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Occurrence and feeding habit of Asiatic black bear (*Ursus thibetanus*) in Nanda Devi biosphere reserve, Uttarakhand, India

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Abstract

The Asiatic black bear (*Ursus thibetanus*) is one of the largest species found in the Greater Himalayan region and very few studies has conducted for investigation its status and feeding habits in the Himalaya. We assessed its occurrence along with altitudes and feeding habits in the Nanda Devi Biosphere Reserve (NDBR), Uttarakhand, India. We collected and analysed scats (n = 38), and based on scat analysis we identified 38 different types of food items, with maximum frequency of occurrence for *Zea mays* (50%) followed by *Ribes himalense*, *Malus pumila*, Honey Bees and Honey with similar frequency of occurrence (47.37%) and *Phaseolus vulgaris* (44.74%). We observed that maximum intake of food items by black bear from the Rosaceae family (41%) followed by the Poaceae family (14%). According to vegetation life form overall percentage of tree, shrub, herb and climber was 28.95%, 23.68%, 18.42% and 5.26% respectively and animal life form percentage of vertebrate, invertebrate and other was 10.53%, 5.26% and 7.89% respectively. We recorded four key types of bear signs (n = 192) from the NDBR; feeding signs (46.35%), claw/bite marks (24.48%), scats (19.79%) and direct sightings (9.38%). Maximum signs were encountered between 2501-3000 m altitude (38.02%) followed by between 3001-3500 m altitude (23.96%). Crop and livestock depredation shows the attraction of Asiatic black bear towards high risk human related food and this attraction is the key factor for human-black bear conflict in the reserve.

Keywords: Altitude, feeding, frequency, himalaya, NDBR, occurrence, vegetation

1. Introduction

Asiatic black bear (*Ursus thibetanus*) placed under carnivore but except Polar bear (*Ursus maritimus*) most bears are opportunistic omnivorous, they are mainly feeding on fleshy plant material rich in energy, insects, fish and mammals etc. It has distributed widely from southwest to East Asia, encompassing Iran, Afghanistan, Pakistan, Indo-China, India, Korea, Japan, Laos, Vietnam and Taiwan with an isolated population [16, 6, 5]. Its habitats ranging up to 4300 m altitudes, including both broadleaved and coniferous forest habitats [22, 6]. However, black bears are shifting their habitat and food habits seasonally [9, 6, 8].

Asiatic black bear have relatively heavy front quarters, short curved claws which are supportive for its frugivorous diet and physically adopted for arboreal feeding [15, 4]. Its mainly feeds on soft mast (*Prunus* spp., *Rubus* spp., *Machilus* spp. & *Ziziphus* spp.), hard mast (*Quercus* spp., *Pinus* spp., *Fagus* spp. & *Juglans* spp.), green vegetation, crops (maize & potato), fruits orchards (date palm, pear, banana, papaya & peach), mammals and insects [10, 7, 9, 8]. If we compare black bear with other carnivorous animals they have a comparatively longer but simple digesting system and they don't have well developed fermentation site such as rumen, caecum or elongated colon like the herbivores animals.

Asiatic black bear occurs in the Greater Himalayan region from 1200 to 3000 m elevation of India but sometimes it goes up to 4500 m altitude in search of food and shares its habitat with Brown Bear (*Ursus arctos isabellinus*) [21, 6]. Population of Asiatic black bear in Indian context is 5000-7000 [23]. Studies on its distribution and ecology have been carried out but information on its population status in throughout its range is scanty. Few studies on feeding have been done in Himalayan region, Northern India [24, 14, 19]. Some methods are useful to have information on feeding habit of bears like direct sighting and collection of indirect feeding signs like feeding platform, claw mark on the food tree, scat analysis and indigenous knowledge of forest dwelling people to record the feeding habit of bears [10, 22, 25]. Direct and indirect observation were recorded of gleaning in Kedarnath Wildlife Sanctuary,

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Uttarakhand, India by Himalayan black bear beneath large *Quercus semecarpifolia* trees with langurs feeding on acorns during the peak fruiting season [18].

