



Status and Distribution of Himalayan Brown Bear

In Deosai National Park and its
Buffer Valleys, Gilgit-Baltistan



SURVEY REPORT 2022



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Report Summary

Deosai National Park (DNP) is the only habitat in Pakistan that harbors the last remaining stronghold of Himalayan brown bears (*Ursus arctos isabellinus*). When DNP was notified in 1993, despite being the only stronghold of brown bears, the brown bear population was declining, and it was at the verge of extinction. The conservation efforts then enabled the brown bears to recover their population. Unlike the brown bear habitats in Europe and America, the Himalayan brown bear lives in alpine plateaus that are devoid of dense vegetation, which makes the visual or direct counting of brown bears possible. We used the double observer survey method, which is based on the Capture Mark Recapture (CMR) model, the white patches of males, pelage color and size of brown bears makes it possible to identify groups of brown bears. We estimated 66 Himalayan brown bears in an area of 4,000 km² including DNP and its buffer valleys, at ± 95 confidence interval the population of Himalayan brown bears could be 58 to 77 individuals. The brown bears occupancy ranged from 0.00 to 0.04 animals/km². The survey team observed the presence of 19 camping sites that were either setup by transhumance tribes for facilitating themselves or their livestock, or locals to run different businesses. Those camping sites housed some 244 people. Additionally, around 4,834 livestock heads were present in DNP and in its buffer valleys. We recommend annual monitoring of Himalayan brown bear using robust techniques, sensitization of local people in the buffer valleys, and complete ban on transhumance grazing permissions in DNP and in its immediate buffer valleys.

1. Introduction

Brown bear (*Ursus arctos*) is a large mammal species that belongs to the family *Ursidae* of the order *Carnivora*. Brown bears are currently occupying approximately 5,000,000 km² in northwestern portion of North America, 1,200,000 km² of Europe without including its range in Russia, and much of northern Asia. The brown bears are resident to 45 countries within their range, while the largest population of brown bears live in Russia followed by USA (Alaska) and Canada (*Figure 01*). The brown bear populations in Europe and in southern parts of Asia and North America are small and isolated. The brown bear populations in south Asia are highly isolated, small and most of them are listed as “Vulnerable”, “Endangered” or “Critically Endangered” on IUCN Red List (McLellan et al., 2017).



Plate 1: Himalayan brown bear in Deosai National Park, Gilgit-Baltistan.

The sub-species of brown bear exist in Pakistan is Himalayan brown bear (*Ursus arctos isabellinus*) (Roberts, 1997). Historically the Himalayan brown bear was approximately distributed over an area of 150,000 km² in the western Himalayas, Karakoram, Hindu Kush, and Pamirs (Nawaz, 2007). Nawaz (2007) identified three populations and five sub-populations of Himalayan brown bear in Gilgit-Baltistan, the population in the Himalayas was considered largest followed by Karakoram and Hindu Kush.

Among the five sub-populations three are present in the western Himalayas i.e., Deosai National Park, Minimergh and Nanga Parbat, two sub populations are present in the Central Karakoram National Park (CKNP) and Khunjerab National Park (KNP) (Nawaz, 2007).

The sub-species Himalayan brown bear has not separately assessed by the IUCN Red List, but the IUCN Red List listed brown bear (*Ursus arctos*) as “Least Concern” (McLellan et al., 2017). Despite vast distribution range Himalayan brown bear listed as “Critically Endangered” by (Sheikh & Molur, 2004).

The food of brown bear in Pakistan is constituted of 64% plant matter and 36% animal matter (Nawaz, 2008), hence the apparent threat to brown bear in Pakistan is competition with livestock for high palatable vegetation. Additionally, brown bears are captured for bear baiting and to use their fate for human male potency (Nawaz, 2007). Anthropogenic activities and climate change (Ali et al., 2021) has declined the brown bear population from most of its distribution range in Pakistan except Deosai.

The brown bear population in Deosai National Park and its buffer valleys is the only largest surviving population of brown bear in Pakistan. To ensure the survival of this population, the managers and conservationists may need to know whether the brown bear population is declining or rising, knowledge of areas with sustainable brown bear populations, or to check whether enhanced protection measures have been resulted to an increased brown bear population or not. These questions could only be answered if the animal's population is monitored for longer time. Estimating how many individuals are in a population or area at a point in time (abundance, N) is one of the most effective ways to assess population status (Caughley, 1977).

