

Contents lists available at ScienceDirect

Global Ecology and Conservation

journal homepage: www.elsevier.com/locate/gecco

Original research article

Assessing patterns of human–Asiatic black bear interaction in and around Wangchuck Centennial National Park, Bhutan

Yonten Jamtsho^a, Sangay Wangchuk^{b,*}^a Wangchuck Centennial National Park, Bumthang, Bhutan^b Ugyen Wangchuck Institute for Conservation and Environment Bumthang, Bhutan

ARTICLE INFO

Article history:

Received 26 July 2016

Received in revised form 12 September 2016

Accepted 12 September 2016

Available online 2 October 2016

Keywords:

Protected areas

Bhutan

Asiatic black bear

Human–bear interaction

ABSTRACT

Bhutan has 2 of the 8 species of bears recorded in the world: Asiatic black bear and Sloth bear. Asiatic black bear is listed in Appendix I of the CITES and categorized as vulnerable in IUCN Red List. Asiatic black bear is increasingly becoming nuisance to people by attacking crops, livestock and even humans, threatening its own existence as a result of retaliation. With the need to understand the interactions between the communities living within the Wangchuck Centennial National Park (WCNP) and the Asiatic black bears, 620 households in and around WCNP were interviewed in 2010. Between 1960 and 2010, Asiatic black bears mauled 40 people in and around WCNP and four district hospitals within which WCNP operates recorded 19 cases of humans mauled by bear from 2013 to 2015. Majority (45% and 43% of respondents) reported the crop and livestock depredation during summer and autumn season respectively and 75% of the respondents reported sighting bear in 2010. About 52% of respondents believed that killing of bears could reduce the conflict, which may be a potential threat to the bear, though stringent conservation rules of the country restricts killing it. Community outreach programs like creating awareness on importance of bear and its habitat conservation may be pursued to help reduce the conflict. Integrated conservation measures such as providing electric fences may be initiated to help garner support for conservation. This may ensure the survival of Asiatic black bear, and also reduce the significant economic losses to inhabitants in and around WCNP.

© 2016 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Out of the total 8 species of bears recorded in the world, six of them are known to occur in Asia (Bargali, 2012) and in Bhutan two species of bears are recorded; Asiatic black bear (*Ursus thibetanus*) and Sloth bear (*Melursus ursinus*) (Wangchuk et al., 2004). Asiatic black bear has a restricted global distribution range; from Bhutan through Kashmir and Sikkim in India to Pakistan (Abbas et al., 2015; Roberts, 1997) and Afghanistan to Baluchistan province of Iran, China, Korea, and Japan with isolated population in Taiwan (Cowan, 1972; Sathyakumar and Choudhury, 2007). Asiatic black bear is listed as a Schedule I species in the Forest and Nature Conservation Act of Bhutan 1995 (RGoB, 1995); listed in Appendix I of the CITES; and as Vulnerable in IUCN Red List of Threatened Species. According to the Forest and Nature Conservation Rules of Bhutan 2006, totally protected species in Bhutan are categorized as Schedule I species (RGoB, 2006).

Among the carnivores in Asia, the Asiatic black bear is also reported to involve in conflicts with rural people of Bhutan (DoFPS, 2011; Sangay and Vernes, 2008), China (Liu et al., 2011a), India (Chauhan, 2003), Nepal (Stubblefield and Shrestha, 2007) and Pakistan (Abbas et al., 2015). Conflicts between humans and bears generally include damage to agricultural and

* Corresponding author.

E-mail address: swangchuk@uwice.gov.bt (S. Wangchuk).

