



Population of Asiatic Black Bear (*Ursus thibetanus*) in Kaghan and Siran Valleys, District Mansehra, Pakistan

Zaib Ullah^{1*}, Sajid Mahmood^{2,3}, Zafar Iqbal⁴, Fakhar-i-Abbas⁵, Naveed Akhtar¹ and Abdul Majid Khan^{6*}

¹Department of Zoology, Hazara University Sub-Campus Battagram, Khyber Pakhtunkhwa, Pakistan

²Department of Zoology Hazara University, Dhodial Mansehra, Khyber Pakhtunkhwa 21120, Pakistan

³Department of Zoology, University of Chakwal, Punjab, Pakistan

⁴Department of Botany Hazara University, Dhodial Mansehra, Khyber Pakhtunkhwa 21120, Pakistan

⁵Centre for Bioresource Research, Islamabad, Pakistan

⁶Institute of Zoology, University of the Punjab, Lahore, Pakistan

ABSTRACT

Population estimation survey of Asiatic black bear (*Ursus thibetanus* G. (Baron) Cuvier, 1823) was conducted in Kaghan and Siran Valleys of Khyber Pakhtunkhwa (KP) province of Pakistan. The different surveys (questionnaire, sighting, and sign survey) were conducted in all sites of the forests from June to November 2018. Thirteen different types of signs were observed during the field survey. Potential site selection was based on sign observation (Encounter Rate; ER). Four black bears were observed from three different spots. Two mature male bears were seen in Kaghan Valley (Kamal Bann and Malakandi Reserve Forest) and a mother with a single cub was observed in Siran Valley during dusk. Population estimation was carried out by transect method, with 18 transects were in Kaghan and 15 transects in Siran Valley. A total of 1858 signs were recorded during the field survey; among these 1213 dig marks, 186 plants uprooting and two setting places. An average of 49.95 signs/km² was recorded; this is a very high encounter rate. According to BBC (British Broadcasting Corporation) Science and Nature, the home range size of Asiatic black bears is 10 to 20 km², so we concluded that more than 24 black bear were present in both valleys.

Article Information

Received 05 December 2021

Revised 28 April 2022

Accepted 18 May 2022

Available online 02 August 2022
(early access)

Authors' Contribution

ZU conducted field surveys and collected data into a meaningful manuscript under the supervision of SM and ZI. FA and NA reviewed the manuscript for grammatical mistakes. AMK helped in tables formation and scientifically proofread and formatted the manuscript.

Key words

Sign survey, Transect method, Encounter rate, Home range, *Ursus thibetanus*

INTRODUCTION

Out of eight bear species worldwide, six are found in Asia (Hwang, 2000; Khan, 2012; Fujiwara *et al.*, 2013; Escobar *et al.*, 2015) and two Asiatic black bear *Ursus thibetanus* and Himalayan brown bear *Ursus arctos* are found in Pakistan (West, 2005; Nawaz, 2007; CITES, 2014; Ripple *et al.*, 2014; Garshelis and Steinmetz, 2016). The Asiatic black bear was once widely distributed in

Karakoram, Himalayas, and the Hindu Kush ranges, but is now limited to specific spots due to habitat degradation and population contraction (Roberts, 1997; Hwang, 2000; Crooks, 2002; Ripple, 2004). Black bear populations are present in northern parts of Pakistan, including Mansehra, Battagram, North Dir, South Chitral, Swat (KP), Gilgit Baltistan (GB) and Azad Jammu and Kashmir (AJ&K) (Roberts, 1997; Sheikh, 2005; Nawaz, 2007; Fakhar-i-Abbas *et al.*, 2015). Asiatic black bear in Pakistan has received very little attention from conservationists/researchers and sighting records indicate a sharp decline in their population during the last 40 to 50 years (Sheikh, 2005; Nawaz, 2007; Waseem and Ali, 2011; Fakhar-i-Abbas *et al.*, 2015).

Black bear prefers to live in den in bushy areas within the forest, mostly in moist temperate coniferous, dry temperate, alpine, sub-alpine, and broad leaved forests (Woods and Kalpatrick, 1997; Waseem and Ali, 2011; Fakhar-i-Abbas *et al.*, 2015; Garshelis and Steinmetz, 2016) at altitudes ranging between 1500 to 4500 meter

* Corresponding author: zaibullah_zoology@hu.edu.pk, majid.zool@pu.edu.pk
0030-9923/2022/0001-0001 \$ 9.00/0



Copyright 2022 by the authors. Licensee Zoological Society of Pakistan.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

above the sea level (asl) (Schaller, 1977; Waseem and Ali, 2011; Ali *et al.*, 2015; Fakhar-i-Abbas *et al.*, 2015). Population density varies from one to ten bear per 10 km², with an average of two bear/ 10 km² (Kolenosky *et al.*, 1992; Hwang, 2000; Waseem and Ali, 2011; Garshelis and Steinmetz, 2016). The conservation status of Asiatic black bear is vulnerable under the International Union for Conservation of Nature (IUCN) Red List (Hwang, 2000; Zahler *et al.*, 2004; Garland *et al.*, 2016; Pires and Moreto, 2016).