Attractions of Asiatic black bear towards human habitation are due to shrinkage and degradation of its habitat and these attractions are leading to increase Asiatic black bear-human conflict [20]. Reported conflicts involve depredation on crops, orchards, apiculture farm, fishery farms and livestock, debarking of trees and mauling, killing and even consuming of humans. There are so many studies on American black bear (*Ursus americanus*), but only few studies has done for its close taxonomic relative Asiatic black bear.

Here we studied occurrence and feeding habits of Asiatic black bear in the Nanda Devi Biosphere Reserve to understand the dependency on forest and human settlement which are main cause for human-black bear conflict. Asiatic black bear were recorded mostly in human habitation in search of food.

2. Materials and Methods

2.1 Study area

The study has been conducted in the first Himalayan Biosphere Reserve of the world i.e. Nanda Devi Biosphere Reserve (NDBR). It lies between (30° 05'-31° 02'N Latitude, 79° 12'-80° 19'E Longitude) and spread over Chamoli district in the Garhwal region and Bageshwar and Pithoragarh districts in the Kumaun region of the Uttarakhand State (Fig.1). The NDBR with an area of 6020.43 km² is comprised of two core zones, both recognized as World Heritage Sites by UNESCO i.e. the Nanda Devi National Park (630 km²) and the Valley of Flowers National Park (87.5 km²); surrounded by a buffer and a transition zones. Being in the inner Himalayan region, it has a different microclimatic condition and the vast altitudinal range (1800-7817m) has given rise to a variety of climates ranging from temperate, sub-alpine and alpine. Human habitations are absent inside the core zones, but there are 47 villages in the buffer zone and 33 villages in the transition zone with six villages in the immediate buffer of the core zones. Human-wildlife conflict is a major issue in management of the natural resources of the area.