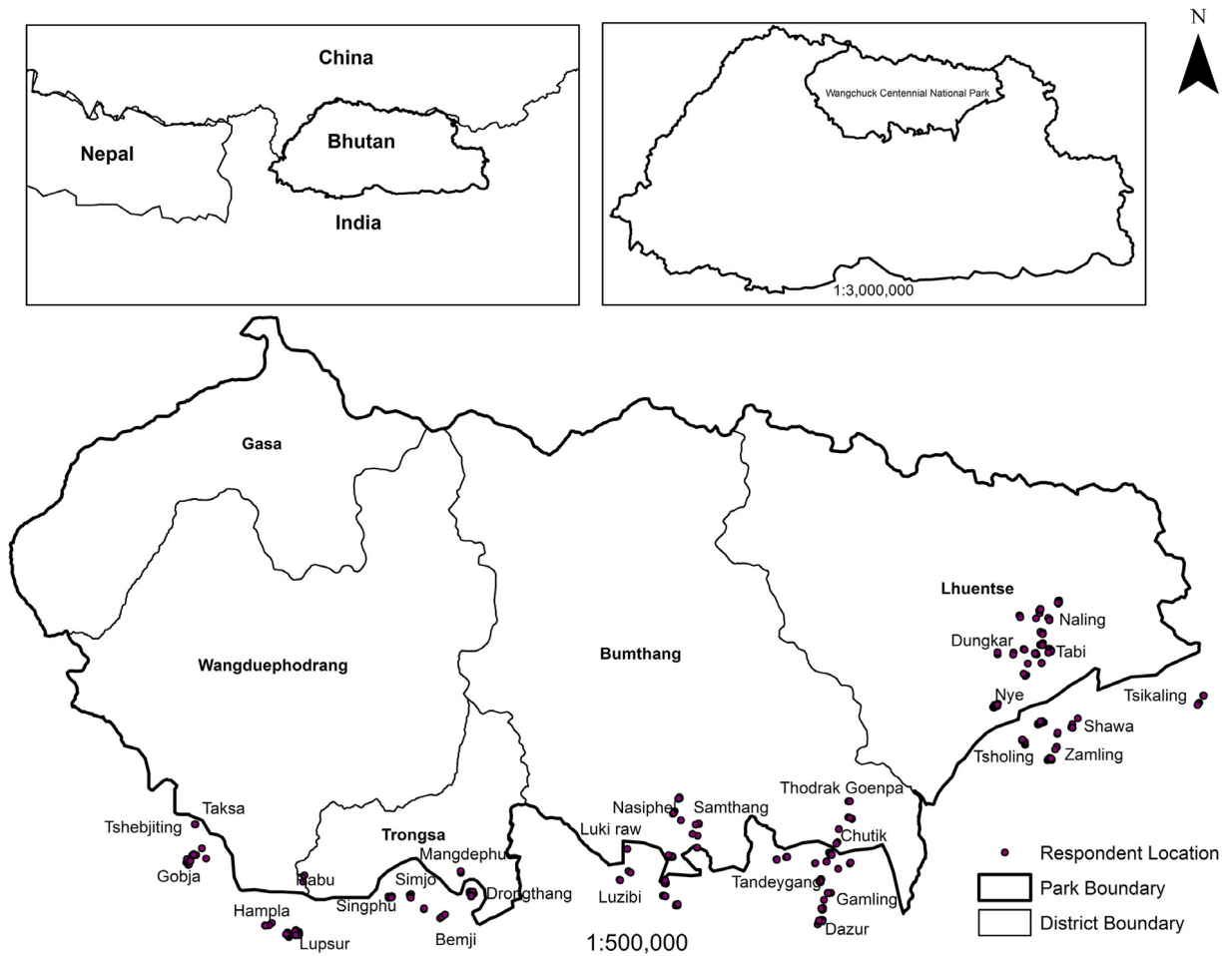


Fig. 1. Study site.

horticultural crops, apiaries, fish farms, livestock, and even humans (Charoo et al., 2011; Liu et al., 2011b; Sangay and Vernes, 2008) throughout the bear range countries. Fear of bears raiding agricultural fields and livestock barns has become a constant problem for rural farmer throughout the Himalayas and results in men, women and even children guarding their farm fields and barns both days and nights (Abbas et al., 2015; NCD, 2008), even to the extent of building watch-towers in farm fields to stay overnight (Liu et al., 2011b; Sillero-Zubiri et al., 2007).

Bears are often killed by people for gall bladder and paws (Charoo et al., 2011; Graham et al., 2005; Liu et al., 2011a; Sathyakumar and Choudhury, 2007) and this is further coupled by retaliation, threatening its survival (Charoo et al., 2011; Graham et al., 2005; Can et al., 2014). Habitat degradation (Peyton, 1994), trade in bear body parts and conflicts with humans are the main threats to bear populations throughout their range (Bargali, 2012). Human–wildlife conflicts in general are of considerable economic importance in many parts of the world (Graham et al., 2005) and are particularly controversial when protected species are involved (Thirgood et al., 2000).

