Asiatic black bear–human interactions around Dachigam National Park, Kashmir, India

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Abstract: We assessed patterns of Asiatic black bear (*Ursus thibetanus*)–human interactions in the peripheral areas of the Dachigam landscape (~1,000 km^2) that encompass Dachigam National Park, Over-Aru Wildlife Sanctuary, and 8 conservation reserves, in Kashmir, India, based on semi-structured interviews with villagers living near the protected areas during 2007–09. We recorded considerable overlap in resource use by bears and humans in this landscape: 72% of villagers interviewed (n = 227) claimed that they depended on forest resources in bear habitats, and 85% reported crop depredation by black bears. The 3 types of bear–human interactions recorded in Dachigam landscape were crop depredation, bear attacks on humans, and livestock depredation. Of these, crop damage (85%) was most common, which occurred during May–December and peaked in summer (Jun–Sep), when bears were active and crop production was at its highest. We recorded 19 cases of attacks on humans; all occurred during May–November with the maximum cases at crepuscular times (59%), in crop fields (63%), and in summer (52%). Livestock depredations were less common than other categories of bear–human interactions; 7 cases were recorded, mostly during winter. Based on our observations, we suggest strengthening indigenous crop protection methods, improving livestock night shelters, and monitoring high conflict areas by strengthened management teams. These measures have improved management of problem bears and have led to gains in local community support for bear conservation in other areas with black bear–human interactions.

Key words: Asiatic black bear, bear attacks, crop depredation, Dachigam, Himalaya, Kashmir, livestock depredation, *Ursus thibetanus*

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Interactions between Asiatic black bears (*Ursus thibetanus*) and humans span a diverse array of geographic and human demographic contexts. Bears typically compete directly with humans for space, food, security, and cover. Anthropogenic food has been documented as the major attractant of bears leading to bear–human interactions throughout their range (Garshelis 1989, Huygens and Hayashi 1999, Herrero and Higgins 2001, Bargali et al. 2005, Fredriksson 2005, Smith et al. 2005, Mordo et al. 2008,Yadav et al. 2009). Asiatic black bear–human interactions occur in the Indian Himalayas and throughout the bear's range (Stubblefield and Shrestha 2007, Honda et al. 2009). Asiatic black bears are known to damage agriculture and horticultural crops, apiaries, fish farms, livestock, and humans (Hazumi 1994, Huygens and Hayashi 1999, Chauhan 2003).

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Asiatic black bear–human interactions have been reported in the Himalayan landscape in the past (Prater 1980), but the intensity of such reports have increased in recent years (Sathyakumar and Choudhury 2007). Increased interaction may be due to changes in land use patterns, such as expansion of agricultural and horticultural lands and encroachment on or disturbance of bear habitats, as well as increased development activities and a rising human population around bear habitats (Sathyakumar 2001, Sathyakumar and Choudhury 2007).

The Himalayan region and the hills of northeast India cover approximately 591,800 km^2 (18% of India) and probably holds one of the largest populations of black bears in Asia (Sathyakumar 2001, Sathyakumar and Choudhury 2007). In the Indian Himalaya, the best known populations of Asiatic black bears are reported from Jammu and Kashmir. Although no rigorous population esti-

mates exist, Dachigam National Park and its adjoining protected areas are reported to hold a number of Asiatic black bears (Sathyakumar 2001). During periods of high fruit abundance in lower Dachigam, a high density of black bears (1.3–1.8 bear/km^2) has been reported (Saberwal 1989).

Such high densities of black bears pose a serious management challenge. The presence of agricultural fields and human habitations in and around Dachigam landscape creates food attractants. Crop depredation and attacks on humans have become more prevalent in the forest–village interface. Black bears are known to prey on livestock, leading to economic losses to local communities (Hazumi 1994, Chauhan 2003). These incidents have generated a strong backlash from local people. Their frustration is evident in reports by local electronic and print media.

Local people have responded by retaliatory killing of bears. Some of the indigenous methods used to reduce crop and livestock depredations in this landscape include drumming empty metal containers, use of guard dogs, barbed wire fencing, and scarecrows (Charoo et al. 2009). A few short investigations on Asiatic black bear ecology and conservation status have been carried out in India (Schaller 1969; Manjrekar 1989; Saberwal 1989; Sathyakumar 1999, 2001; Chauhan 2003; Johnsingh 2003; Sathyakumar and Viswanath 2003; Sathyakumar and Choudhury 2007). The need for research on black bears in India has been emphasized by Sathyakumar (2001) and Sathyakumar and Choudhury (2007). A rapid assessment of the bear–human conflicts in the Kashmir region based on the records of Department of Wildlife Protection, Jammu and Kashmir, was carried out by Choudhury et al. (2008), who presented the spatial distribution of conflicts, and using GIS, correlated them with variables such as land cover. Their study reported an increase in bear–human interactions through the last decade. In this paper, we present patterns of black bear–human interactions in Dachigam landscape based on semi-structured interviews carried out with families living on the periphery of Dachigam National Park, as well as some field investigations during 2007–09.