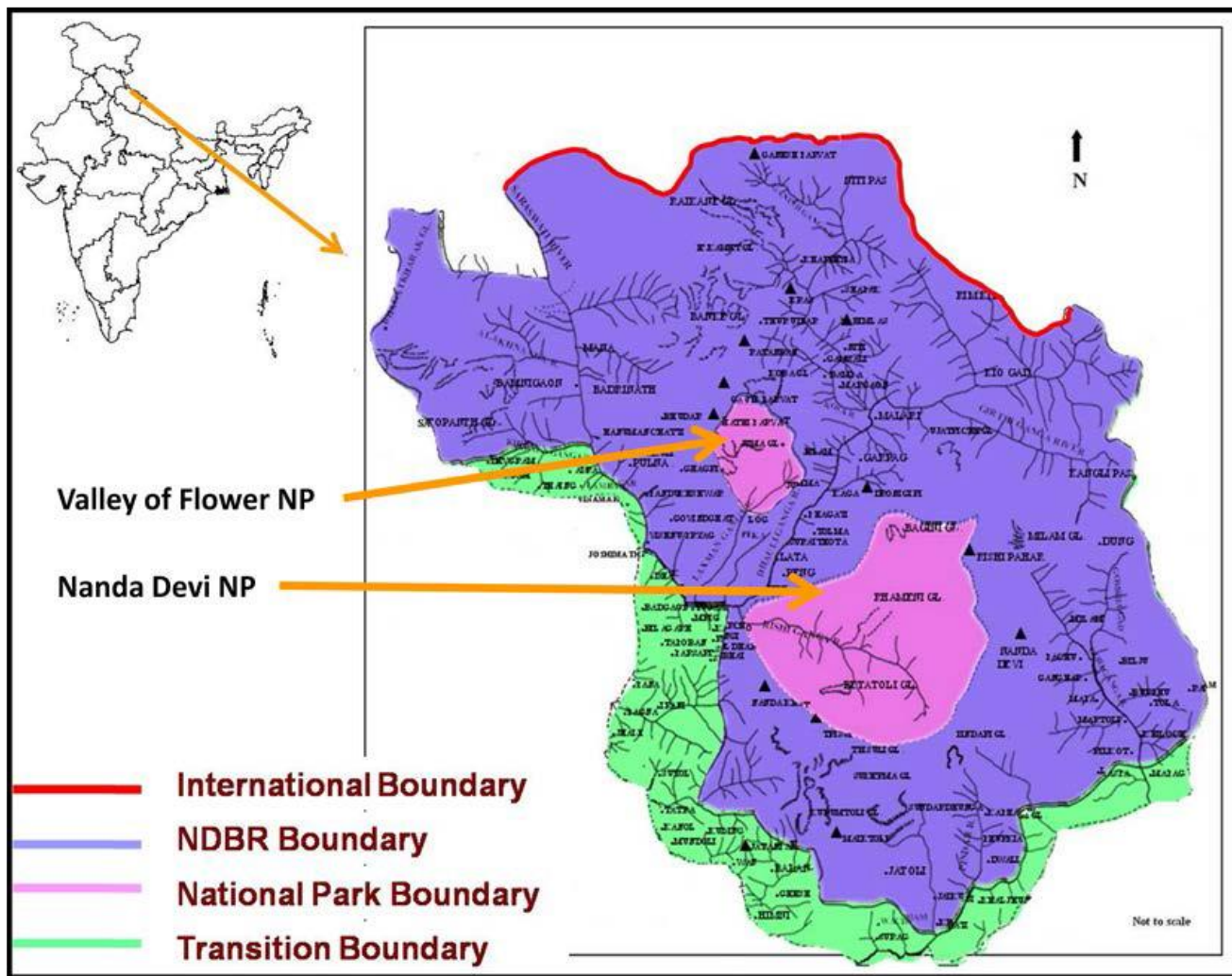


Fig 1: Map of study area (NDBR)

2.2 Methodology

We observed casual food and feeding habits of Asiatic black bear between since 2016-2018 in the NDBR. We trekked along trails at altitudes ranging from 1800 to >4000 m for direct sightings and indirect observations such as scats, feeding signs and collection information on black bear habitat

use tracks were also used. Data on food plants and feeding habit were also recorded during direct sightings. An inventory of black bear food items was prepared based on fresh feeding signs and remnants of undigested material identified in their scats. We opportunistically collected 38 scats from croplands, around riverine habitat and forests in the study areas with

equal effort for each elevation class. At the time of scat collection, we also collected available fruits and their seeds for the identification of fruits items in the scats, as described by Mealey [17]. We also recorded information provided to us by wildlife staff and villagers on black bear food habits and about local names, description, phenology and distribution of plants in the study area [10].

We kept scats in water soaked for overnight for easy separation of the items. We washed and cleaned the scats through normal running water from a series of metal sieves (0.5 mm, 1.0 mm and 2.0 mm mesh) and separated food items as animal, plant material and seeds from each scat [2]. Each food item present in each scat was identified to the lowest possible taxon [7, 8]. Seeds found in scats were identified with the help of seeds and fruit samples collected from the reserve [12]. We calculated the relative frequency of occurrence (FO%) for each item in the scats using the following formula [1]:

$$FOi \% = \frac{ni}{N} \times 100$$

Where, N is the total number of scats and ni is number of scats containing item 'i'

3. Results and Discussion

We recorded four prime types of bear signs (n = 192) from the NDBR; feeding signs (46.35%), claw/bite marks (24.48%), scats (19.79%) and direct sightings (9.38%). Indirect evidences like feeding signs, claw/bite marks and scats constituted (90.63%) were collected from the study area. We collected most of the signs by active searching from forest, riverine habitat, crop depredation sites and all possible sites of bear availability from the NDBR. We recorded altitudinal occurrence and maximum encounter of signs between 2501-3000 m altitudes (38.02%) followed by between 3001-3500 m altitudes (23.96%). Asiatic black bear most the signs were recorded between 2301-2700 m altitude (>40%) and between 2701-3100 m altitude (>25%) from Nepal [3]. Ali *et al.* also recorded most of the signs between 2500-3000 m altitudes, which were similar to our present study from NDBR [1]. Distributions of black bears home range can extent up to 4500 m altitude, depending upon availability of food resources in the area [6] (Fig. 2).