Reports of conflicts between Asiatic black bears and humans are common in Wangchuck Centennial National Park (NCD, 2008; Tshering, 2012; WWF, 2014, WWF, n.d) and Bumthang is reported as one of the three districts in Bhutan (of the twenty districts) wherein highest bear kills were recorded (Sangay and Vernes, 2008). However, the types, distribution and nature of human–bear conflicts have not been documented in WCNP. With reports of bear conflicts within WCNP and human mauling cases treated every year in hospitals, it may become difficult to make people appreciate the conservation activities. Thus, before the animal attacks and retaliation gets out of proportion, which in-turn might affect the survival of the bear, it becomes important to understand the extent in which areas conflicts generally occur in order to draw certain conservation measures.

This study was undertaken in four districts of Bhutan (Bumthang, Lhuentse, Trongsa and Wangduephodrang) that are within WCNP in northern Bhutan (Fig. 1). WCNP was established in 2008 and is Bhutan's largest protected areas covering

4914 km² (NSB, 2015). Vegetation in WCNP ranges from warm broadleaf forests at 2500 m of elevation to alpine meadows at 5100 m.

Communities within the WCNP were traditional migratory herders moving around with their yaks and sheep in the alpine meadows of the country. However, with the legalization of the collection of cordyceps (*Ohiocordyceps sinensis*), livelihood activities for the communities are now shifting towards permanent settlement and growing agricultural crops owing to the economic potential of the cordyceps (Wangchuk et al., 2012). WCNP is home to several rare and endangered mammalian species including Bengal Tigers (*Panthera tigris tigris*), Snow leopard (*Panthera uncia*), Bhutan takin (*Budorcas taxicolor whitei*), Red panda (*Ailurus fulgens*), and Asiatic black bear. The park is also home to cordyceps, a highly valued fungi, which attracts large number of collectors in alpine areas of WCNP every May–June. Unlike national parks and protected areas elsewhere, Bhutan has unique policy of allowing settlements within the national parks allowing limited rights to harvest non-timber forest produce. Royal Government of Bhutan has always acknowledged the communities as the partners of conservation and not as a threat to conservation.

2. Methods

We developed and administered a semi-structured questionnaire to as many households as possible that live in and around WCNP. Efforts were made to interview as many households as possible, however we were able to interview only those households, which were occupied during the time of our visit. We interviewed 620 households (218, 95, 70 and 237 households from Bumthang, Lhuntse, Trongsa and Wangduephodrang districts respectively), which represents approximately 20% of all households in and around WCNP. We collected information on the type of conflicts with Asiatic black bear along with the types of crops grown and livestock reared by the communities. Information on various protective measure practiced by the communities to reduce the conflict with Asiatic black bear were also obtained. Based on the information supplied by respondents, we mapped the location of conflict using GIS and Arc/Info within the WCNP map.

3. Results

3.1. Resident reports of Asiatic Black Bears in WCNP

Majority (75% of the respondents) of the Asiatic black bear sightings were reported from 2500 to 4500 m of elevation range in the year 2010. Of this 60% of respondents who sighted bears reported seeing them during the summer (June–August), 30% in autumn (September–November) and 10% in the months of December to May. Asiatic black bears mauled 40 people between 1960 and 2010 in and around WCNP according to survey respondents. About 94% of the respondents could not recollect the activity of the victim during the time of bear attack. However, those who remembered reported that 47% of the victims were in the forests to collect non-timber forest products, 25% were attacked while herding their cattle/yaks and 28% of the victims were attacked when they were traveling from one village to another. This could be a conservative estimate as district hospitals in Bumthang (5 cases), Wangduephodrang (4 cases), Trongsa (6 cases) and Lhuntse (4 cases) recorded total of 19 incidences of Asiatic black bear mauling cases treated from 2013 to 2015. This calculates to average of six humans being mauled by Asiatic black bears annually from 2013 to 2015 comparing to about one human mauled by bear from 1960 to 2010 in and around WCNP.

3.2. Crop depredation

Crop production in the study area occurs from May to August, and majority (62% of the respondents) reported sighting bears around that time. The most common human–bear conflicts involve crop depredation, particularly of grains, and the maximum being for maize. Comparing to cereal crops, respondents stated of less depredation of vegetable and horticultural crops (Table 1).