The population diversity of black bear depends upon their home range in a specific region, and it varies among different species of bears (Garland *et al.*, 2016). Usually, male bears occupy a larger home range (more than 50 km²) as compared to females (12 to 50 km²) (Rogers, 1977; Young and Ruff, 1982; Ali *et al.*, 2015). The breeding process occurs from May to June, while cubs (one to five) are born from early December to late February and cubs stay with their mother for 12 to 20 months (Stevens and Lofts, 1988; Waseem and Ali, 2011; Furusaka *et al.*, 2017; Hamasaki *et al.*, 2020; Deus *et al.*, 2021; Hamasaki and Dan, 2021; McCormack and Cotoras, 2021). The presence of black bear can also be determined from the pattern of feeding including claw marks, broken branches, soil digging for termites, and bark removal from the trees that are used as a food source during the winter season (Servheen, 1990; Crooks *et al.*, 2011; Cardinale *et al.*, 2012). IUCN Bear Specialists Group (BSG) points out that, Asiatic black bears are at high risk in a different part of Southeast Asia (Servheen, 1990; Hwang, 2000; Fujiwara *et al.*, 2013; Pires and Moreto, 2016). The species declined due to habitat destruction, and increase in human activities like cultivation shifting, grazing of livestock, illegal killing for sport, poaching, reactive killings against crops depredation (Servheen, 1990; Garland *et al.*, 2016).

Population estimation of black bear was carried out in Kaghan and Siran Valleys of the District Mansehra (Khyber Pakhtunkhwa, Pakistan). The presence of black bear has been indicated by different researchers (Roberts, 1997; Sheikh, 2005; Nawaz, 2007; Ripple *et al.*, 2014; Fakhar-i-Abbas *et al.*, 2015; Ullah *et al.*, 2020), in the area without reporting the size of the population exploiting the area. Present research reports the size of the population of black bear in the District Mansehra by following multiple sampling techniques.

MATERIALS AND METHODS

Study area

Kaghan (22,000 ha) and Siran (13,744 ha) valleys (North-East of District Mansehra: 34.234°-35.184°N; 72.817°-74.134°E; Khyber Pakhtunkhwa) constitute the

present study area. These valleys have diverse ecosystems, including moist temperate coniferous forest, sub-alpine forest, and subtropical woodlands. The area also has small lakes and streams, river Kunhar along with, mountain peaks covered by snow.

Methods

Structured interviews of 100 volunteers randomly selected from local community and wildlife and forest staff in different villages of the study area (Fig. 1) (original in Urdu, facsimile of English translation), after letting them know the purpose of the study (Ullah *et al.*, 2021a, b; Khan *et al.*, 2021a). After potential site selection, we visited the specific sites between June and November 2018 and searched for bear signs (recorded with high-resolution DSLR Camera: Canon Eos 6d WG DS126401, Japan, with zoom lenses: EF 24-105 mm 1:4 L IS, and 70-200 mm, IS USM, Japan), taking help of binocular (Nikon Aculon A211 12X50 No.6055245, China) and plotted position of the detected signs on the map using GPS (GARMIN: etrex 10 and etrex 30, FCC ID: IPH-01842, Taiwan) and sites having bear signs were selected for detailed survey. Transects sampling methods were followed at all potential sites. We also visited crop fields and tried to observe bears, with the help of local farmers (Khan *et al.*, 2021b; Ullah *et al.*, 2021).

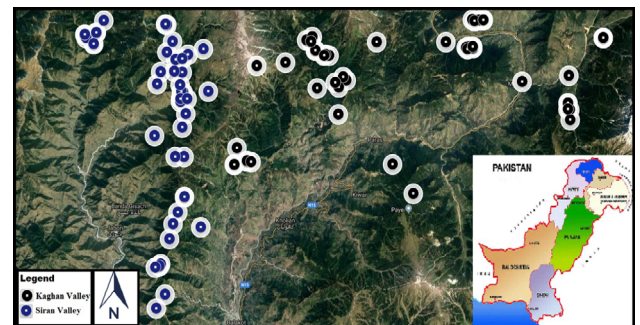


Fig. 1. Map showing the locations of volunteers responding to the questionnaire.

Population estimation was carried out by sign survey technique. Signs of black bear, i.e., pug marks/footprint, claw marks, tree marks/bark off, plants uprooting, stone replacing, dig marks, bite marks, scat samples, hair samples, bee hive damages, trafficking routes, location of livestock killing, crop damages, coarse wood damages and place of temporary setting/sleeping were observed in the forest. Variable-length transects (100-500 m and 10-20 m wide) were drawn in each potential site. Two persons walked through transect areas adopting a zigzag path to search for bear signs, while the third person moved straight

to record the data. We surveyed 33 transects with a total length of 4900 m (18 in Kaghan, 15 in Siran) (Fig. 2). The encounter rate was calculated for each sign by dividing the number of signs observed by the length of the transect.

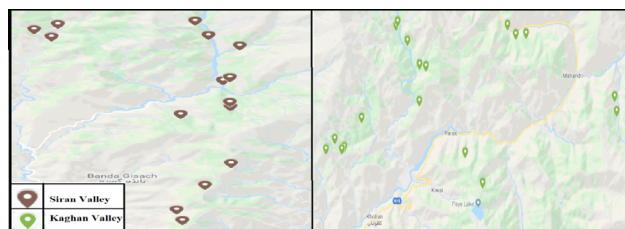


Fig. 2. Map location of different transects.