We categorized the food items found in scats into thirteen major groups: achene, berries, capsule, drupe, nut, pome, rosehip, other plants, crops, livestock, insects, others and unidentified items. Based on scat analysis we identified 38 different types of food items, with maximum frequency of occurrence (50%) for *Zea mays* followed by *Ribes himalense*, *Malus pumila*, Honey Bees and Honey with similar frequency of occurrence (47.37%) and *Phaseolus vulgaris* (44.74%). Similarly, Ali *et al.* reported 21 different types of food items in scats, with maximum frequency of occurrence (22.64%) for maize in the Kaghan valley, Pakistan [1]. Direct and indirect feeding observations were recorded of Himalayan black bear gleaned beneath large *Quercus semecarpifolia* trees with

langurs (*Semnopithecus schistaceus*) in Kedarnath Wildlife Sanctuary, Uttarakhand, India [18]. Overall composition of feeding habit of black bear maximum on fleshy fruits like berries (31.58%) than easily available food item from crops (15.79%), similar value calculated for nut and livestock (7.89%) which were rich in fat contents. Similarly, Yadav *et al.* black bear depredation on fat rich hump portion of cow and just before or after calf delivery was reported (Table 1 and fig. 3) [27]. Asiatic black bear reported that maximum food items from the plant originated food items (81.58%) which were much higher than the animal originated food items (18.42%) from the NDBR. We observed that maximum intake of food items by black bear from the Rosaceae family (41%) followed by the Poaceae family (14%). According to vegetation life form overall percentage of tree, shrub, herb and climber was 28.95%, 23.68%, 18.42% and 5.26% respectively and animal life form percentage of vertebrate, invertebrate and other was 10.53%, 5.26% and 7.89% respectively (Table 1 and Fig. 4 & 5).

Collection and analysis of scats of large carnivores is the most common method used to assess the feeding ecology [13]. Asiatic black bear foraging habit confirmed based on scat analysis as omnivorous in NDBR and agricultural crop depredation frequency was higher because availability of crop residues frequently in scats [1]. Attraction of black bear towards human resources was due to the anthropogenic pressure and habitat degradation in the reserve. Hibernation is the important phenomenon in black bear life but due to the behavioral changes they were not going into resting phase in winters and became aggressive in nature. According to Yadav *et al.* we also observed maximum activity of black bear during winter season, so that frequency of black bear conflicts as crop depredation, attacks on humans and livestock depredation was higher in winter season the NDBR [27]. When there is a scarcity of preferable food items in the forest black bears can survive on less-preferred or high risk food items such as human related food items and incidences of conflict with humans increases [4]. They prefer mostly hard mast but whenever it is limited in habitat they feed on have soft mast and green vegetation [10, 1]. Similar observations were recorded during present study of Asiatic black bear behavior of food preferences for survival. Black bear hunting or threatening for protection of crops, livestock and human safety, human encroachment on black bear habitat, human pressure, construction of road over black bear habitat, village & farmland expansion are the main threat to black bear in the NDBR. The main reason behind the crop or livestock depredation is lack of natural food resources in many parts of the India [26]. To reduce the conflict between human-black bear potential solutions are use of proper fencing, construction of night shelters for livestock, proper disposal of house waste material, restoration of natural food resources and educating villagers for black bear conservation in the NDBR.