In 2010 bears raided 11% of all household's farms in the study area. Majority of respondents (45%) reported of bear attacks to crops during summer season, followed by autumn (34%) and winter season (21%) in study area.

3.3. Livestock depredation

Of the 620 households interviewed, 597 households rear livestock, including sheep, yaks, horses, cattle and poultry. We recorded that in the year 2010, 27 individuals of livestock were reported to have killed by bear in and around WCNP, of which 62% were cattle, 22% yaks and 16% horses. The greatest proportion of the Asiatic black bear kill was reported from Bumthang district (78%), followed by Wangduephodrang district (18%) and by Trongsa district (4%). Majority of the respondents (43%) reported of most livestock attacks occurring in autumn season (Fig. 2). Respondent's report on livestock losses to Asiatic black bears suggests the increasing trend. This is inferred as only 20% of households reported losing livestock in 2006 while 36% of respondents reported of losing livestock to bear kill in 2010 alone. While asked on the population trend of bear, majority of respondents (59%) perceive the bear populations to be increasing in WCNP, 21% reported the population to be constant, while 20% thought bear populations were decreasing.

Table 1
Type of crops depredation in study area.

Scientific name	Common name	No. of cases
Cereals		
<i>Zea mays</i>	Maize	94
<i>Eleusine coracana</i>	Millet	6
<i>Oryza sativa</i>	Paddy	4
<i>Hordeum vulgare</i>	Barley	11
<i>Fagopyrum esculentum</i>	Buckwheat	29
<i>Triticum sp.</i>	Wheat	8
Vegetable Crops		
<i>Phaseolus vulgaris</i>	Beans	2
<i>Cucumis sativus</i>	Cucumber	6
<i>Solanum tuberosum</i>	Potato	1
<i>Cucurbita pepo</i>	Pumkin	4
Horticultural Crops		
<i>Malus domestica</i>	Apple	11
<i>Prunus persica</i>	Peach	5
<i>Pyrus sp.</i>	Pear	3
<i>Prunus domestica</i>	Plum	1

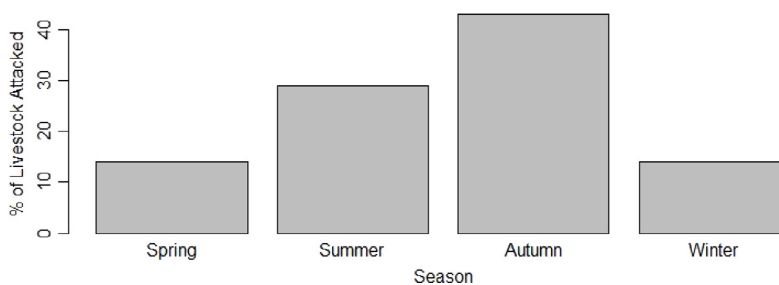


Fig. 2. Seasonal pattern of livestock attack by Asiatic black bear.

3.4. Practices of communities to keep off Asiatic black bear

People in and around WCNP are pursuing various modes to reduce or prevent conflicts with bears. Some of the measures practiced are shouting; making of fires and even using weapons (bow and arrow or putting up snares). Shouting is reported to be the most effective methods (70% respondents) of reducing conflicts with bears or any-other wild animals, while lighting of fires and using weapons were considered comparatively less effective to shouting. They remarked that making of fire and weapons require wider coverage of area comparing to shouting.

With Asiatic black bear becoming the cause of more and more economic loses to the farmers, 52% of respondents believe that conflicts can only be reduced by reducing the number of bears and majority (55%) of the respondents see hunting down bears as the only solution to the problem. However, 26% of respondents were opposed to killing bears due to religious beliefs or citing law of the nation and rest of the respondents were reluctant to provide comments on this.

4. Discussion

Crop raiding, livestock predation and attacks on humans by Asiatic black bear are a serious problem in WCNP and it appears to be on increasing trend in other parts of Bhutan (NCD, 2008). The increase in conflicts could be due to habitat degradation resulting from the extension of agricultural and pasture lands or increasing bear populations as reported by survey respondents (59% of survey respondents). This findings of ours is similar to what has been reported from India (Sathyakumar and Choudhury, 2007). Though majority of survey respondents (75%) claim to have sighted bear in 2010, it could be attributed to the increasing trend of human population as reported by Fakhari Abbas et al. (2015) from Pakistan. Population of humans in WCNP might have increased as nomadic herders are now preferring to settle and derive income from the collection and sale of cordyceps in WCNP (Wangchuk et al., 2012). Our results reveal a link between the season of bear sighting and conflicts. Asiatic black bears are observed to be active at the time collection of non-timber forest produce begins and when agricultural and livestock production is at its maximum. We found that majority (62% of respondents) of the bear sightings occurred during summer at the time when agricultural crops were reported to have attacked by Asiatic black bear (45% of respondents). However, depredation of livestock by Asiatic black bears peaked during autumn (43%) and summer season (29%). Communities were certain on the attacks being made by bear either through direct sightings, presence