RESULTS

Potential bear sites

Interviews with respondents suggested 14 potential Asiatic black bear population sites of which 9 are in Kaghan and 5 in Siran valley (Table I).

Bear sighting

Three adults and two cubs of a black bear were sighted at three localities. On July 16 (6:36 pm) an adult Male black bear was recorded from a distance of 300 m in Kamal Bann Reserved Forest (Compartment No. 13) of Kaghan Valley. The second time a female bear, with a single cub, was sighted from a distance of 335 m on September 1 (6:51 pm) at Punjul Reserve Forest (Compartment No. 3₁) of Siran Valley while digging (fresh footprints and dig marks later observed). The third time a Male black bear was observed from a distance of 450 m on September 29 (7:26 pm) at Malakandi Reserve Forest (Compartment No. 4) of Kaghan. All sightings of the bears were associated with dense shrubs within the forest suggesting denser shrubby areas as the preferred habitat of the Asiatic black bear (Fig. 3). The black bear is a very shy animal and usually avoids human encounter, Survey team did not intentionally disturb the black bear for sighting, and only accidental sightings of the black bear were recorded casually during the field survey.

Sign survey

We recorded 13 bear signs; which were further divided into two main types based on appearance rate, i.e. frequent and rare (Supplementary Table I).

Of 1858 bear signs recorded, dig marks (1213; 65.2%) appeared in the highest frequency, followed by plants uprooting (186; 10%), other signs appeared in low frequency. An average number of bear signs (49.95/ km²)

suggests a very high encounter rate. According to BBC Science and Nature, the average size of the Asiatic black bear home range is 10 to 20 km². A of total 33 potential sites (37.19 km²) were selected as the sample area from both valleys (357.44 km²). Bear signs observation among all the sites of the sample area indicated that bear is present in the entire study area because selected spots covered the whole study area by placing distance between them. Based on the average home range (15 km²), we calculated that more than 24 ($24/33,744 = \text{one per } 1406 \text{ m}^2$) black bears are present within the entire study area of both valleys.

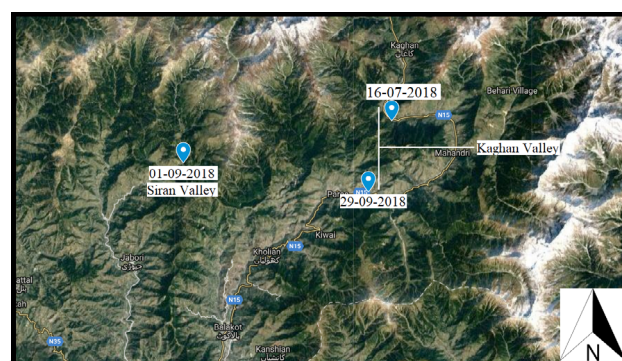


Fig. 3. Google location of the sighted black bear.

Potential sites confirmation based on data analysis

The percentage of each sign in the following table determined highly potential sites from both valleys. This percentage was calculated based on standard encounter rates (SER). There are 28 high potential sites in the study area, among these 16 sites are present in Kaghan Valley while 12 are in Siran Valley. These potential sites were recommended for the conduction of a detailed and genetic-based survey of black bears. Comparison between questionnaire-based survey and data analysis for potential sites are mostly the same. A questionnaire-based survey represents 33 potential sites in both valleys, while after analyzing bear signs only 28 potential sites were confirmed to be present in both valleys.

Percentage of the standard encounter rate for both categories (mostly appeared and rarely appeared signs) is given in Supplementary Table II. The total percentage for each sign was considered as 100, but only those were shown in the table which occurred above the standard encounter rate, below this was ignored for highly potential site selection.

Among 33 potential sites, only 28 sites were selected as highly potential sites because a very high number of signs were recorded above the standard encounter rate (SER). Only five sites (K4, K12, S19, S23, and S28) do not follow the rules of SER. Mostly and rarely appeared

signs were divided based on the appearance rate. Total six different types of (mostly appeared) signs were observed 46 times in 24 potential sites, similarly, seven different types of (rarely appeared) signs were observed 30 times in 18 potential sites from both valleys (Fig. 4).

Public response

The vast majority of respondents (92%) suggested an increase in the sighting of Asiatic black bear during the recent past. The average number of sightings during the last 8 years was 4.5 bears per respondent.

Respondent responses suggested that black bear lives in groups as well as solitary forms, presence in the group depends upon various combinations i.e. single adult male, single adult female, male and female, Male, female with cubs, cubs only and female with cubs. Sighting observations represented the population size of black bears. According to the local respondents, black bears were mostly sighted in a group of female mothers with cubs (29.68%) followed by a single female (17.96%) from different locations (Table II). Based on the average, 2.13 bears were seen by each individual among different groups.

The population fluctuation depends upon the encounter rate and is last seen in the forest. All the latest observations were divided into three categories (2018, 2017, and 2016) on annual basis. Among these, the highest observations (57.4%) were recorded in 2018 followed by (35.4%) in 2017 (Table III).