Study area

The Kashmir Valley is an oval plain within a surrounding chain of mountains ranging from 2,700 m in the south to 5,000 m in the north. The Valley has forests, orchards, croplands, and human habitations. Vegetation is classified as Himalayan moist temperate forest (Champion and Seth 1968): west Himalayan upper broad-leaved conifer mixed forests at lower elevations is replaced by the west Himalayan sub-alpine birch forests above 3,000 m. The study was carried out in the peripheral areas of Dachigam landscape (~1,000 km^2) that encompasses Dachigam National Park, Over-Aru Wildlife Sanctuary, and 8 conservation reserves (i.e., Dara, Brein, Nishat, Khonmoh, Khrew, Khahgund, Shikargah, Khiram; Fig. 1). All these protected areas and reserved forests (i.e., protected by the Constitution) are contiguous, but in most places have human habitations and croplands adjoining them. The Kashmir valley experiences 4 distinct seasons: winter (Dec–Feb), spring (Mar–May), summer (Jun–Aug), and autumn (Sep–Nov). The average rainfall is about 664–700 mm and the average temperature is around 24°C in summer and −5°C in winter. The climate is sub-Mediterranean with bixeric regime having 2 spells of dryness in June and September–November (Singh and Kachroo 1978).

The human population in Jammu and Kashmir has increased over the last 100 years, and grew ~24–30% during 1961–91 to an estimated 10,069,917 in 2001. In rural areas of Srinagar, Budgam, and Anantnag districts encompassing the study area, human populations were 256,281, 558,721, and 10,004,241 respectively (Planning Commission of India 2008). The consequences of this population increase were decreases in forest cover and habitat degradation. The official estimate of forest encroachment in Jammu and Kashmir (as of Dec 2007) was 14,375 ha (http://www.indiastat.com). The livelihoods of the majority of villagers living near the protected areas mainly depended on agriculture. Two main communities living in the study area were *Kashmiris* and *Gujjars*. These communities were mainly dependent on horticulture for their subsistence. The *Gujjar* community was the only tribal community in the area, and their socio-economic condition was poor (Planning Commission of India 2008). They raised cows, goats, and sheep to supplement their income, and were also involved in firewood and herb collection in reserved forests and protected areas. Prior to our work, no surveys had been conducted to asses the socio-economic condition of the rural communities in Dachigam landscape.

