow throated marten and common leopard among others. A system of damage control developed for black bear would not only ensure that negative interactions between Asiatic black bear and humans are reduced, but would also ensure reduction in conflict situations caused due to invasion of other animals.

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Conclusion and Recommendations

The present study shows that Senchal Wildlife Sanctuary houses a healthy population of Asiatic black bears. It was also evident that the incidents of wildlife conflict were comparatively low. But considering that there are about 19 settlements within and in close proximity of the sanctuary, it cannot be denied that future interactions between the black bears can lead to fatal consequences, for both humans as well as for the black bears. Assessments did show that regular bear reports are there from at least 47% of the villages situated within the highly and moderately vulnerable zones and immediate steps need to be taken to put in place proper measures that would help minimise the negative interactions between humans and wildlife. Based on the outcomes of the present study, the following recommendations are put forward:

• The present survey did provide an insight into the probable status of Asiatic black bears at Senchal Wildlife Sanctuary. However, the samples derived out of research for analysis were very small and sustained research and monitoring should be performed to understand the status, population, behavioural patterns and ecology from time to time so that the bear management plan can be revised according to the requirement in future.

• Assessment of the conflict situations for the sanctuary suggested that the incidents of conflict associated with black bears are comparatively lower than other animals. However, with high density of bears in the sanctuary and with increasing number of human settlements, increase in frequency of conflicts in future cannot be ruled out. Therefore, it is necessary that a conflict management team is developed at the village level comprising Eco-Development Committee members, villagers and Forest Department officials who would keep a record of conflict incidents.

• This team would also help in building capacity of the villagers in developing a warning system and setting up crop protection systems at individual villages.

• The core team would also create a night vigil team at every village and train them in driving away the problem causing animals without causing harm to them.

• Indigenous techniques developed by villagers need to be studied and the most effective ones can be replicated. Various techniques like chilly bombs, bio-fencing and use of mechanised alarms, have proved very useful in driving away problem causing animals, including black bears. Such techniques can be used at Senchal WLS too, initially on an experimental basis and can be scaled up depending on their effectiveness.

Hiding place of an Asiatic black bear in Senchal WLS

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Annexures

Annexure I: List of the tree species recorded in Senchal Wildlife Sanctuary

Sl no.	Scientific name	Local name
1.	*Quercus spicata*	Arakula
2.	*Prunus napaulensis*	Arupatey
3.	*Quercus* sp.	Bantey katus
4.	*Aporosa dioica*	Barkaunli
5.	*Elaeocarpus* sp.	Bhadrasey
6.	*Magnolia champaca*	Champ
7.	*Schima wallichii*	Chilauney
8.	*Garuga gamblei*	Dabdabey
9.	*Echinocarpus* sp.	Gobrey
10.	*Syzigium cumini*	Jamun
11.	*Evodia fraxinifoila*	Khanakpa
12.	*Machilus odoratissima*	Lali kaulo
13.	*Nyssa javanica*	Lekh Chilauney
14.	*Ilex hookeri*	Lissi
15.	*Eriobotrya petiolata*	Maya
16.	*Michelia lanuginosa*	Phusrey champ
17.	*Brassaiopsis hispida*	Puta
18.	*Cinnamonum tamala*	Sinkoli
19.	*Michelia catcarthii*	Titey champ
20.	*Quercus lamellose*	Buk
21.	*Pentapanax leschenaultii*	Chindey
22.	*Machilus gammieana*	Chipley kaulo
23.	*Cryptomeria japonica*	Dhupi
24.	*Leucoseptum canum*	Ghurpis
25.	*Eurya japonica*	Jhinguni
26.	*Acer campbelli*	Kapasi
27.	*Castanopsis hystrix*	Katus
28.	*Machilus edulis*	Kaulo
29.	*Symplocos theifolia*	Kharaney
30.	*Symplocos* sp.	Kholmey
31.	*Glochidion thomsonii*	Lati kath
32.	*Engelhardtia spicata*	Mauwa
33.	*Michelia exelsa*	Mithey champ
34.	*Litsae polyantha*	Paheley
35.	*Photinia integrifolia*	Phalamey
36.	*Quercus lineate*	Phalant
37.	*Cinnamonum impressinervium*	Sissi
38.	*Endospermum chinensis*	Seti Kath
39.	*Tsuga brunoniana*	Tengrey salla
40.	*Macaranga* sp.	Malata
41.	*Quercus lanceaefolia*	Patle katus
42.	*Machilus sp.*	Patley kaulo
43.	*Meliosma sp.*	Patpatey
44	*Betula alnoides*	Saur
45	*Alnus nepalensis.*	Utish