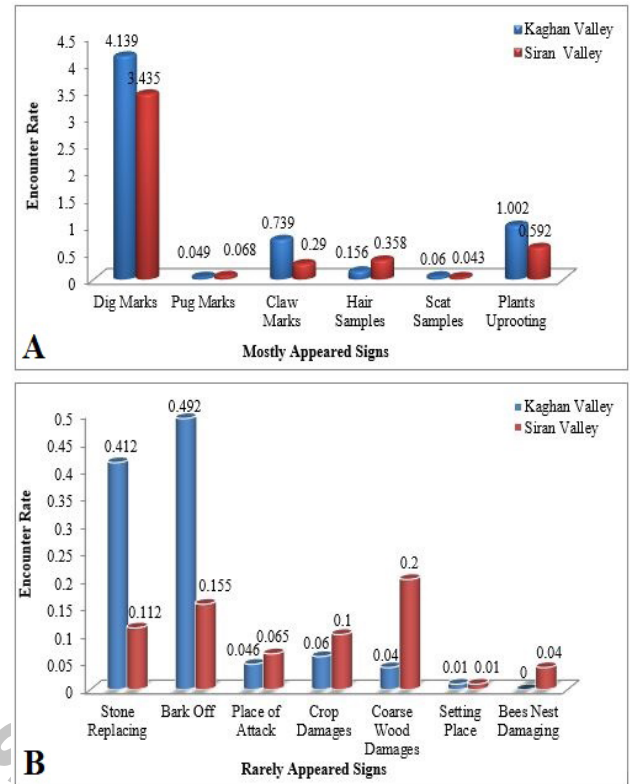


Fig. 4. Encounter rate of mostly (A) and rarely (B) appeared signs from both valleys.

Table I. Potential sites of black bear.

S.#	Forest zone	Number of compartment	Compartment number having Bear signs	Potential bear area (ha)
Kaghan valley				
1	Manshi Reserve Forest	36	4 {C1, C8, C10, C12}	582.50
2	Malakandi Reserve Forest	19	3 {C1, C4, C6}	349.60
3	Kamal Bann Reserve Forest	14	3 {C8, C10, C13}	309.90
4	Nuri Bichla Reserve Forest	32	2 {C26, C27}	270.70
5	Nagan Reserve Forest	18	2 {C8, C14}	253.30
6	Bageer Guzara Forest	6	1 {C14}	233.00
7	Bhonja Guzara Forest	25	1 {C24}	158.00
8	Ganila Guzara Forest	2	1 {C1}	103.60
9	Hungrai Guzara Forest	1	1 {C7}	163.00
Siran valley				
10	Punjul Reserve Forest	12	7 {C3 _I , C3 _{III} , C4 _I , C9 _{II} , C10 _{II} , C11 _{II} , C12 _{II} }	679.80
11	Una Reserve Forest	06	3 {C2 _{II} , C3, C5 _{III} }	292.90
12	Manda Guchha Guzara Forest	18	2 {C7, C15}	97.12
13	Jacha Guzara Forest	23	1 {C14}	89.03
14	Deoli Guzara Forest	49	2 {C17, C20}	85.30
Total		261 33		3667.75

C, Compartment; Roman numbers (I, II, III). Sub-Division in the compartments

Table II. Sighting frequency of the black bear from the local community

	Single male	Single female	Male and female	Male, female, cubs	Cubs only	Female and cubs	Total
Average No of black bears per sighting	1.8	2.3	1.5	1.3	2.1	3.8	2.13
Sighting frequency (%)	14.06	17.96	11.71	10.15	16.40	29.68	100

Table III. Information's about the black bear population collected from the local community.

S. #	Questions from interviewers (n=100)*	Response of the interviewers (in percentage)		
1	Frequency of Asiatic black bear in the study area?	Increased 92%		
		Decreased 1%		
		Do not know 7%		
2	Did you see the black bear in the study area?	Yes 68%		
		No 32%		
		Average: 4.5 bears seen/ respondent		
3	Have you ever seen bears in a group? (two or more)	Yes 47%		
		No 53%		
		Average No. seen per group = 3.8 bears		
4	When the black bear was last sighted? (annual wise)	54% community answer this question		
		2018	2017	2016
		57.4%	35.4%	7.2%

*n, Number of Questionnaires

DISCUSSION

A signed survey was conducted for population estimation of black bears in Kaghan and Siran Valleys using the transect method. A survey of 33 (18 Kaghan and 15 Siran) transects suggested a sign density of 49.95/km² which is reasonably high indicating a wider distribution of bear. Using BBC Science and Nature information on the home range of Asiatic black bears (10-20 km²) we estimate a population of more than 24 black bears in these valleys. A similar study conducted by [Waseem and Ali \(2011\)](#) at two potential sites (Punjul and Malakandi Reserved Forest) of District Mansehra recorded 35 black bear signs with an average sign density of 4.3 /km², which is very low compared with the presently reported sign density. [Waseem and Ali \(2011\)](#) suggested a population of 4 black bears in the two valleys surveyed by them.