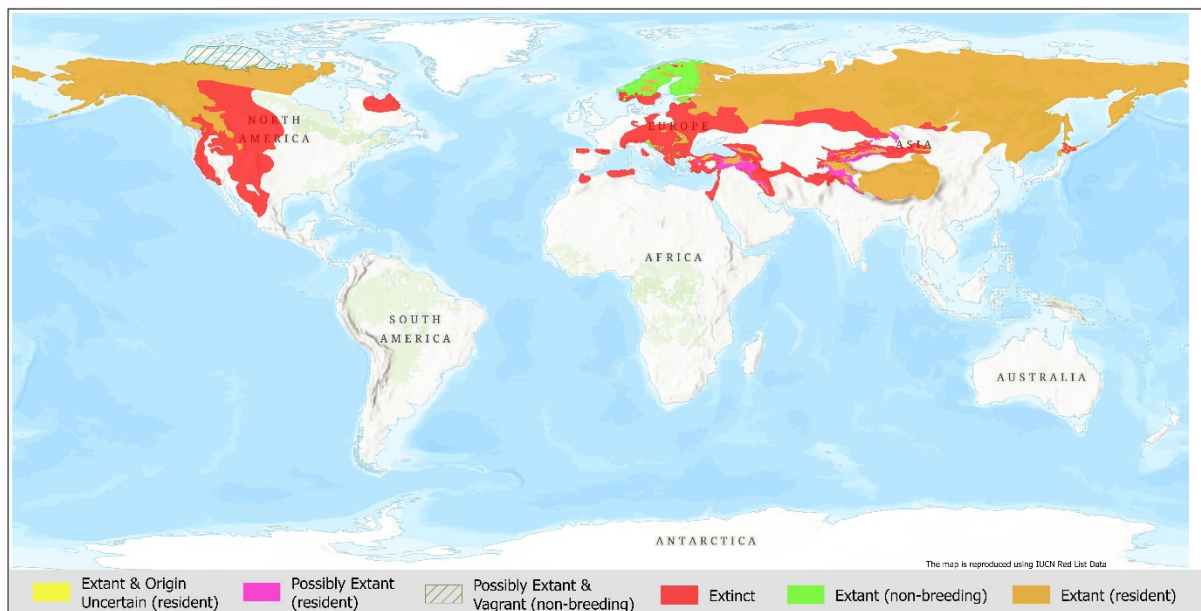


Figure 1: Global distribution range of brown bear.

Ecologists often prefer to estimate density ($D = N / \text{area}$) rather than abundance to assess change in brown bear numbers in any area over time. For reliable density estimation the population be geographically isolated with no entry and exit of brown bears (Tumendemberel et al., 2021). Though N or D are preferred methods, but both require intensive sampling. If intensive sampling are made the main challenge still remains, as it is rarely possible to observe or census all individuals due to the cryptic nature of brown bears and their low densities (Gopalaswamy et al., 2015).

The classical Capture Mark Recapture Model (CMR) becomes handy in these situations, where it is impractical to count every individual (Pradel, 1996). In CMR some individuals from a closed population are captured, they are marked and then released, they are again captured and check for number of marked and new captures in the second attempt. The prerequisite to accurately apply capture–recapture approach is identifying animals individually, which is a real challenge in applying capture–

recapture approach to Asian bears, as they all almost look similar (Amstrup et al., 2005). Sun bears, sloth bears and Asiatic black bears can be distinguished through patterns in their chest blazes, and some brown bears have prominent markings that can aid in individual recognition, especially in the Himalayan brown bear (Nawaz, 2008). As the focus of this study was Himalayan brown bear, therefore, it was decided to apply double observer survey method which is an extension of CMR with the following objectives.

- 1) To estimate population of Himalayan brown bears based on CMR.
- 2) To find the density of Himalayan brown bears in different watersheds of DNP and in its buffer valleys.
- 3) To suggest management recommendations to ensure survival of Himalayan brown bears in DNP and in its buffer valleys.

2. Material and Methods

2.1 Study Area

The study was conducted in Deosai National Park (DNP) and its buffer valleys/nullahs (*Figure 02*). DNP was notified as a national park in 1993, primarily to protect brown bears population. The Deosai plateau had only the remaining sizeable population of brown bears in Pakistan.

DNP is an alpine plateau of 1665 km² and is extended between (36.61° to 35.35° N and 74.53° to 76.25° E) in the east of Nanga Parbat Peak, Gilgit-Baltistan, Pakistan. The altitude of DNP ranges from 3,400 to 4,000 m, the central part of this park is relatively flat (0–10° slope), while the peripheral areas are steeper (up to 50° slope), in the peripheries the elevation reaches up to 5,300 m. Climatically DNP is considered one of the harshest locations, where the mean annual temperature may fall to -20 °C degrees and may hike to 12 °C. The annual mean precipitation oscillates between 510 mm to 750 mm and falls mostly as snow (Nawaz, 2008).