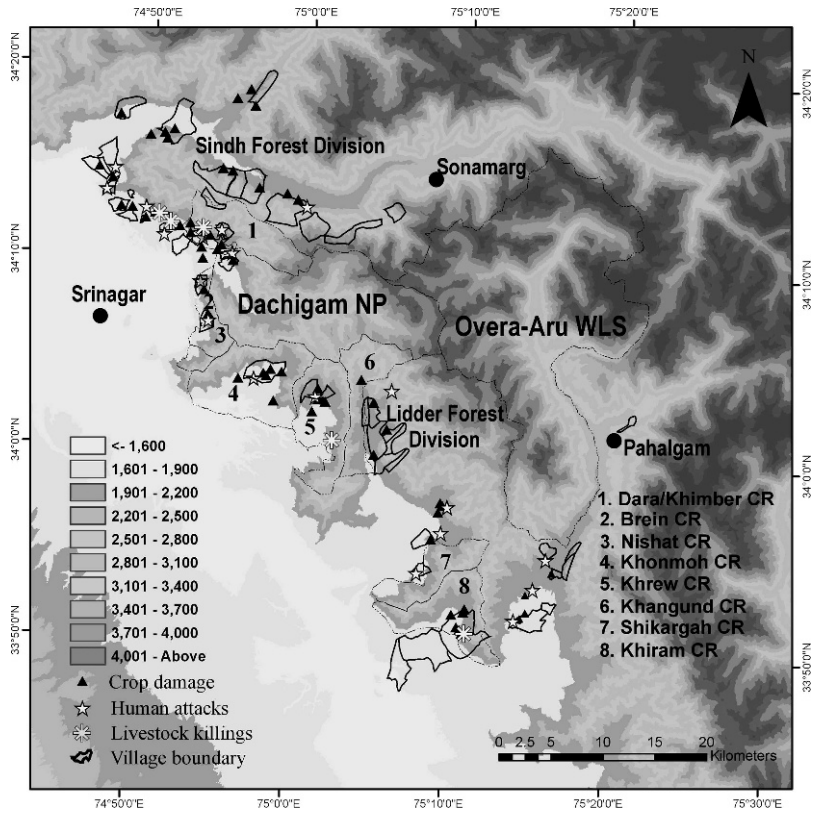

Fig. 1. Map of the Dachigam landscape in Kashmir, India, with locations of Asiatic black bear–human interaction and human habitations (NP–National Park; WLS–Wildlife Sanctuary; CR–Conservation Reserve).

Methods

During May 2007–April 2009, we conducted semi-structured interviews (S. Sathyakumar, 2003; Brown bear–human conflicts in Zanskar and Suru Valleys, Ladakh; Wildlife Institute of India, Dehradun, India) in the villages located at the periphery of Dachigam landscape. Interviews were mostly interaction based; however, the information was recorded in the pre-designed formats.

We considered only bear–human interactions that occurred between May 2007 and April 2009. In each village, a stratified sample of households was selected by compiling census data of village households and by adopting participatory rural appraisal (PRA) techniques (Richards et al. 1999). Based on economic status, the government of India has classified households into 2 groups: below poverty line (BPL) families have annual incomes <20,000 Indian rupees (INR; as of June 2011, approximately US$440) and above poverty line (APL) families have annual incomes >20,000 INR (Planning Commission of India 2008). In villages adjoining Dachigam landscape, families were categorized as either APL or BPL, and they were generally equal in proportions. Because we sampled only 5 families (households) in each village, we selected 3 from whichever group exceeded 50% of the population in that village.

We collected information on black bear encounters (number, place, and time), cropping pattern, crop damage, livestock depredation, attacks on humans, protection measures, and forest dependency (fuel wood/fodder collection and livestock grazing) from each family interviewed. We conducted field investigations ($n = 87$) on crop depredations, attacks on humans, and livestock depredations.

We categorized bear–human interactions as (1) crop damage, (2) attacks on humans, or (3) livestock depredation. We recorded data on crop damage (crop type, part eaten, month), GPS location, elevation, and approximate distance from the nearest bear habitat. For bear attacks on humans, we recorded month, time, and location as reported by the victim, family members of the victim, or a witness. The location of

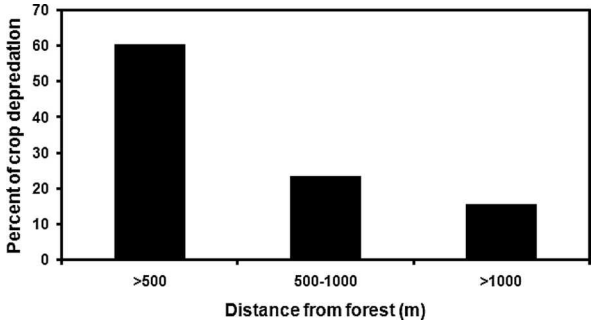

Fig. 2. Asiatic black bear crop depredation–human interactions by distance from forest around Dachigam landscape, India, as reported by respondents to a survey ($n = 227$), May 2007–Apr 2009.

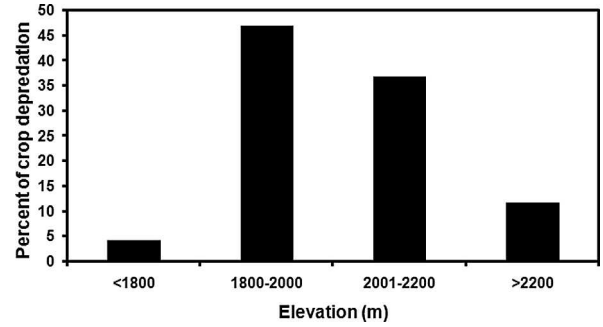

Fig. 3. Asiatic black bear crop depredation–human interactions at different altitudinal zones around Dachigam landscape, India, as reported by respondents to a survey ($n = 227$), May 2007–Apr 2009.

the bear attack, altitude, and distance from the nearest forest was recorded by visiting the site of encounter. For livestock depredation cases, the location, time, and month were recorded. To understand the spatial distribution of bear–human interactions, we plotted the locations of all types of interactions using Arc GIS 9.3 (ESRI 2006).