A questionnaire-based survey (n= 1873) was conducted in different areas (258 localities) of Pakistan to assess the population of bears. Among all the sites, Asiatic black were exclusively present in 45 localities of District Mansehra and Battagram. The black bear is a very clever animal and usually destroys the maize crops (regularly in two localities irregular in 6 localities) and fruits such as grapes, apricot, walnut, and mulberry. The average

depredation of bears is 54 cattle, 188 sheep and goats, 4 yaks, and 9 horses and donkeys with a total loss of US\$ 28,400 ([Fakhar-i-Abbas et al., 2015](#)). Similarly, this study is based on the questionnaire-based survey, sign survey and human bear conflict in Kaghan and Siran Valleys. It indicated that quite a good population (n=24) of Asiatic black bears is present in both valleys.

CONCLUSION

Population estimation survey of an Asiatic black bear was conducted in Kaghan and Siran Valleys. Thirteen different types of signs were observed during the field survey. Four black bears were observed from three different spots. Two mature bears were seen in Kaghan Valley and a mother with a single cub was observed in Siran Valley during dusk. Total 1858 signs were recorded during the field survey; among these Dig marks (1213) were recorded the highest number of signs followed by Plants uprooting (186), while the lowest number of the observed sign was setting places (2). An average of 49.95 signs/km² was recorded; this is a very high encounter rate. According to BBC Science and Nature, the home range size of Asiatic black bears is 10 to 20 km², so we concluded that there are more than 24 black bears (one per 1406 m²) present in

both valleys.

Availability of data and materials

Data of this article is available for any sort of publicity after publication.

Ethics approval consent to participate

This research work has no such animals or data where we provide ethical approval certificate, therefore there is no need for ethical approval.

Supplementary material

There is supplementary material associated with this article. Access the material online at: <https://dx.doi.org/10.17582/journal.pjz/20211205151252>

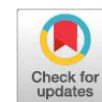
Statement of conflict of interest

The authors have declared no conflict of interest.

REFERENCES

- Ali, R., Khan, B., Khan, G., Khan, M. Z., Abass, S., and Rais, U., 2015. Status and Threats of Asiatic Black bear in Gais Valley of Diamer District, Gilgit-Baltistan, Pakistan. *Int. J. Sci. Res. Publ.*, **5**: 1-8.
- Cardinale, B.J., Duffy, J.E., Gonzalez, A., Hooper, D.U., Perrings, C., Venail, P., Anita, N., Georgina, M.M., David, T., David, A.W., Ann, P.K., Gretchen, C.D., Michel, L., James, B.G., Anne, L., Diane, S.S., and Shahid, N., 2012. Biodiversity loss and its impact on humanity. *Nature*, **486**: 59. <https://doi.org/10.1038/nature11148>
- CITES, 2014. *Appendices I, II and III*. <http://www.cites.org/eng/app/appendices.php>. Downloaded on 09 October 2014.
- Crooks, K.R., 2002. Relative sensitivities of mammalian carnivores to habitat fragmentation. *Conserv. Biol.*, **16**: 488-502. <https://doi.org/10.1046/j.1523-1739.2002.00386.x>
- Crooks, K.R., Burdett, C.L., Theobald, D.M., Rondinini, C., and Boitani, L., 2011. Global patterns of fragmentation and connectivity of mammalian carnivore habitat. *Philos. Trans. R. Soc. B Biol. Sci.*, **366**: 2642-2651. <https://doi.org/10.1098/rstb.2011.0120>
- Deus, J.P.A., Queiros, C.N., and Buschini, M.L.T., 2021. Nesting biology of the solitary wasp *Pisoxylon amenkei* (Hymenoptera, Crabronidae, Trypoxylini) in a Neotropical Hotspot of Southern Brazil. *Zool. Stud.*, **60**.
- Escobar, L.E., Awan, M.N., and Qiao, H., 2015. Anthropogenic disturbance and habitat loss for the red-listed Asiatic black bear (*Ursus thibetanus*): Using ecological niche modeling and nighttime light satellite imagery. *Biol. Conserv.*, **191**: 400-407. <https://doi.org/10.1016/j.biocon.2015.06.040>
- Fakhar-i-Abbas, Bhatti, Z.I., Haider, J., and Mian, A., 2015. Bears in Pakistan: distribution, population biology and human conflicts. *J. Bioresour. Manage.*, **2**: 1. <https://doi.org/10.35691/JBM.5102.0015>
- Fujiwara, S., Koike, S., Yamazaki, K., Kozakai, C., and Kaji, K., 2013. Direct observation of bear myrmecophagy: Relationship between bears' feeding habits and ant phenology. *Mamm. Biol. Z. Säugetierkunde*, **78**: 34-40. <https://doi.org/10.1016/j.mambio.2012.09.002>
- Furusaka, S., Kozakai, C., Nemoto, Y., Umemura, Y., Naganuma, T., Yamazaki, K., and Koike, S., 2017. The selection by the Asiatic black bear (*Ursus thibetanus*) of spring plant food items according to their nutritional values. *ZooKeys*, **672**: 121. <https://doi.org/10.3897/zookeys.672.10078>
- Garland, L., Ellis, C., and Steury, T., 2016. Food habits of black bears in suburban versus Rural Alabama. *J. Southeastern Assoc. Fish Wildl. Agencies*, **3**: 185-189.
- Garshelis, D.L., and Steinmetz, R., 2016. *Ursus thibetanus*. The IUCN red list of threatened species 2008. e. T22824A9391633.
- Hamasaki, K., and Dan, S., 2021. Seasonal changes in the sexual size dimorphisms of the chelipeds and pleons of the porcellanid crab *Petrolisthes japonicus*. *Zool. Stud.*, **60**: e18.
- Hamasaki, K., Okada, M., Nishimoto, S., and Dan, S., 2020. Larval performance of amphidromous and landlocked atyid shrimp species in the genus *paratya* under different feeding conditions. *Zool. Stud.*, **59**.
- Hwang, M.H., 2000. *Ecology of Asiatic black bears and people-bear interactions in Yushan National Park, Taiwan*. Doctoral dissertation, University of Minnesota.
- Khan, A., Umhang, G., Ullah, Z., Boué, F., Bastid, V., Ullah, I., and Ahmed, H., 2021a. Investigation of *Echinococcus multilocularis* in foxes and dogs in Pakistan by detection of copro-DNA. *Parasitol. Res.*, **120**: 731-737. <https://doi.org/10.1007/s00436-020-07001-x>
- Khan, M., 2012. *Islamic Republic of Pakistan: Collaborative management of protected areas*. In First Asia Parks Congress.
- Khan, R.A., Ullah, Z., Zaman, I.U., Khan, M.S., Mahmood, S., Akhtar, N., and Hussain, S.S.,