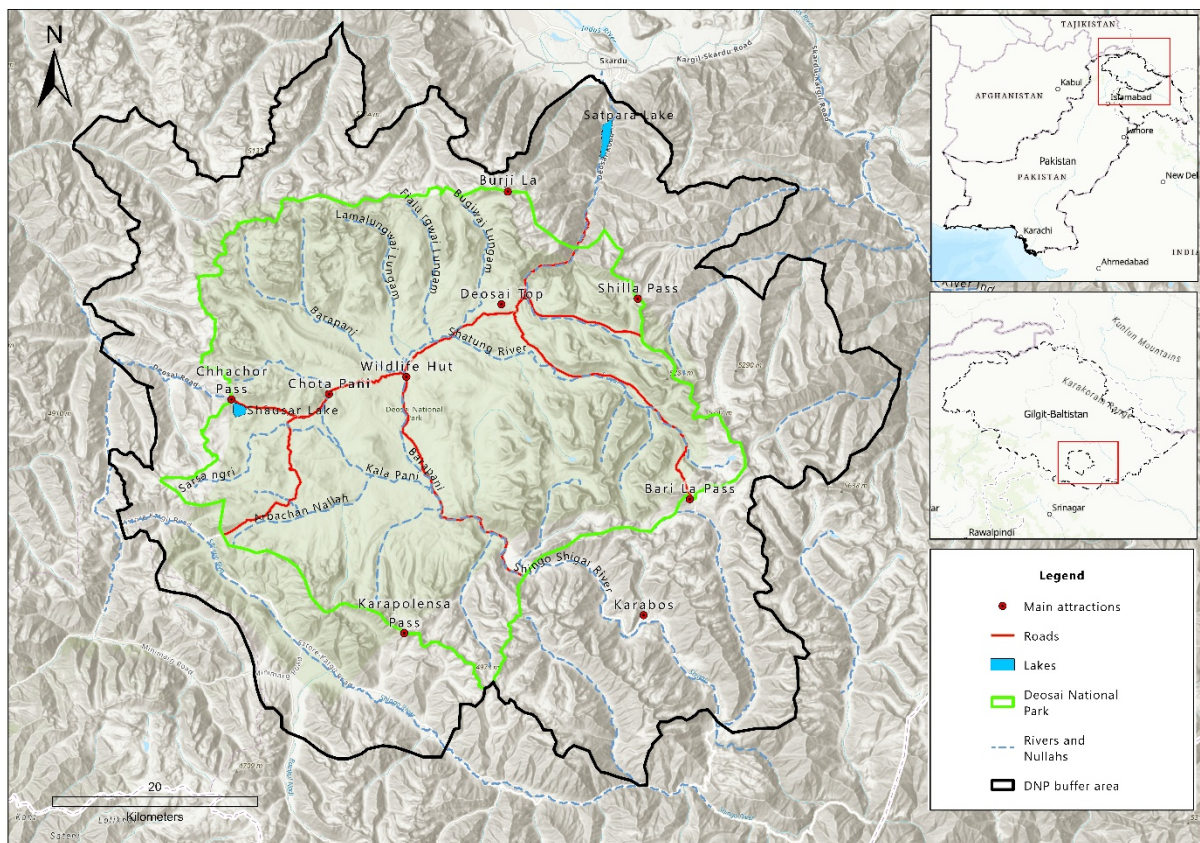


Figure 2: Study area green polygon (Deosai National Park), black polygon (Buffer valleys of DNP).

The land area of DNP is a representative of four habitat types including marshy, grassy, stony, and rocky. The vegetation that dominates in these habitat types is perennial herbs, grasses, and sedges.

Marshy habitat is dominated by *Poa* and *Carex* spp., with some herbaceous plants. Grassy habitat is dominated by the Poaceae family, and stony habitat has a great variety of herbaceous flowering plants. Rocky habitat is generally devoid of vegetation. Marshy habitats contribute most to the forage production, followed by grassy and stony vegetation habitats, whereas rocky areas are unproductive. The surrounding valleys have habitats distinct from the park (coniferous forest, shrubs, rocky and grassy slopes) (Nawaz, 2008).

Wildlife species besides brown bear include Tibetan wolf (*Canis lupus chanco*), Himalayan ibex (*Capra sibirica*), Tibetan red fox (*Vulpus vulpus montana*), golden marmot (*Marmota caudata*) and 17 other small mammal species (Nawaz, 2007).

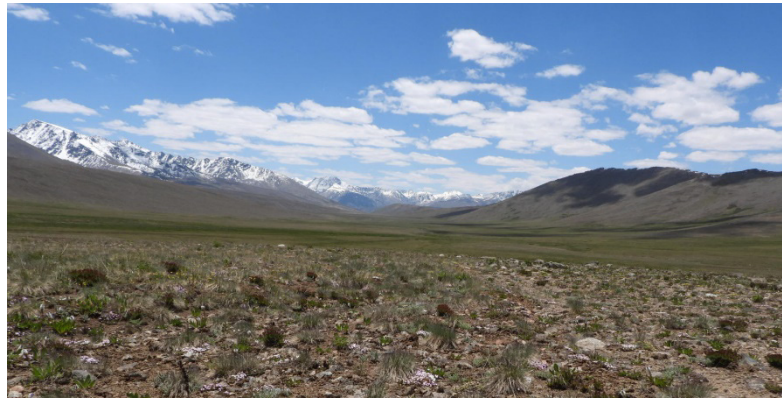


Plate 2: Typical Himalayan brown bear habitat in Deosai National Park.

The harsh climatic conditions make DNP only usable during the summer months, and hence makes less favorable for any permanent habitation. Many permanent settlements exist along the periphery of DNP among them Sadpara, Shilla, Dappa and Karabos the valleys which have grazing rights inside the DNP core area. In addition to these permanent communities, transhumance (*Bakarwals* or *Gujjars*), come from the lowlands (Nawaz, 2007).



Plate 3: Marmot the main prey species of Himalayan brown bears.



Plate 4: A common flowering plant of Himalayan brown bear habitat.

2.2 Double Observer Method

Unlike the brown bears habitat in Europe and America, in Pakistan their habitat is devoid of dense forests and understory vegetations, which makes possible the direct sightings of brown bear from (2-3 km) (Nawaz, 2007). We used double observer survey method (DOSM) for brown bear estimation. In Pakistan DOSM has been mostly used for estimating ungulates population (Ahmad et al., 2020; Ali et

al., 2019; Khattak et al., 2019; Suryawanshi et al., 2012), but it has also been used for estimating brown bear population in DNP (Hameed et al., 2013).

The double observer survey method (DOSM) was developed to estimate the detection probabilities of different wild species (Cook & Jacobson, 1979), while (Magnusson et al., 1978) added the ability in the analysis to measure the detection probabilities of each observer to detect the target species. DOSM is based on the principles of Capture Mark Recapture (CMR). This method usually involves two observers, scan for and count animals simultaneously, without signaling each other about the location of animal. The two observers conduct the survey as independent surveyors. Hence, an individual group of animals becomes the unit that is being “marked” and “recaptured” in a double observer technique.



Plate 5: Himalayan brown bear survey team.

DOMS requires dividing the study area into manageable small watersheds that should not be larger than the daily movement ability of animals and surveyors. The high ridges hinder the movement of animals to adjacent watersheds and hence evades the suspicion of evading of animals to the next watershed.

The blocks could be surveyed using two possible approaches i.e., the observers start the survey simultaneously on the predetermined routes, if two routes are available, which will be termed as “spatial separation”, or the observer B start moving into watershed after pre decided time, if only one route is available in this case it will be termed as “temporal separation”.

2.3 Data collection in the field

2.3.1 Survey maps

We divided 4,000 km² (including DNP area (1665 km²) and its buffer valleys (2,335 km²) into 49 survey blocks of varying area (17 – 370 km²) using ArcGIS Pro ver.3.0.1 (ESRI, Redland, CA, USA) (Figure 03).