Annexure II: List of shrub species recorded in Senchal Wildlife Sanctuary

Sl no	Scientific name	Local name
1.	*Calamus* sp.	Bet
2.	*Dichroa febrifuga*	Basak
3.	*Litsaea lancifolia*	Makkai kath
4.	*Acanogonum molle*	Thotney
5.	*Dhapney cannabina*	Lokote
6.	*Mahonia acantifolia*	Chutro
7.	*Rubus ellipticus*	Aiselu
8.	*Rubus lineatus*	Aiselu
9.	*Rubus moluccanus*	Bhotey pan
10.	*Smilax* sp.	Kukkur dainey
11.	*Viburnum erubescens*	Asarey
12.	*Astilbe rivularis*	Buro Okhati
13.	*Maesa chisia*	Bilaunae
14.	*Urtica parviflora*	Sisnu

Annexure III: Herb species recorded in Senchal Wildlife Sanctuary

Sl no	Scientific name	Local name
1.	*Polygonum runcinatum*	Rat naulo
2.	*Strobilanthus* sp.	
3.	*Begonia* sp.	Begonia
4.	*Cissus elongata*	Charcharey lahara
5.	*Cissus repanda*	Pani lahara
6.	*Elastostema obtusom*	Gogleto
7.	Fern	Unio
8.	*Carex* sp.	Harkata
9.	*Hydrocotyl javanica*	Dhungri jhar
10.	*Hypoestis triflora*	
11.	*Oplisminus* sp.	Bansu
12.	*Oxalis corniculata*	Chari amilo
13.	*Pilea* sp.	Chipley
14.	*Polygounm chinense*	Lahare Ratnyaula
15.	*Rubia manjit*	Majito
16.	*Selaginella* sp.	
17.	*Seteria plicata*	Dhoti sara
18.	*Viola* sp	
19.	*Anaphilis* sp.	Bukki Phool
20.	*Bidens pilosa*	Kuro jhar
21.	*Clemitis* sp.	Pinnasa lahara
22.	*Clinopodium umbrosa*	
23.	*Commelina* sp.	
24.	*Eupatorium adenophorum*	Banmara
25.	*Fragaria* sp.	Bhui aiselu
26.	*Lycopodium* sp.	Nagbeli
27.	*Ophiophogon* sp.	Nakima
28.	*Ophiorrhiza treutleri*	Chire
29.	*Pouzolzia hirta*	Chiple
30.	*Rubus calycinus*	Dhungri jhar
31.	*Stellaria* sp.	

Plates

1. Camera trap captures of Asiatic black bear (*Ursus thibetanus*)


11/03/2010 10:55 PM


11/23/2010 12:39 AM


10/05/2010 3:06 AM


10/05/2010 4:32 AM


11/26/2010 5:29 AM


11/06/2010 4:08 PM

2. Camera trap captures of other wildlife from Senchal Wildlife Sanctuary

(A) Assamese macaque
(*Macaca assamensis*)

(B) Barking deer, dark morph
(*Muntiacus muntjak***)**

(C) Himalayan palm civet
(*Paguma larvata***)**

(D) Leopard cat
(*Prionailurus bengalensis***)**

(E) Barking deer
(*Muntiacus muntjak***)**

(F) Wild boar
(*Sus scrofa***)**

(G) Large Indian civet
(*Viverra zibetha***)**

(H) Yellow throated marten
(*Martes flavigula***)**

(I) Common leopard
(*Panthera pardus***)**

(J) Himalayan crestless porcupine
(*Hystrix brachyura***)**

(K) Himalayan serow
(*Capricornis thar***)**

26,36,663 saplings

Over 2 million saplings of indigenous plant species planted to reinstate the degraded areas of Darjeeling Hills

3,73,445 trees

Shade trees planted in 30 different tea estates to provide ecological services such as retaining soil moisture, organic manure etc.

33 camera traps

Camera traps setup for a total of 986 trap nights to determine status of Asiatic black bear in Senchal Wildlife Sanctuary

+ 603 farmers

trained on modern bee-keeping to enhance their livelihood and to improve the environment of Darjeeling hills

+230 people

people trained in briquette making from 24 villages to reduce dependance on forests for fuelwood

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To stop the degradation of the planet,s' natural environment and to build a future in which humans live in harmony with nature

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