of claw marks or the scats. Similar observations of seasonal pattern for livestock attacks were observed in China (Li et al., 2013).

There has been a considerable increase in humans mauled by Asiatic black bear from 2013–2015 comparing to that from 1960–2010. This may be accounted to the institution of better recording and people opting to get treated in hospitals unlike the earlier years when victims were treated by local traditional practitioners coupled with absence of better communication facilities. Having said that, we cannot over-rule the increase in number of people preferring to settle in and around WNCNP owing to the increase in income from the collection and sale of non-timber forest produce, the biggest of which is cordyceps (Wangchuk et al., 2014, 2012).

Our survey data reveal that crop losses to bears are overwhelmingly related to maize. Similar pattern is also reported in Kashmir, India by Charoo et al. (2009), wherein they stated maize as one the frequently raided crops by bear besides apple, cherry, pear and walnut. This may reflect a preference by bears for maize as similar observations were also reported from the Sichuan province in China (Liu et al., 2011b) and from Pakistan (Fakhar-i Abbas et al., 2015). However, we believe that inferring bear's preference to maize would require additional study as we could not determine the quantities of various crops grown by the communities within WNCNP and all previous literatures reporting the major attacks on maize were purely based on interviews.

Communities in and around WNCNP reported on the increase in livestock depredation; however we could not determine the rate of increase in attacks. This, we believe warrants another study involving both the communities as well as the conservationist. One possible explanation for the reported increase in livestock depredation could be due to growing practice of unsupervised livestock rearing (NCD, 2008; Sangay and Vernes, 2008) particularly on higher slopes. Similar findings are also reported from China (Li et al., 2013) and from Himachal Pradesh India (Chauhan, 2003). Unsupervised livestock rearing is coupled with little or no efforts by villagers to locate the missing livestock. Livestock depredation by bears may remain a serious area of conflicts as bears are reported to attack almost all the livestock (Sangay and Vernes, 2008).

Bhutanese at large has been guided by the Buddhist principles of compassion and negative attitudes towards killing of animals. However, with frequent conflicts with bears and other wildlife, communities now see them as pest to their livelihood. A survey by Wang et al. (2006) on attitudes of farmers towards livestock loss in Jigme Singye Wangchuck National Park in Bhutan showed that 68% of the respondents wanting to exterminate problem wildlife. Their finding is no different from what has been expressed by the majority of respondents (68%) in and around WNCNP favoring to cull Asiatic black bears. Our findings and what has been reported by Wang et al. (2006) contradict with what Seeland (2000) remarked of Bhutanese 'neither cursing or looking at wildlife as nuisance' because of their Buddhist ethos. This change in attitude towards wildlife may be out of frustration and with the hope that killing bears would reduce the conflicts as reported by Can et al. (2014) from their global survey on resolving human–bear conflicts. Such an attitude poses a major threat for bear conservation as it is reported to be one of the most serious limiting factors for bear conservation in India (Sathyakumar and Choudhury, 2007). There has been incidences of poachers being apprehended by Bhutanese conservationist, which further questions the survival of the species (Dema, 2014).

We believe that it is of utmost importance to strongly work on resolving the conflicts or at-least to reduce it if we are to witness successful conservation efforts of bear or for that matter any perceived problem wildlife. However, given the frequent and widespread incidences of human–Asiatic black bear conflicts in and around WNCNP boundary (Fig. 3), it becomes essential to work beyond the protected area's boundaries as recommended by Treves et al. (2006) based on their findings elsewhere in the world and Peyton (1994) also suggests focusing bear conservation activities beyond park boundaries.