- 2021b. Population distribution and habitat analysis of Rufous treepie (*Dendrocitta vagabunda*) in Abbottabad, Pakistan. *Braz. J. Biol.*, **83**: <https://doi.org/10.1590/1519-6984.247018>
- Kolenosky, G.B., Abraham, K.F., and Greenwood, C.J., 1992. *Polar bears of southern Hudson Bay. Polar Bear Project, 1984–88, final report*. Unpublished report. Ontario Ministry of Natural Resources, Maple, Ontario, Canada.
- McCormack, J.J., and Cotoras, D.D., 2021. Beetle diversity across micro-habitats on lizard island group (Great Barrier Reef, Australia). *Zool. Stud.*, **60**.
- Nawaz, M.A., 2007. Status of the brown bear in Pakistan. *Ursus*, **18**: 89-100. [https://doi.org/10.2192/1537-6176\(2007\)18\[89:SOTBBI\]2.0.CO;2](https://doi.org/10.2192/1537-6176(2007)18[89:SOTBBI]2.0.CO;2)
- Pires, S.F., and Moreto, W.D., 2016. *The illegal wildlife trade*. <https://doi.org/10.1093/oxfordhb/9780199935383.013.161>
- Ripple, W.J., Estes, J.A., Beschta, R.L., Wilmers, C.C., Ritchie, E.G., Hebblewhite, M., Berger, J., Elmhagen, B., Letnic, M., Nelson, M.P., Schmitz, O.J., Smith, D.W., Wallach, A.D., and Wirsing, A.J., 2014. Status and ecological effects of the world's largest carnivores. *Science*, **343**: 1241484. <https://doi.org/10.1126/science.1241484>
- Roberts, T.J., 1997. *The mammals of Pakistan (revised ed.)*. Oxford University Press, Karachi, Pakistan. pp. 525.
- Rogers, L.L., 1977. *Social relationships, movements, and population dynamics of black bears in northeastern Minnesota*. Doctoral dissertation, ProQuest Information and Learning.
- Schaller, G.B., 1977. *Mountain monarchs. Wild sheep and goats of the Himalaya*. University of Chicago Press.
- Servheen, C., 1990. The status and conservation of the bears of the world. *Int. Conf. Bear Res. Manage. Monogr.*, **2**: 32.
- Sheikh, K.M., 2005. *The status and conservation on bears in Pakistan*. Understanding Asian bears to secure their future, pp. 1-6.
- Stevens, V., Lofts, S., and Harcombe, A.P., 1988. *Wildlife habitat handbooks for the southern interior ecoprovince, Vol. 1: Species notes for mammals*. Ministry of Environment, Wildlife Branch.
- Ullah, Z., Mahmood, S., Iqbal, Z., Akhtar, N., Khan, M.F., Said, A., and Arif, M., 2021a. Damages to Himalayan white pine (*Pinus wallichiana*) by Asiatic black bear (*Ursus thibetanus*) in Kaghan Valley, Pakistan. *Forests*, **12**: 1130. <https://doi.org/10.3390/f12081130>
- Ullah, Z., Mahmood, S., Iqbal, Z., Khan, J., Akhtar, N., Khan, M.A., and Yasmin, S., 2021b. Habitat selection by Asiatic black bear (*Ursus thibetanus*) in Siran and Kaghan Valleys, Pakistan. *Braz. J. Biol.*, **83**. <https://doi.org/10.1590/1519-6984.247890>
- Ullah, Z., Sajid, M., Iqbal, Z., Akhtar, N., Khan, G.B., Ali, A., and Arif, M., 2021c. Movement of Asiatic black bear: Sign survey evidence from Kaghan and Siffran Valleys, Pakistan. *Biosci. Res.*, **18**: 1433-1445.
- Ullah, Z., Ullah, I., Ullah, I., Mahmood, S., and Iqbal, Z., 2020. Poaching of Asiatic black bear: Evidence from Siran and Kaghan valleys, Pakistan. *Glob. Ecol. Conserv.*, **24**: e01351. <https://doi.org/10.1016/j.gecco.2020.e01351>
- Waseem, M., and Ali, A., 2011. *Sign survey report Asiatic black bear in district Mansehra District Mansehra, Khyber Pakhtoonkhawa, Pakistan*. April 2017.
- West, B.C., 2005. *Ecology and management of the Louisiana Black Bear*. Mississippi State University Extension Service.
- Woods, C.A., and Kalpatrick, W.C., 1997. *Biodiversity of small mammals in mountains of Pakistan. Biodiversity of Pakistan*. Pakistan Museum of Natural History, Islamabad, Pakistan, and Florida Museum of Natural History, Gainesville, Florida, USA, pp. 437-467.
- Young, B.F., and Ruff, R.L., 1982. Population dynamics and movements of black bears in east central Alberta. *J. Wildl. Manag.*, **46**: 845-860. <https://doi.org/10.2307/3808217>
- Zahler, P., Lhagvasuren, B., Reading, R.P., Wingard, J.R., Amgalanbaatar, S., Gombobaatar, S., Barton, N., and Onon, Y., 2004. Illegal and unsustainable wildlife hunting and trade in Mongolia. *Mongol. J. biol. Sci.*, **2**: 23-31. <https://doi.org/10.22353/mjbs.2004.02.14>