Results

We interviewed 227 respondents in the Dachigam landscape. Bear–human interactions were more frequent in the northern region of Dachigam landscape than elsewhere. About 72% of respondents reported that they were dependent on forest products, and about 56% were below poverty line. Bear–human interactions were most intense close to bear habitats (Fig. 2) and in the elevational range of 1800–2200 m (Fig. 3). Interactions occurred from May to December (Fig. 4). We plotted the 3 types of human–black bear interactions (i.e., crop depredation, bear attacks on humans, and livestock depredation) on a map of Dachigam landscape (Fig. 1).

Crop patterns and damage

Crop production in the Dachigam landscape occurred from May to December, with peak production of crops and fruits during summer (i.e., production of cherry: May–Jul; maize: Aug–Oct; apple: Oct–Dec). The most common type of bear–human conflict recorded was crop depredation. About 85% of villagers interviewed reported crop depredation by black bears. Areas closer to bear habitats were more prone to raiding than those further away. Crop damage varied temporally (Fig. 4). Summer had the largest number of crop damage cases (87%) followed by autumn (9%) and winter (4%). A small proportion of crop depredations (12%) occurred in June and July (coinciding with cherry production). The majority of the crop depredations (70%) occurred in August and September (coinciding with the production of maize and apple). During October and November, there were fewer cases (9%) and the instances of crop depredation declined as autumn progressed, with only 3% of cases reported in December (winter).

The proportion of villagers who took actions to prevent problem interactions with bears varied by type of action. Drumming on empty metal containers was the most commonly used protection measure (practiced by 74% of respondents), followed by use of barbed wire fencing (17%), scarecrows (29%), guard dogs (7%), and building an animal-proof wall (4.8%).

Attacks on humans

We recorded 19 attacks on humans. Most were on people working in crop fields ($n = 13$) or forests ($n = 4$). Two attacks occurred in villages. Bear attacks occurred during May to November. Most (61%) occurred in summer, followed by autumn (22%), spring (8%), and winter (9%). Over 60% of the attacks occurred during early mornings or late evenings, 25% during the day, and 15% at night.

Livestock depredation

We recorded 28 livestock killed by black bears during 2007–09 in 7 incidents. Of these, 19 were killed at night in cattle sheds or night shelters and 3 were killed while in the forest. Livestock depredation

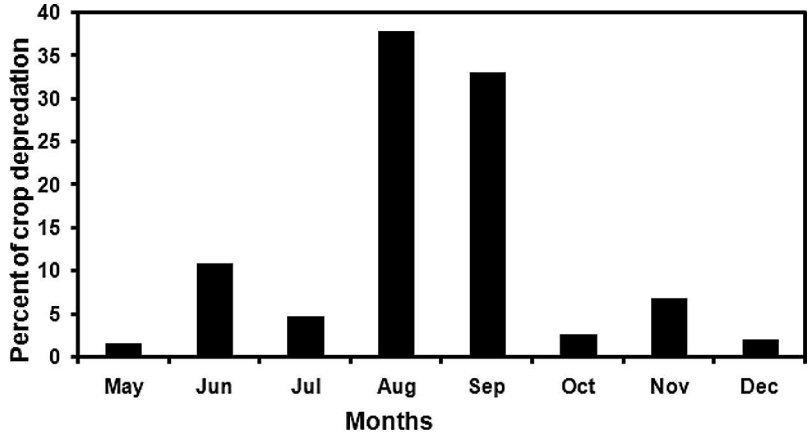

Fig. 4. Asiatic black bear crop depredation–human interactions in different months around Dachigam landscape, India, as reported by respondents to a survey ($n = 227$), May 2007–Apr 2009.

by black bear in cattle sheds or night shelters has also been reported from Nepal (Yadav et al. 2009). Most livestock killings ($n = 21$) occurred in winter. Of the 21 livestock killed in winter, 11 were killed by a black bear in a single incident.

Discussion

Black bear–human interactions have been reported to be increasing in the recent past in Kashmir. Choudhury et al. (2008) also indicated the same pattern, and recognized Dachigam landscape as a high conflict zone. As in other parts of the Kashmir Valley, in Dachigam landscape the expansion of habitation toward the forest fringes has increased the frequency of encounters between humans and bears. High levels of interactions between American black bears (*Ursus americanus*) and humans have been reported at the interface of wild and developed areas in the USA (Beckmann and Berger 2003), and humans are expected to be at more risk for problem interactions with Asiatic black bears under such circumstances (Honda et al. 2009). Human development at the edges of suburban landscapes makes those areas more prone to bear–human conflicts (Mordo et al. 2008). Fragmented habitats with adjacent human habitations and croplands or orchards increase the close interactions between humans and bears (Bargali et al. 2005).