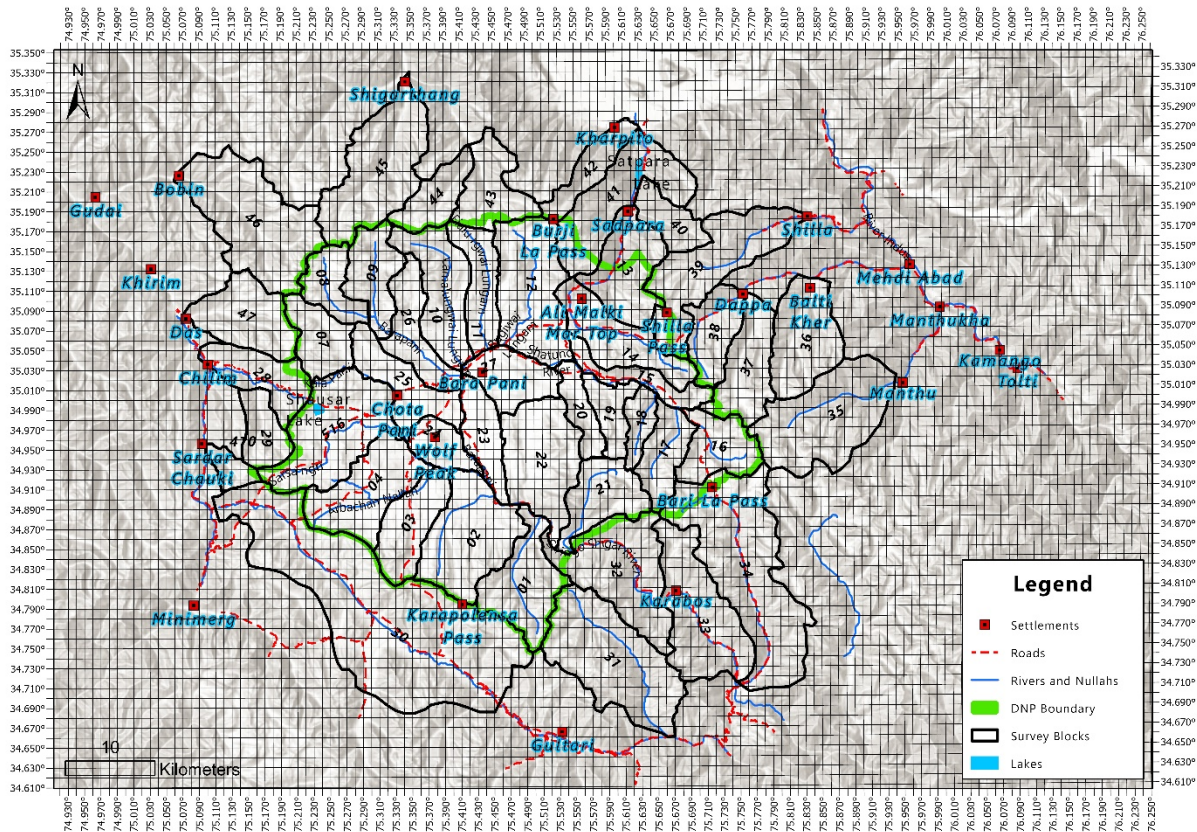


Figure 3: Survey blocks developed using Arc GIS Pro for DOMS.

2.3.2 Scanning for Animals

The teams were sent for survey after training them in using map and data collection format. Brown bears usually spent many hours in search of food; hence, the survey teams started surveying for brown bears at very early hours to complete dusk. The scanning for brown bears was aided with spotting scopes (Swarovski, 30x70), and binoculars (Nikon, 10x50). Whenever, any brown bear group was sighted the information required to record in the field data collection sheet was recorded, using Geographical Positioning System (GPS) Garmin™



Plate 6: A survey team member is scanning for Himalayan brown bear during the survey.

(64S, 66S and 66st) the location of observer was recorded, and the location of brown bear group was marked on the map.



Plate 7: Training sessions for survey team in map reading and GPS handling.

2.3.3 Demographic classification

As the “Capture Recapture” could only be accurately apply on any wildlife species, if they are dimorphic or possible to identify based on age classes or group size (Suryawanshi et al., 2012), using demographic classification suggested by (Hameed et al., 2013) (Table 1). The brown bears were identified based on 1) size (small, medium, and large 2) sex (male/ female and yearling 3) classification of cubs (C1, C2, C3 and U) (Table 01). The pelage of brown bears is another distinguishing feature, brown bears were tried to classify based on pelage color i.e., blonde, sliver-tip, light brown, and dark brown. Brown bears often have white patches the brown bears were tried to identify based on absence or presence of white patches or location of white patches i.e., snout, ear tips, shoulder, neck, or any other location.

Table 1: Demographic classification suggested by Hameed et al., 2013 for brown bears.

Size			Sex			Cubs Classification			
Small	Medium	Large	Male	Female	Yearling	C1= Cub One year Old	C2=Cub Two-Year- Old	C3= Cub Three- Year-Old	Unidentified

2.3.4 Habitat features of groups

To aid identification of same or different individuals of brown bears or brown bear groups, habitat features where brown bears were present were also recorded i.e., marshy, grassy, stony, and rocky. To ascertain whether the brown bears had given the chance to observers to count well, the behavior of brown bears while sighting was also recorded i.e., grazing, digging, walking, resting, mating, nursing or any other. Brown bears have weak eyesight, but they are strong at sniffing so to ascertain whether brown bear had become aware of observer's presence, wind speed at the time of sighting was also recorded i.e., light, moderate, or strong.

2.3.5 Post Survey Discussion

Both observers matched the field records in the evening to ascertain repeated and single sightings based on size, sex or cub number, pelage color, presence or absence of white patches, habitat type, location, and behavior. The information was then compiled in the summary sheets for population estimation analysis.



Plate 8: Post survey discussions of survey team.