We suggest that crop depredation by bears could potentially be reduced by exploring and implementing a variety of community and household-based protection measures including cooperative crop guarding and fencing (e.g., with solar-powered electric fences). Research on Asiatic black bear food preferences, feeding habits and habitat utilization could also help identify sources of conflict and facilitate bear conservation and management in WNCNP and Bhutan in general. It would also be useful to assess the illegal trade in bear parts to understand the extent and magnitude of impacts on bear populations.

We re-iterate that, creating awareness and educating communities on importance of bear conservation should be initiated by officials from national parks. Liu et al. (2011b) also believed that education programs can help increase local people's tolerance towards wildlife. However, such activities should extend to communities living outside the national park or any protected areas as major Asiatic black bear sightings and conflicts happened outside of the national park. We also suggest the need to work with communities to identify and implement socially acceptable and conservation friendly measures to reduce human–bear conflicts. We acknowledge the daunting task for the conservationist of Bhutan and the region to save the species and also to garner support from the communities in the areas of conservation. There is a long up-hill battle to face for both the communities and conservationist before putting an end to the problem.

Acknowledgments

We express our deepest gratitude to the management of Wangchuck Centennial National Park and UWICE for having allowed us to conduct the study. We would like to thank generous support of WWF-Bhutan program for having funded the study. We would also like to thank all the interviewees for having sacrificed their time during the process of the study. Our deepest appreciation goes to all the reviewers who played considerable role in shaping this manuscript. We would also like to thank the Ugyen Wangchuck Institute for Conservation and Environment for generously funding the part of this study.

Funding

This work was supported by WWF-Bhutan program and the Royal Government of Bhutan.