Table 1. Identified food items in scats (n = 38) of Asiatic black bear and total measurements from NDBR

S.No.	Food items	Family	Life Form	Feeding Parts	Numbers	FO%
Achene						
1.	<i>Fragaria nubicola</i>	Rosaceae	Herb	Fruits	6	15.79
Berries						
2.	<i>Berberis asiatica</i>	Berberidaceae	Shrub	Fruits	7	18.42
3.	<i>Berberis lycium</i>	Berberidaceae	Shrub	Fruits	8	21.05

4.	<i>Cotoneaster garhwalensis</i>	Rosaceae	Shrub	Fruits	4	10.53
5.	<i>Cotoneaster rotundifolius</i>	Rosaceae	Shrub	Fruits	3	7.89
6.	<i>Prinsepia utilis</i>	Rosaceae	Shrub	Fruits	9	23.68
7.	<i>Prunus cornuta</i>	Rosaceae	Tree	Fruits	7	18.42
8.	<i>Pyracantha crenulata</i>	Rosaceae	Shrub	Fruits	11	28.95
9.	<i>Ribes himalense</i>	Grossulariaceae	Shrub	Fruits	18	47.37
10.	<i>Rubus pedunculatus</i>	Rosaceae	Shrub	Fruits	10	26.32
11.	<i>Sorbus foliolosa</i>	Rosaceae	Tree	Fruits	7	18.42
12.	<i>Morus alba</i>	Moraceae	Tree	Fruits	9	23.68
13.	<i>Morus serrata</i>	Moraceae	Tree	Fruits	8	21.05
Capsule						
14.	<i>Rhododendron arboreum</i>	Ericaceae	Tree	Flower & Leaves	8	21.05
Drupe						
15.	<i>Prunus armeniaca</i>	Rosaceae	Tree	Fruits	11	28.95
Nut						
16.	<i>Juglans regia</i>	Juglandaceae	Tree	Fruits	14	36.84
17.	<i>Quercus floribunda</i>	Fagaceae	Tree	Acorn	8	21.05
18.	<i>Quercus leucotrichophora</i>	Fagaceae	Tree	Acorn & Leaves	13	34.21
Pome						
19.	<i>Malus pumila</i>	Rosaceae	Tree	Fruits	18	47.37
20.	<i>Pyrus pashia</i>	Rosaceae	Tree	Fruits	11	28.95
Rosehip						
21.	Rosa spp.	Rosaceae	Shrub	Fruits	12	31.58
Other Plants						
22.	<i>Arundinaria falcata</i>	Poaceae	Herb	Leaves & Stem	7	18.42
23.	<i>Thamnochalamus spathiflorus</i>	Poaceae	Herb	Leaves & Stem	8	21.05
Crops						
24.	<i>Amaranthus sp.</i>	Amaranthaceae	Herb	Fruits	4	10.53
25.	<i>Eleusine coracana</i>	Poaceae	Herb	Fruits	8	21.05
26.	<i>Zea mays</i>	Poaceae	Herb	Seeds	19	50.00
27.	<i>Cucurbita maxima</i>	Cucurbitaceae	Climber	Fruits	4	10.53
28.	<i>Cucumis sativus</i>	Cucurbitaceae	Climber	Fruits	6	15.79
29.	<i>Phaseolus vulgaris</i>	Fabaceae	Herb	Fruits/Legume	17	44.74
Livestock						
30.	Domestic Sheep			Flesh	4	10.53
31.	Domestic Cow			Flesh	8	21.05
32.	Domestic Buffalo			Flesh	2	5.26
Insects						
33.	Black Ants, Hymenoptera			All parts	16	42.11
34.	Honey Bees, Hymenoptera			All parts	18	47.37
Others						
35.	Honey				18	47.37
36.	Bones				8	21.05
Unidentified Items						
37.	A				7	18.42
38.	B				5	13.16