2.4 Analytical Approach

The estimated population, detection probabilities, mean group size and variance in the group size were calculated by using formulas following (Forsyth & Hickling, 1997).

2.4.1 Estimated Number of Groups

$$G = (B+S1+1) (B+S2+1) / B+1-1 \quad (1)$$

Where,

S1 = number of groups sighted by observer 1

S2 = number of groups sighted by observer 2

B = number of animal groups sighted by both observers

N = population estimated (rather than the number of individuals)

2.4.2 Estimated Population Size

Population size estimated as the number of groups in the population multiplied by the mean group size (Choquenot, 1990).

$$\check{N} = \hat{G} \hat{u} \quad (2)$$

Where,

\check{N} = estimated population as the product of estimated number of groups \hat{G} and mean group size

The variance of estimated population, $\text{Var}(\check{N})$ is the variance of the product of independent random variables (Goodman, 1960).

2.4.3 Variance in Estimated Population

$$\text{Var}(\check{N}) = \hat{G}^2 \text{Var}(\hat{u}) + \hat{u}^2 \text{var}(\hat{G}) - \text{Var}(\hat{G})\text{Var}(\hat{u}) \quad (3)$$

Where,

$$\text{Var}(\hat{G}) = \frac{S1S2(S1+B1+1)(S2+B+1)}{(B+1)^2(B+2)} \quad (4)$$

S1 = number of groups sighted by observer 1

S2 = number of groups sighted by observer 2

B = number of animal groups sighted by both observers

2.4.4 Confidence Interval

Confidence intervals were calculated for each population estimated in each conservancy using the following formula (Forsyth & Hickling, 1997).

$$\check{N} \pm z_{\alpha/2} \text{se}(\check{N}) \quad (5)$$

2.4.5 Estimating Density

The density was estimated by dividing the total number of animals by the surveyed area (Suryawanshi et al., 2012).

$$D = (\text{Total number of animals sighted}) / (\text{surveyed area}) \quad (6)$$

2.4.6 Detection Probability

We used multinomial regression to determine the detection probability of observers with three possibilities for each herd in the study area:

- i. Herd sighted by observer OB-1 only,
- ii. Herd sighted by OB-2 only and/or
- iii. Sighted by both observers (Unique sighting).

Based on the “Walt test” (Yan & Su, 2009), the significance variable was selected for our model and according to p-value criteria removed the insignificant variables from the model.

3. Results

Using double observer survey, we estimated 66 individuals (95% CI 58 – 77) of Himalayan brown bears in DNP and in its buffer valleys. The survey team encountered with Himalayan brown bears at 37 locations. The mean group size was 1.83 (variance ± 0.01) with a detection probability of 0.95 for observer 1 and 0.62 for observer 2 (Table 02). In DNP, 27 sightings were recorded, while 11 sightings were



Plate 9: Adult Himalayan brown bear sighted during the survey.

recorded in the buffer valleys of DNP (Figure 4). Inside DNP, 43 Himalayan brown bears were sighted, while in the buffer valleys, 23 Himalayan brown bears were sighted (Table 03 and Figure 4).

Table 2: Parameter estimates of double observer survey method.

Estimates parameters	
Number of Groups sighted by both observers	23
Number of Groups sighted by observer one only	14
Number of Groups sighted by observer two only	0
Estimated number of groups	37
Mean Group size	1.83
Estimated population	66
Variance in mean group size	0.01
Variance in estimated number of Groups	0.00
Variance in estimated population	12.29
+ 95% Confidence interval (Himalayan brown bear population)	58 - 77
Detection probability Observer 1	0.958
Detection probability Observer 2	0.622

Table 3: Number of Himalayan brown bear sighted in DNP and in its buffer valleys.

S. No	Survey Block	Numbers of Bears	Valley Conservation status
1	Fialong	5	DNP
2	Burjila	1	DNP
3	Shatung	4	DNP
4	Lamalong	2	DNP
5	Bara Pani	3	DNP

S. No	Survey Block	Numbers of Bears	Valley Conservation status
6	Bowl and Stadium	2	DNP
7	Wolf Peak Area	4	DNP
8	Marshi Lake	2	DNP
9	Black Hole	4	DNP
10	Sarsungri	4	DNP
11	Murtaza Top	6	DNP
12	Kala Pani	3	DNP
13	Sher Qulli Nullah	2	Buffer Valley
14	Sardar Kothi	1	Buffer Valley
15	Lolo Top	2	DNP
16	Ali Malik Mar Top	1	DNP
17	Shela	1	Buffer Valley
18	Lay Longma	3	Buffer Valley
19	Ribu Nullah	2	Buffer Valley
20	Dappa	2	Buffer Valley
21	Shawarun	2	Buffer Valley
22	Sheosar Lake Area	2	DNP and Buffer Valley
23	Sadpara Shikari	2	Buffer Valley
24	Karabosh	3	Buffer Valley
25	Bobin Nullah	3	Buffer Valley