Supplementary Material

Population of Asiatic Black Bear (*Ursus thibetanus*) in Kaghan and Siran Valleys, District Mansehra, Pakistan

Zaib Ullah^{1*}, Sajid Mahmood^{2,3}, Zafar Iqbal⁴, Fakhar-i-Abbas⁵, Naveed Akhtar¹ and Abdul Majid Khan^{6*}

¹Department of Zoology, Hazara University Sub-Campus Battagram, Khyber Pakhtunkhwa, Pakistan

²Department of Zoology Hazara University, Dhodial Mansehra, Khyber Pakhtunkhwa 21120, Pakistan

³Department of Zoology, University of Chakwal, Punjab, Pakistan

⁴Department of Botany Hazara University, Dhodial Mansehra, Khyber Pakhtunkhwa 21120, Pakistan

⁵Centre for Bioresource Research, Islamabad, Pakistan

⁶Institute of Zoology, University of the Punjab, Lahore, Pakistan

Online First Article

* Corresponding author: zaibullah_zoology@hu.edu.pk, majid.zool@pu.edu.pk
0030-9923/2022/0001-0001 \$ 9.00/0



Copyright 2022 by the authors. Licensee Zoological Society of Pakistan.

This article is an open access  article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Supplementary Table I. Frequency of black bear signs (ER: Encounter Rate per transect) for each category of signs.