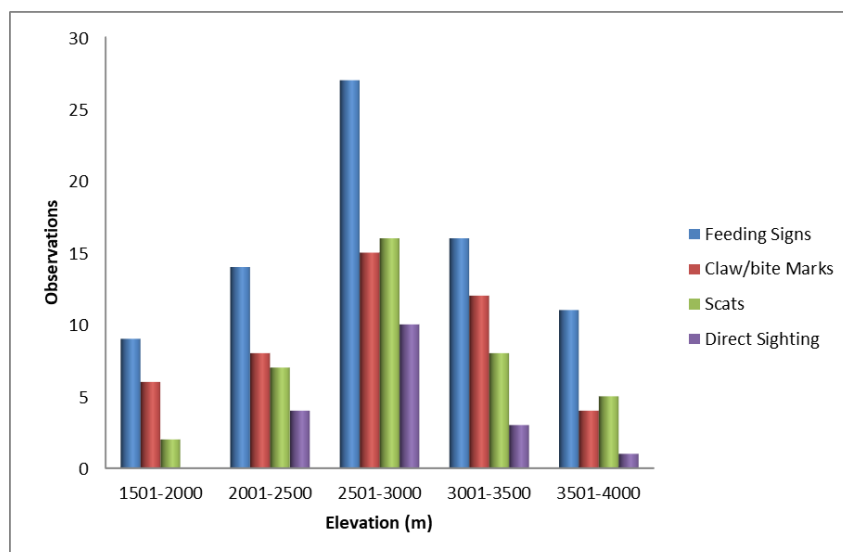


Fig 2: Occurrence along altitudes of Asiatic black bear recorded from NDBR

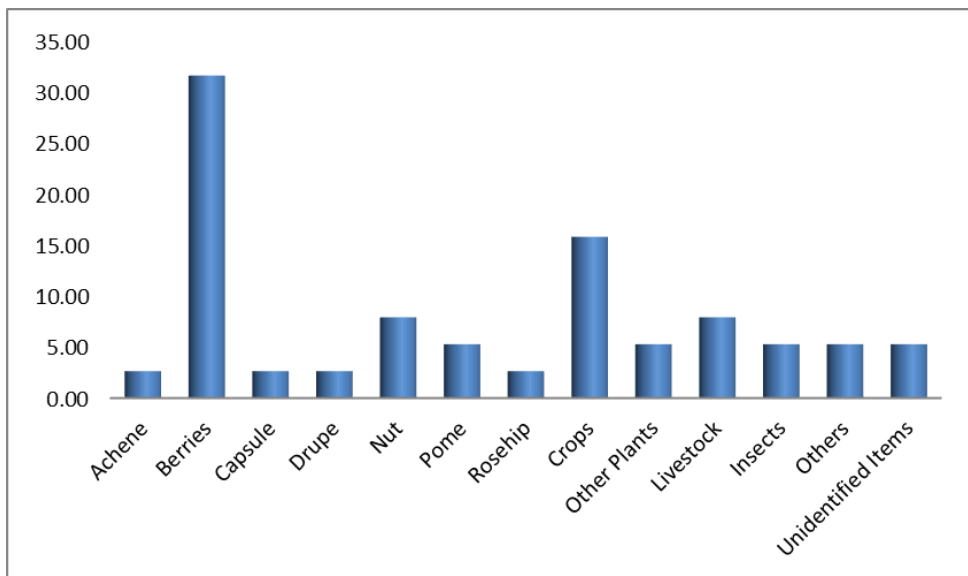


Fig 3: Available food sources for Asiatic black bear in NDBR

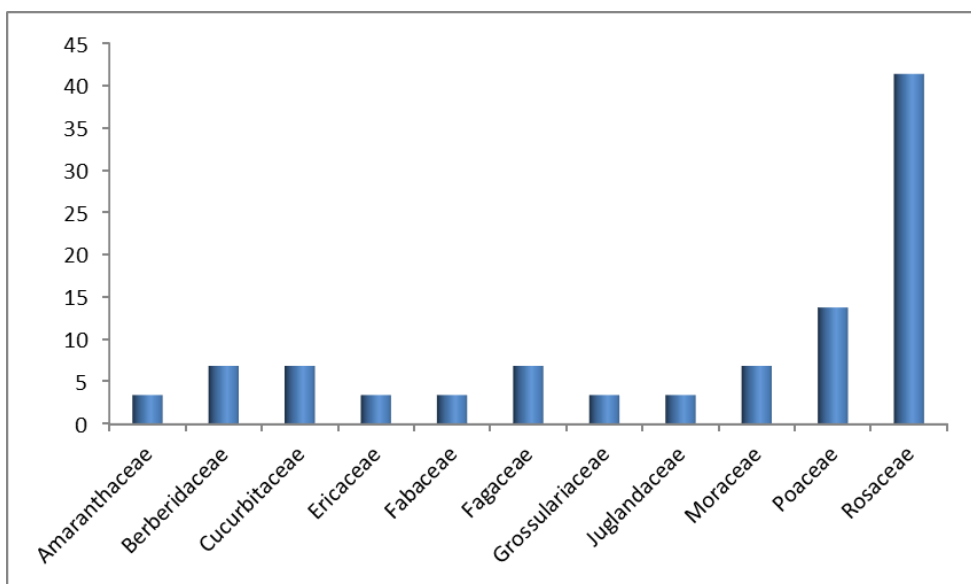


Fig 4: Plants family preferred by Asiatic black bear for food in NDBR

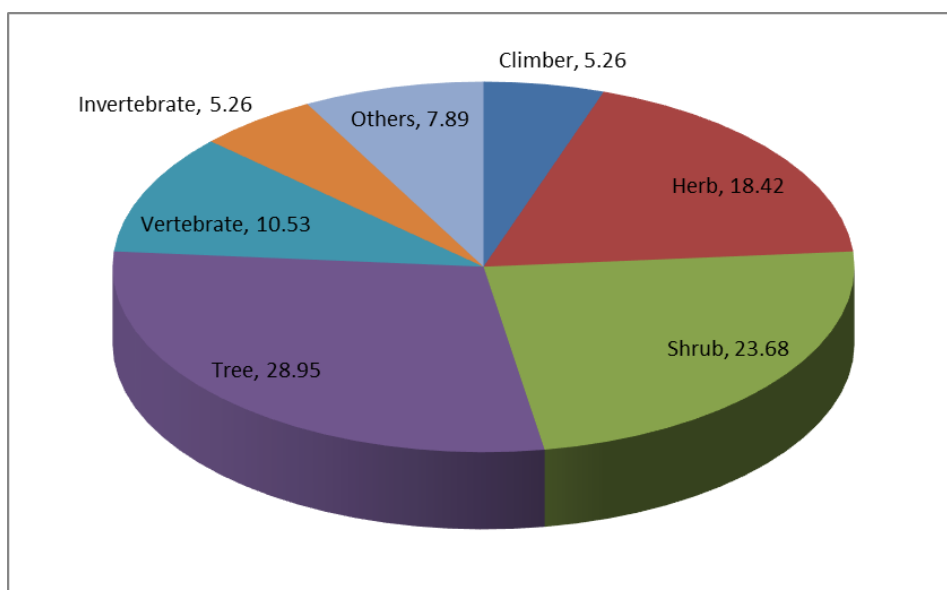


Fig 5: Floral and faunal life form used as food by Asiatic black bear in NDBR



Fig 6: Asiatic black bear identified feeding behaviour in NDBR, Uttarakhand, India :- (a) Black bear depredation on *Zea mays*; (b) Black bear depredation on Pumpkin; (c) *Malus pumila*; (d) *Prunus armeniaca*; (e) *Juglans regia*; (f) Black bear attacked on hump of the cow; (g) Asiatic black bear damaged honeycomb for honey; (h) *Berberis asiatica*; (i) Asiatic black bear of NDBR; (j) Scat of Asiatic black bear; (k) Collection of Asiatic black bear scat

4. Conclusion

The present study was carried out to know the occurrence along altitudes and feeding habit of Asiatic black bear in the NDBR. According to our present finding we found 38 different food items from 38 scats collected from the study area. We noticed maximum activity of black bear during the winter season and crop depredation was high in rainy and winter season. To know the occurrence we collected direct

and indirect signs along the altitudinal gradient from 1800 - >4000 m. We found that most of the signs encountered between 2500-3000 m altitudes, it might be availability of preferable food material.

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