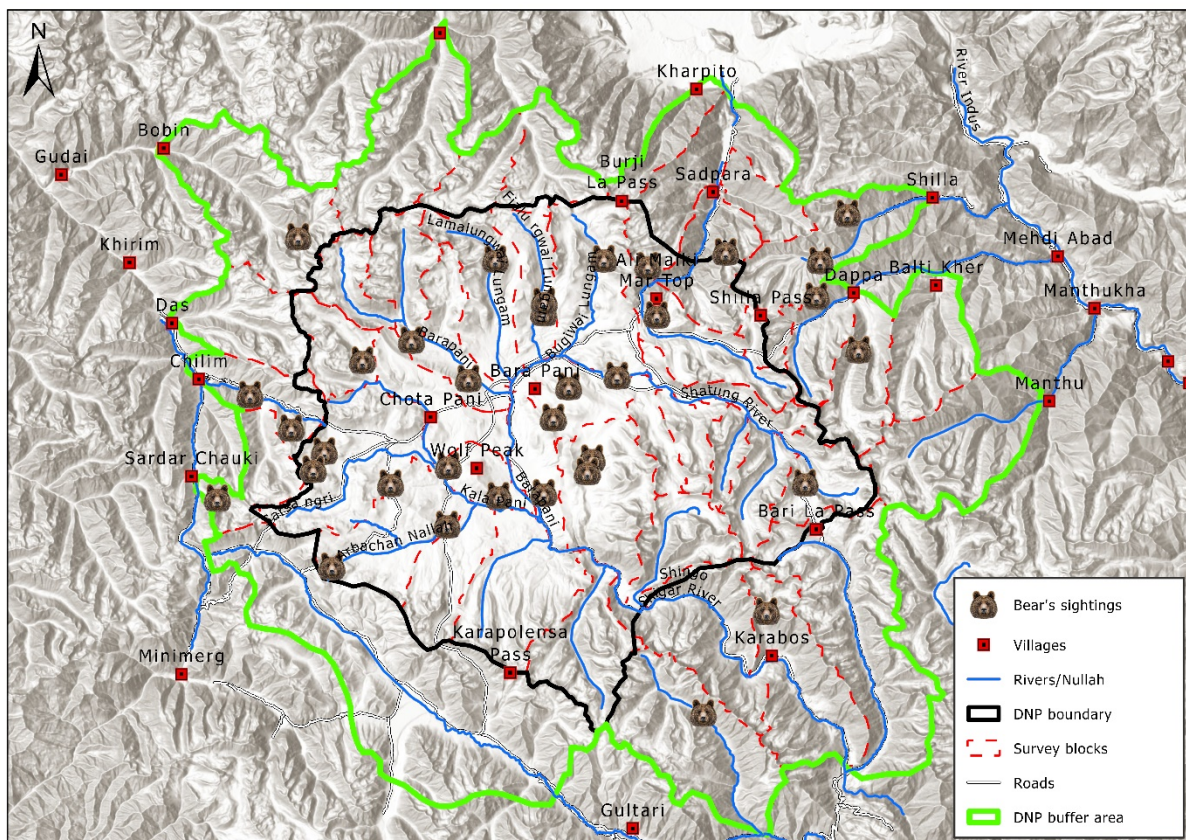


Figure 4: Sighting locations of Himalayan brown bear in DNP and in its buffer valleys.

3.1 Demography of Himalayan Brown Bears

A total of 66 Himalayan brown bears sighted in DNP and in its buffer valleys, among them 26 were identified as males, 23 as females and 17 as cubs (Figure 5). The comparative figures during the last three surveys in DNP show a steady increase in the Himalayan brown bear population in DNP. Based on the available literature in 2008 survey the bear population in DNP was 43 (Nawaz, 2008), in 2013 the survey shows the number as 56 (Hameed et al., 2013) and a survey in 2022 estimated the number as 77 (Naeem et al., 2022) (Figure 6).



Plate 10: Himalayan brown bear cubs sighted during the survey.

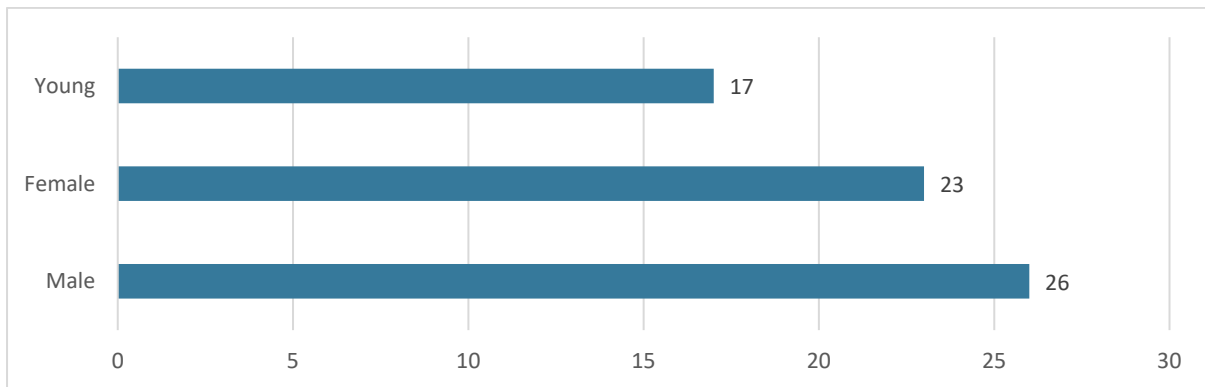


Figure 5: Demography of Himalayan brown bear recorded during the survey.

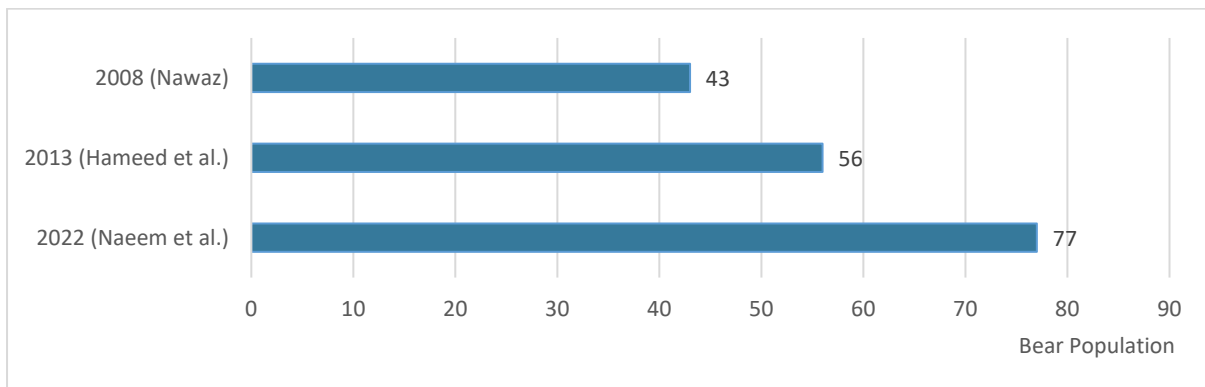


Figure 6: Population trends of Himalayan brown bear reported from 2008 to 2022.