Transect code	Transect length (m)	Compartment Area (ha)	Dig Marks	Mostly appeared signs						Rarely appeared signs						Total
				Pug Marks	Claw Marks	Hair	Scat	Plants uprooting	Stone turning	Bark off	Livestock killing	Crop damage	Wood damage	Setting place	Bees hive damage	
K1	100	245.200	85(0.85)	2(0.02)	4(0.04)	1(0.01)		2(0.02)	1(0.01)	1(0.01)						96(0.96)
K2	300	115.300	12(0.04)		3(0.01)	2(0.006)		1(0.003)	1(0.003)	28(0.093)						74(0.245)
K3	100	170.400	4(0.04)		2(0.02)		1(0.01)	3(0.03)		2(0.02)						12(0.12)
K4	300	233.099	20(0.066)	1(0.003)		3(0.03)		2(0.006)	1(0.003)	1(0.003)						28(0.111)
K5	100	105.900	18(0.18)		8(0.08)	8(0.08)		4(0.04)	4(0.04)	6(0.06)	1(0.01)					49(0.49)
K6	100	90.244	6(0.06)		2(0.02)		1(0.01)		4(0.04)	2(0.02)						15(0.15)
K7	100	158.000	21(0.21)		2(0.02)		1(0.01)	2(0.02)	3(0.03)	3(0.03)						32(0.32)
K8	100	105.218	9(0.09)		8(0.08)			2(0.02)	1(0.01)	5(0.05)						25(0.25)
K9	100	99.148	3(0.03)	1(0.01)	2(0.02)			2(0.02)		1(0.01)			2(0.02)			38(0.38)
K10	300	77.699	20(0.66)	2(0.006)	8(0.026)			9(0.01)	6(0.02)	4(0.013)	1(0.003)					23(0.0.73)
K11	300	141.640	16(0.533)	3(0.01)	19(0.06)			7(0.023)	5(0.016)	1(0.0033)	1(0.003)					205(0.67)
K12	100	90.649	4(0.04)		2(0.02)	1(0.01)		1(0.01)	2(0.02)	1(0.01)	1(0.01)					12(0.12)
K13	100	125.453	5(0.05)		4(0.04)			2(0.02)		4(0.04)		4(0.04)				19(0.19)
K14	100	145.282	2(0.02)		1(0.01)			4(0.04)	6(0.06)	1(0.01)			2(0.02)			16(0.16)
K15	100	103.600	2(0.02)		8(0.08)			2(0.02)	2(0.02)	5(0.05)	2(0.02)					23(0.23)
K16	100	163.088	52(0.52)		4(0.04)		1(0.01)	5(0.05)	5(0.05)	3(0.03)					1(0.01)	116(1.16)
K17	100	113.312	3(0.03)		7(0.07)	2(0.02)		15(0.15)	9(0.09)							63(0.63)
K18	100	140.021	16(0.16)		1(0.01)		2(0.02)	7(0.07)		1(0.01)						27(0.27)
S19	400	40.468	33(0.0825)		5(0.012)	2(0.005)		3(0.007)		2(0.005)						45(0.11)
S20	300	75.676	28(0.093)	1(0.003)	1(0.003)	7(0.023)	1(0.003)	3(0.01)	1(0.003)	1(0.003)	1(0.003)		3(0.01)			46(0.151)
S21	100	63.535	4(0.04)	2(0.02)	1(0.01)	1(0.01)		4(0.04)					2(0.02)			50(0.5)
S22	100	56.656	5(0.05)		5(0.05)	4(0.04)		1(0.01)		1(0.01)	2(0.02)	1(0.01)				27(0.27)
S23	100	74.057	11(0.11)		1(0.01)	1(0.01)		1(0.01)				1(0.01)				15(0.15)
S24	100	106.432	9(0.09)		1(0.01)	2(0.02)				2(0.02)	3(0.03)					17(0.17)
S25	100	89.030	11(0.11)	1(0.01)		10(0.10)		3(0.03)	1(0.01)	1(0.01)			2(0.02)			29(0.29)
S26	100	35.612	3(0.03)		1(0.01)				1(0.01)	1(0.01)			4(0.04)			10(0.1)
S27	100	49.776	5(0.05)		2(0.02)			3(0.03)	2(0.02)						1(0.01)	13(0.13)
S28	100	112.503	2(0.02)		3(0.03)			2(0.02)		1(0.01)	1(0.01)					09(0.09)
S29	400	94.696	>200(>0.5)	2(0.005)	2(0.005)	8(0.02)		10(0.025)	1(0.002)	3(0.0075)	1(0.0025)		12(0.03)			139(0.59)
S30	100	126.262	>80(>0.80)	1(0.01)	2(0.02)	3(0.03)		20(0.20)	3(0.03)	2(0.02)			3(0.03)		2(0.02)	116(1.16)
S31	100	125.453	>60(>0.60)		4(0.04)	6(0.06)	1(0.01)	7(0.07)		4(0.04)			5(0.05)			87(0.87)
S32	100	70.010	3(0.03)		2(0.02)	3(0.03)	1(0.01)	6(0.06)		2(0.02)					1(0.01)	45(0.45)
S33	100	124.238	20(0.20)	2(0.02)	5(0.05)	1(0.01)	2(0.02)	8(0.08)	4(0.04)							43(0.43)
Total	4900	3667.657	1213	18	146	65	11	186	62	98	14	16	35	2	4	187
		(7.574)	(0.117)	(1.02)	0.514	(0.10)	(1.594)	(0.524)	(0.647)	(0.111)	(0.16)	(0.24)	(0.02)	(0.04)	(12.664)	

Keys for transect code: K, Kaghan; S, Sitan; Natural No, number of transect.

Supplementary Table II. Percentage of the standard encounter rate (SER) for highly potential site selection.

Transect code	Dig marks (%)	Pug marks (%)	Claw marks (%)	Hairs samples (%)	Scat samples (%)	Plants uprooting (%)	Stone replacing (%)	Bark off (%)	Place of Livestock's killing (%)	Crop damages (%)	Coarse wood damages (%)	Setting place (%)	Bees nest damaging (%)
(SER) model	≥0.30	≥0.02	≥0.05	≥0.02	≥0.02	≥0.03	≥0.03	≥0.03	≥0.02	≥0.02	≥0.03	≥0.01	≥0.02
K1	11.222	17.094											
K2			9.718					14.374					
K3				5.836		1.882							
K4													
K5			7.774	15.564		2.509	7.633	9.273					
K6							7.633						
K7							5.725	4.636					
K8			7.774					7.727					
K9	3.960												
K10	8.714												
K11	7.037							5.100					
K12													
K13								6.182		25.0			
K14						2.509	11.450						
K15			7.774					7.727	18.018	12.5			
K16	6.865					30.367	9.541	4.636				50.0	
K17	3.960		6.802	3.891		9.410	17.175						
K18					19.417	4.391							
S19													
S20				4.474									
S21	5.281	17.094				2.509							
S22			4.859	7.782					18.018	62.5			
S23													
S24				3.819					27.027				
S25				19.455		1.882					16.666		
S26													
S27						1.882							
S28													
S29	6.601			3.891							12.5		
S30	10.562			5.836			5.725				12.5		50.0
S31	7.921			11.673		4.391		6.182			20.833		
S32	3.960			5.836		3.764							
S33		17.094	4.859		19.417	5.018	7.633					50.0	
Total	76.083	51.282	49.56	88.057	38.834	70.514	80.148	65.837	63.063	100.0	62.499	100.0	50.0

Keys for transect code: K, Kaghan; S, Siran; Natural No, number of transects; blue color represent non-significant for highly potential sites.