The active sharing of resources between humans and bears that we documented in Dachigam is leading to close human–bear interactions. Attraction for food resources has been claimed to be the primary reason for bear–human interactions (Bargali et al. 2005, Honda et al. 2009). Croplands adjacent to forested areas unintentionally attract bears with high quality food. Crop raiding by black bears in this landscape has been documented in earlier studies (Prater 1980, Chakraborty 1983). In our study, crop damage was reported to be the most common type of bear–human interaction. Almost all agricultural lands and orchards at the fringes of Dachigam landscape were raided by black bears. The recent changes in agricultural practices from low crops to orchards adjacent to these high density bear habitats (Choudhury et al. 2008) compounded the problem of crop depredation, leading to high economic losses for farmers. Crop damage peaked in summer.

Attacks on humans are a secondary effect of attraction of bears for human food. The intensive periods of bear–human interaction corresponds to the periods of increased human activity: most crop cultivation occurred between May–December, and increases human movement in summer and autumn probably made humans vulnerable to bear attacks. During interviews, local people claimed that bears were more active in croplands during early morning and late evening, resulting in more casualties during these hours. Attacks on humans by bears are the most serious concern of all the types of bear–human interactions.

Black bears are known to depredate livestock (Chauhan 2003, Yadav 2009) in cattle sheds or during grazing. Economic losses in the form of livestock depredation or crop damage results in retaliatory killing of bears and therefore has serious implications for bear conservation.

Management recommendations

Incident response

A fully equipped, well trained and motivated conflict management team comprised of wildlife staff, veterinarians, and staff of related departments or institutions and wildlife non-governmental organizations (NGOs) has been formed at the Wildlife Division Level to respond to conflict situations, including bear rescue, treatment (if required), translocation, and monitoring. Efficient and effective response to complaints is now more feasible because rapid communication is possible to and from the interaction site, among members of the conflict management team, and when duties are shared among team members. However, one team for a Division may not be sufficient because the area is large and >1 incident at the same time may occur. Therefore, we suggest that a few individuals of every village or block be trained in responding to such situations, in controlling resident behavior toward bears in crop fields or in villages until the management team arrives at the site.

Monitoring

Documenting spatial and temporal patterns of black bear–human interactions across the Kashmir Valley will be extremely important to understand underlying causes and to plan a strategy for mitigating bear–human conflict in the region. For instance, in Alaska, USA, a database containing a century (1901–2000) of bear–human conflicts has been maintained (Smith and Herrero 2008), facilitating proposal and implementation of analyses, management actions, and awareness education. It is extremely important for the Department of Wildlife Protection, Jammu and Kashmir, to develop and maintain a database on conflicts using GIS. Such a database is necessary to distinguish causes and symptoms of bear–human interactions.

Resident behavior

Elected bodies at the village and block levels, religious and educational establishments, and other government or non-governmental agencies already deliver some messages about ways to reduce negative interactions with bears in the Kashmir Valley. Those practices should be continued. Findings from this study suggest that bear attacks on people might be reduced through education campaigns that make local residents aware that they are especially vulnerable to bear attacks when alone during early morning and late evening in farm lands and forests during summer and autumn; that they can reduce the risk of a bear attack by providing safe passage or escape routes to bears they encounter; and that they should never attempt to scare off a bear when alone.

Because most livestock depredations occurred at night shelters within villages, we emphasize the necessity of strengthening doors, windows, and other vulnerable portions of these shelters to reduce loss due to predation by black bears as well as leopards (*Panthera pardus*). Some villagers who adopted our suggestion to replace wooden doors of livestock night shelters with metal doors succeeded in preventing livestock losses to black bears and leopards. Also, use of guard dogs (Green and Woodruff 1989, Andelt and Hopper 2000, Smith et al. 2005) and supervised livestock grazing has been recommended to reduce livestock depredations (Chauhan 2003, Sathyakumar 2003 unpublished report) when livestock are grazed in bear habitats.

We suggest a village-level cooperative effort for guarding crop fields and orchards on a rotational basis using the effective means of scaring bears such as drumming empty metal containers. Proper lighting in the corners or boundaries of crop fields and orchards, particularly the vulnerable points lying close to forest fringes, may be another option to reduce crop depredation, as we observed in a few cases during the survey. Traditional deterrent methods already in practice may be helpful when used in combination. The traditional method of burning red chilies mixed in cow dung practiced in Uttarakhand State was used experimentally in many orchards of the villages at the periphery of Dachigam National Park. This traditional method was found to be effective in preventing bears from entering fields and therefore recommended for use by local villagers.

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