3.2 Density of Himalayan brown bears

The density of Himalayan brown bears per square in the DNP and its buffer valleys is between 0 to 0.09 animals/km² in different survey blocks/Nullahs. The highest occupancy of Himalayan brown bears/km² was observed in the survey block wolf peak area, black hole area, and Bara Pani (Figure 7).

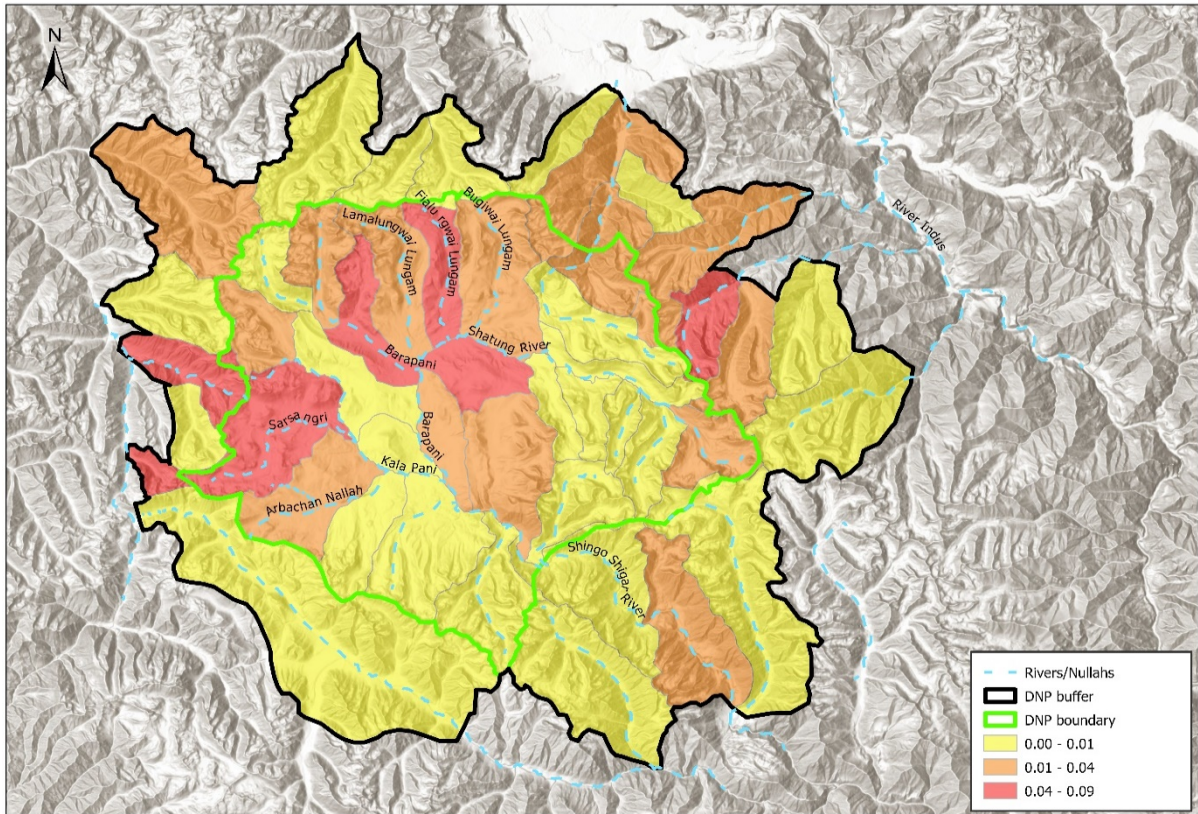


Figure 7: Density of Himalayan brown bear in different survey blocks.

3.3 Human Presence inside DNP

The transhumance tribes (*Gujjars* or *Bakarwals*) brought their livestock to Deosai National Park. The survey team observed 12 Camps sites, 66 tents and 173 people living in those tents. Those 173 people facilitated herding of a total of 4,834 livestock including 3,460 goats, 1,234 sheep, 138 mules or horses. In addition to transhumance tribes, the survey team observed 6 locations where restaurants,



Plate 11: Camp site at Deosai National Park.

shops or accommodation services were setup to facilitate tourists, and 59 people were present there to serve the customers. While DNP, watch and ward camp had 12 wildlife watchers (Figure 8).