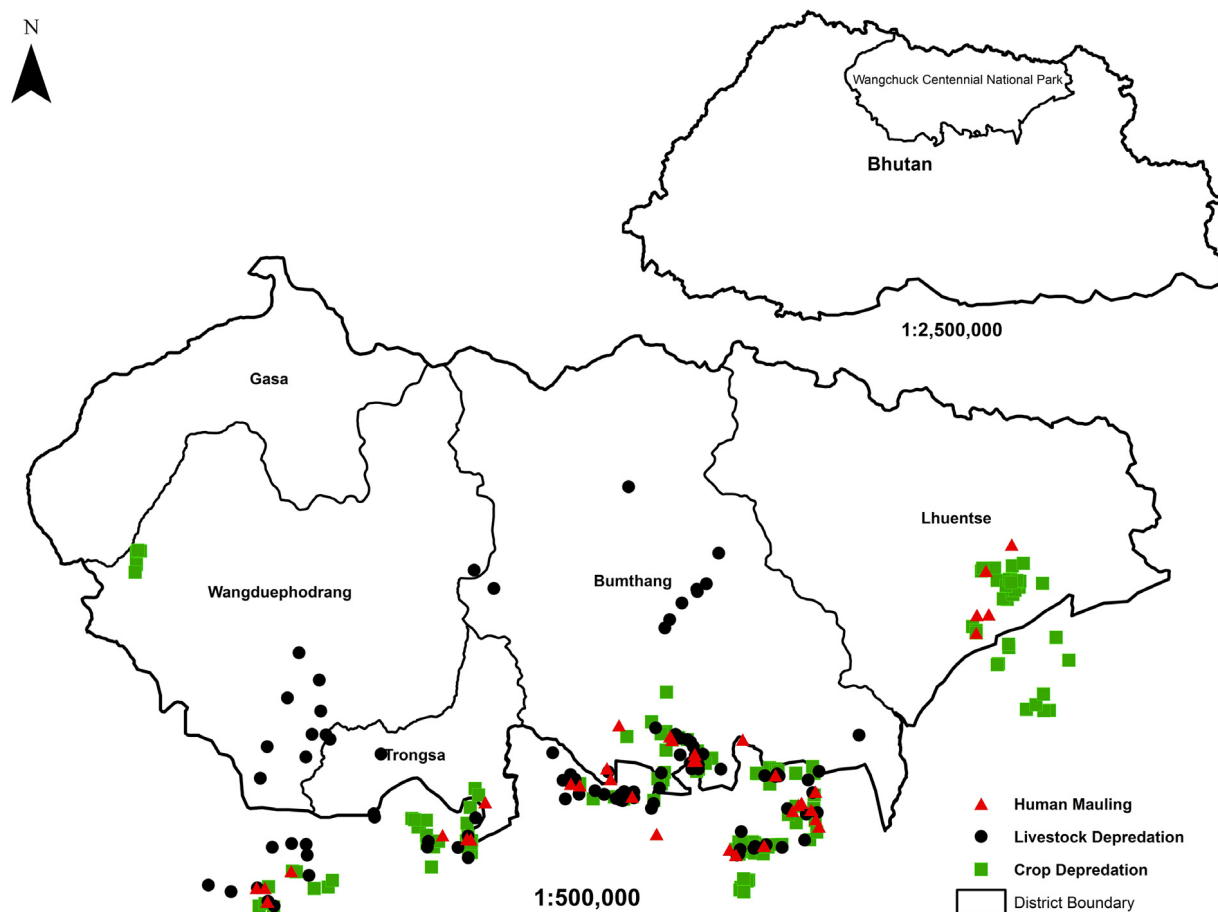


Fig. 3. Human–Asiatic black bear interaction sites in and around WCNP.

References

- Abbas, F., Bhatti, Z.I., Haider, J., Mian, A., 2015. Bears in Pakistan: Distribution, population biology and human conflicts. *J. Bioresour. Manag.* 2, 1–13.
- Bargali, H.S., 2012. Distribution of different species of bears and status of human–bear conflict in the state of Uttarakhand, India. *Adv. Biol. Res. (Rennes)* 6, 121–127. <http://dx.doi.org/10.5829/jidosi.abr.2012.6.3.64181>.
- Can, O.E., D'Cruze, N., Garshelis, D.L., Beecham, J., Macdonald, D.W., 2014. Resolving human–bear conflict: A global survey of countries, experts, and key factors. *Conserv. Lett.* 7, 501–513. <http://dx.doi.org/10.1111/conl.12117>.
- Charoo, S.A., Sharma, L.K., Sathyakumar, S., 2011. Asiatic black bear–human interactions around Dachigam National Park, Kashmir, India. *Ursus* 22, 106–113.
- Charoo, S.A., Sharma, L.K., Sathyakumar, S., 2009. Asiatic Black Bear - Human Conflicts around Dachigam National Park, Kashmir. *Wildlife Institute of India, Dehradun, India*.
- Chauhan, N.P.S., 2003. Human casualties and livestock depredation by black and brown bears in the Indian Himalaya, 1989–98. *Ursus* 14, 84–87.
- Cowan, I.M., 1972. The status and conservation of bears (Ursidae) of the world–1970. *Int. Conf. Bear Res. Manag.* 2, 343–367.
- Dema, Y. (2014) Poacher slapped with heavy penalty [WWW Document]. URL <http://kuenselonline.com/archive/poacher-slapped-with-heavy-penalty/> (accessed 15.02.16).
- DoFPS, 2011. Forestry Facts, Figures & Trends 2011. Department of Forests and Park Services, Ministry of Agriculture and Forests Thimphu.
- Fakhar-i Abbas, Bhatti, Z.I., Haider, J., Mian, A., 2015. Bears in Pakistan: Distribution, population biology and human conflicts. *J. Bioresour. Manag.* 2, 1–13.
- Graham, K., Beckerman, A.P., Thirgood, S., 2005. Human–predator–prey conflicts: Ecological correlates, prey losses and patterns of management. *Biol. Conserv.* 122, 159–171. <http://dx.doi.org/10.1016/j.biocon.2004.06.006>.
- Li, X., Buzzard, P., Chen, Y., Jiang, X., 2013. Patterns of livestock predation by carnivores: Human–wildlife conflict in Northwest Yunnan, China. *Environ. Manage.* 52, 1334–1340. <http://dx.doi.org/10.1007/s00267-013-0192-8>.
- Liu, F., McShea, W.J., Garshelis, D.L., Zhu, X., Wang, D., Shao, L., 2011a. Human–wildlife conflicts influence attitudes but not necessarily behaviors: Factors driving the poaching of bears in China. *Biol. Conserv.* 144, 538–547. <http://dx.doi.org/10.1016/j.biocon.2010.10.009>.
- Liu, F., McShea, W.J., Garshelis, D.L., Zhu, X., Wang, D., Shao, L., 2011b. Human–wildlife conflicts influence attitudes but not necessarily behaviors: Factors driving the poaching of bears in China. *Biol. Conserv.* 144, 538–547. <http://dx.doi.org/10.1016/j.biocon.2010.10.009>.
- NCD, 2008. Bhutan National Human–Wildlife Conflicts Management Strategy. Department of Forests and Park Services. Royal Government of Bhutan, Thimphu.