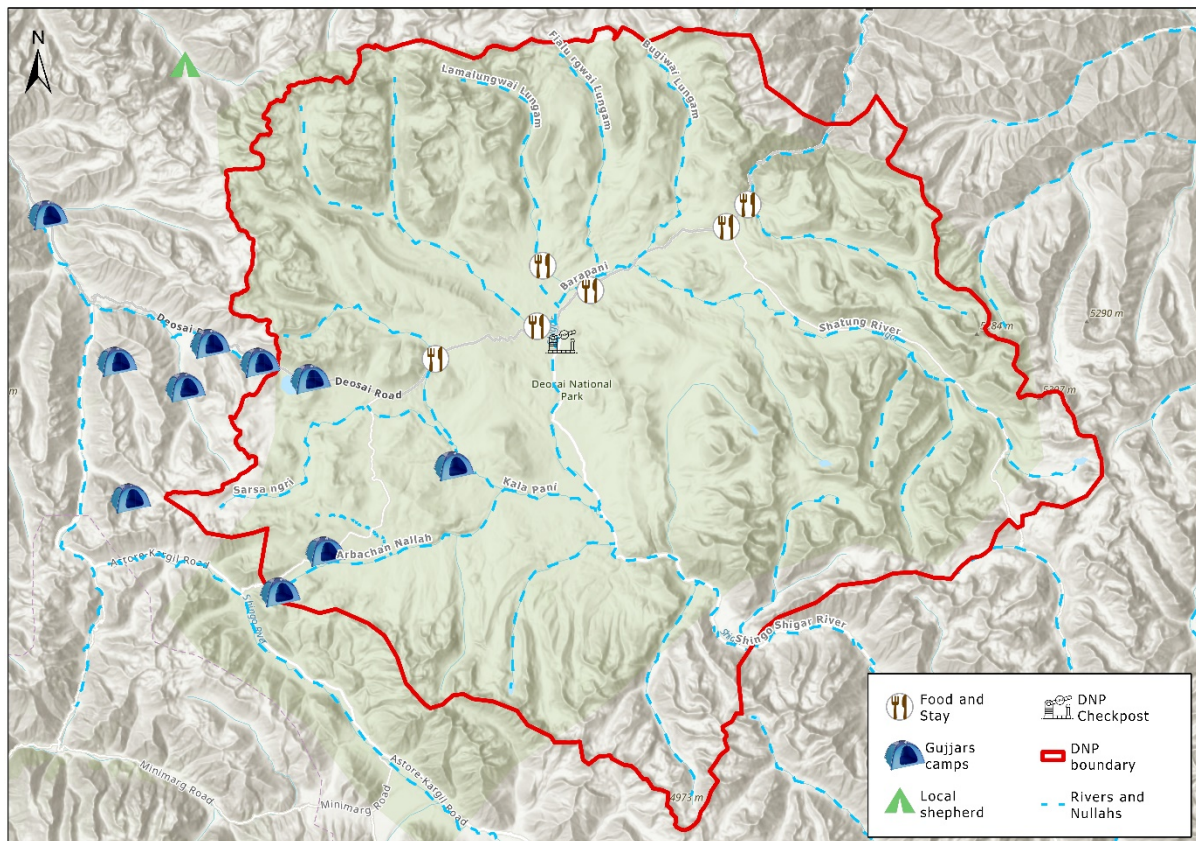


Figure 8: Camp locations used by shepherds and for tourist facilitation.



Plate 12: Camping site at Deosai National Park.

4. Discussion

Himalayan brown bears in Pakistan were distributed approximately on 150,000 km², in three major populations i.e., Himalayas, Hindu Kush and Karakoram-Pamirs. The brown bear population in the western Himalayas was most stable among them, especially that of the Deosai National Park (DNP) (Schaller, 1977; Nawaz, 2007).



Plate 13: Tourist influx into Deosai National Park.

the verge of extinction (Nawaz, 2008).

The Himalayan brown bear had extirpated from majority of their historical range, as they were killed to extract their fat, and their cubs were captured to use in bear baiting (Nawaz, 2007). The notification of DNP in 1993 and subsequent conservation projects run by the Himalayan Wildlife Foundation (HWF) helped the brown bear population to recover from the

During 1993 to 2008, Himalayan brown bears were extensively monitored using the direct count method (Nawaz, 2008). In most of brown bear range, direct counting is not possible as brown bears live in dense forest, but Himalayan brown bear especially the bear population of Deosai and its buffer valleys live in a habitat that is devoid of dense forest and understory vegetation (Morin et al., 2022), hence making direct counts of brown bear possible (Nawaz, 2007).



Plate 14: Transhumance tribes livestock in side DNP.

The valuable outcome of the monitoring and genetic tracking of Himalayan brown bears by (Nawaz, 2008) was the baseline population of estimates of the Himalayan brown bear using direct count, which was 38 Himalayan brown bears, and 40 to 43 brown bears through the DNA barcoding technique (Bellemain et al., 2007).

Hameed et al. (2013) reported 56 Himalayan brown bears in DNP and its buffer valleys. No other scientific study estimated Himalayan brown bear since 2012 in DNP and in its buffer valley, even though monitoring of species using effective and efficient methods is important to gauge the effectiveness of conservation efforts made for protection of threatened species (Morin et al., 2022).

This study used double observer survey method recommended by (Hameed et al., 2013) and estimated 66 Himalayan brown bears, using the Capture Mark Recapture method. This study estimated 58 to 77 Himalayan brown bears, at 95% confidence interval. The results of this study were very similar to (Hameed et al., 2013), as only 21 Himalayan brown bears have been increased, the reason for slow population growth could be the migration of brown bear from DNP and its buffer valleys, as now DNP has become a tourist attraction besides heavy grazing pressure from Gujjars livestock (Hameed et al., 2013).



Plate 15: A Golden marmot is feeding on left over tissue paper.

5. Management Recommendations

1. Beside its annual population surveys, Parks and Wildlife Department should conduct population survey of Himalayan brown bear every three years involving conservation organizations, and academia.
2. The entry of transhumance tribes should be totally banned in and around DNP.
3. The private hotels and restaurants should be banned in DNP and in its immediate buffer.
4. There should be solid waste management in DNP and its buffer valleys.
5. Tourists should be guided to avoid close encounters with brown bears, and not to offer any food item to brown bears.
6. There should be a compensation scheme for local people in the DNP buffer valleys to compensate them against crop raiding and livestock predation by Himalayan brown bear.
7. The current field staff of DNP are low in number to protect Himalayan brown bear in DNP and in its buffer valleys.
8. During the summers the DNP flat terrain makes it possible to drive the vehicles to almost each corner of the DNP, and tourists takes vehicles to each corner, to ensure the protection and monitoring of tourist activities, the field staff of DNP must be provided with motor bikes, and vehicles.
9. We Recommend creation of two check posts at Murtaza Top and Bari La Top.

6. References

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