- NSB, 2015. *Statistical Yearbook of Bhutan 2014*. National Statistical Bureau. Royal Government of Bhutan, Thimphu.
- Peyton, B., 1994. Conservation in the developing world: ideas on how to proceed. *Int. Conf. Bear Res. Manag.* 9, 115–127. <http://dx.doi.org/10.2307/3872691>.
- RGoB, 2006. *Forest and Nature Conservation Rules of Bhutan*. Royal Government of Bhutan.
- RGoB, 1995. *Forest and Nature Conservation ACT of Bhutan*. Royal Government of Bhutan.
- Roberts, T.J., 1997. *The Mammals of Pakistan, Revised ed.* Oxford University Press, Karachi, Pakistan.
- Sangay, T., Vernes, K., 2008. Human-wildlife conflict in the Kingdom of Bhutan: Patterns of livestock predation by large mammalian carnivores. *Biol. Conserv.* 141, 1272–1282. <http://dx.doi.org/10.1016/j.biocon.2008.02.027>.
- Sathyakumar, S., Choudhury, A., 2007. Distribution and status of Asiatic black bear *ursus thibetanus* in India. *J. Bombay* 3, 316–323.
- Seeland, K., 2000. National park policy and wildlife problems in Nepal and Bhutan. *Popul. Environ.* 22, 43–62. <http://dx.doi.org/10.1023/A:1006629531450>.
- Sillero-Zubiri, C., Sukumar, R., Treves, A., 2007. Living with wildlife: the roots of conflict and the solutions. *Key Top. Conserv.* 255–272.
- Stubblefield, C.H., Shrestha, M., 2007. Status of Asiatic black bears in protected areas of Nepal and the effects of political turmoil. *Ursus* 18, 101–108. [http://dx.doi.org/10.2192/1537-6176\(2007\)18\[101:SOABBI\]2.0.CO;2](http://dx.doi.org/10.2192/1537-6176(2007)18[101:SOABBI]2.0.CO;2).
- Thirgood, S.J., Redpath, S.M., Haydon, D.T., Rothery, P., Newton, I., Hudson, P.J., 2000. Habitat loss and raptor predation: disentangling long- and short-term causes of red grouse declines. *Proc. Biol. Sci.* 267, 651–656. <http://dx.doi.org/10.1098/rspb.2000.1051>.
- Treves, A., Wallace, R.B., Naughton-Treves, L., Morales, A., 2006. Co-managing human-wildlife conflicts: A review. *Hum. Dimens. Wildl.* 11, 383–396. <http://dx.doi.org/10.1080/10871200600984265>.
- Tshering, U., 2012. Trapped wild board rescued. *RNR Newsl.* XXXII, 13.
- Wang, S.W., Lassoie, J.P., Curtis, P.D., 2006. Farmer attitudes towards conservation in Jigme Singye Wangchuck National Park, Bhutan. *Environ. Conserv.* null 148–156. <http://dx.doi.org/10.1017/S0376892906002931>.
- Wangchuk, S., Norbu, N., Sherub, S., 2012. *Impacts of Cordyceps Collection on Livelihoods and Alpine Ecosystems in Bhutan as Ascertained from Questionnaire Survey of Cordyceps Collectors*. UWICE Press.
- Wangchuk, S., Siebert, S., Belsky, J., 2014. Fuelwood use and availability in Bhutan: Implications for national policy and local forest management. *Hum. Ecol.* 42, 127–135. <http://dx.doi.org/10.1007/s10745-013-9634-4>.
- Wangchuk, T., Thinley, P., Tshering, K., Tshering, C., Yonten, D. and Pema, B. (2004). *A Field Guide to the Mammals of Bhutan*. Department of Forests, Royal Government of Bhutan, Thimphu.
- WWF, 2014. *Conservation and Adaptation in Asia's High Mountain Landscapes and Communities: Semi-annual Report, October 1, 2013–March 31, 2014*.
- WWF, n.d. Wangchuck Centennial National Park (WCNP), WWF [WWW Document]. URL http://www.wwf.org/bhutan.org/bhutan_biological_conservation_complex/wangchuck_centennial_national_park/ (accessed 22.04.16).