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# DENSITIES AND POPULATION SIZES OF LARGE MAMMALS IN KISHTWAR HIGH ALTITUDE NATIONAL PARK, JAMMU AND KASHMIR, INDIA

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ABSTRACT

Large mammal census exercise was conducted in Kishtwar High Altitude National Park to estimate their populations using Belt Transect Count approach. For seven common species of large mammals, the densities (number of animals/ $km^2$) estimated from our survey were 0.2 mean ± 0.1 95% CI (Red deer, *Cervus elaphus hanglu*), 0.18 mean ± 0.04 95% CI (Musk deer *Cervus chrysogaster*), 1.73 mean ± 0.56 95% CI (Goral, *Nemorhaedus goral*), 1.76 mean ± 0.24 95% CI (Himalayan ibex, *Capra ibex*), 3.45 mean ± 1.79 95% CI (Common langur, *Semnopithecus entellus*), 7.1 mean ± 0.69 95% CI (Rhesus macaque, *Macaca mulatta*) and 0.29 mean ± 0.04 95% CI (Yellow-throated martin, *Martes flavigula*). We estimated 60 - 90 Musk deer, 4 - 20 Red deer, 527 - 1036 Goral, 684 - 900 Himalayan ibex, 747 - 2360 Common langur, 2884-3508 Rhesus macaque and 109 - 148 Yellow-throated martin. The sex ratio of Rhesus macaque was 1 male : 2 female and age composition being 2.94 adults : 1 young. Similarly, 2.5 females were available for every male with age composition being 3.23 adults : 1 young.

*Key words:* Kishtwar, Mammals, Age and Sex Ratio, Abundance and Checklist.

## Introduction

Previous workers (Kichloo, 1992; Parsa, 1999) conducted accidontal surveys in Kishtwar High Altitude National park and recorded 15 mammalian species. Baba (2003) estimated Himalayan ibex (*Capra ibex*) population but unscientifically. Thus, authentic information on animal abundance, population sizes and structures in Kishtwar lacked for mammal in general and for large bodied mammals in particular who critically influence forest structure and functioning besides being seriously threatened by anthropogenic pressures. Consequently, there is some uncertainty about mammalian distribution in the park.

For assessing their populations, surveys of sign encounters are widely used because of their practicality. However, these yield unreliable results because of their failure to address the problem of imperfect detection. We, therefore, undertook a study that primarily aimed to estimate populations of large mammals and to generate baseline data for monitoring populations of these groups in Kishtwar High Altitude National Park vis-à-vis developing a census protocol which is likely to be followed in future for monitoring populations of key animal species. An attempt has also been made to add on the existing checklists of animal species.

## Study area

Kishtwar High Altitude National Park is located between $33^0$ 20' and $34^0$ 04' North latitude and $75^0$ 40' and $76^0$ 10' East longitude. The park encompasses an area of over 1700 $km^2$, including 450 $km^2$ area (roughly 30% of the landscape) under forest cover (see map). Over 70% of the park area is under glacier. Most of the landscape inside the park is rugged and hilly with steep slopes and high ranges broken by cliffs and narrow valleys. The altitude ranges between 1200 and 4800 m amsl. Numerous small streams drain into Nanth, Kiyar and Kibber nalahs (streams) which further drain into river Marwah that finally merge into river Chanderbhaga at Bhandarkot forming river Chenab. There are 31 administrative units or forest compartments (Compartment No. 19 to 38 of Dachhan Range and 77 to 87 of Marwah Range) under the notified limits of Kishtwar National Park.

The floristic component of the sanctuary is rich and diverse due to marked variations in topography, climate and altitude. Champion and Seth (1968) have described major vegetation communities of the park. These communities support diverse avian and mammalian communities. Previous expeditions conducted in the park reported 18 species of mammals including

Kishtwar High altitude National Park was found to have estimated 60-90 musk deer (*Cervus chrysogaster*) 4-20 red dear (*C. elaphus*), 527-1036 goral (*Nemorhaedus goral*) 684-900 Himalayan ibex and considerable number of other large mammals.

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populations of several species of global conservation priority (e.g. Himalayan black bear, brown bear, Ibex, Indian common leopard, goral, hangul and Himalayan tahr).

## Method

### *Animal Census*

For estimating populations of mammals in Kishtwar High Altitude National Park, Block Count Surveys of targeted animal groups were conducted. The preferred method for estimating populations of target animal groups was counting their numbers within Belt Transects (Sutherland, 1996). The landscape identified for estimating populations of the targeted animal groups covered most existing administrative units and major habitat types/ vegetation communities occurring inside the park.

Transects were identified on map on 12 March 2006 after discussion held with the concerned wildlife officials. The major criteria for identifying transects were major habitat types. Transects were re-identified on ground between 13 and 18 March 2006 during a reconnaissance survey of the park for their ground verification. Though initially census exercise was planned between 19 and 23 March 2006 but we were unable to conduct survey due to fresh heavy snowfall in the higher reaches of the park on 18 and 19 March 2006. We variably opted this time because nomadic graziers (Bakkerwals/ Gujjars) descends down to the lower reaches of Jammu region during winter and therefore park experiences minimum biotic interference in the form of livestock grazing. Also, most of the animal species descend down to the lower reaches in the winter due to heavy snowfall on the higher reaches and therefore it becomes easier to approach them.

We followed sample count strategy with Belt Transect Method (Sutherland, 1996). Nalas (streams) and major trails were identified inside the park with the aim of permanently marking starting and ending points of these transects with the help of metallic plates and also recording geographic locations of these points using GPS for future references after survey is over. We variably opted for nalas for sampling areas for posterity and therefore lay down transects along Kibber Nala, Nanth Nala, Kiyar Nala and Marwah Nala. Transects were established at considerable distances from each other in order to avoid double counts of animals and were long enough for covering larger landscape. The identified nalas and trails have also been identified on topo maps. Each transect was scanned by a team of five observers and each observer scanned 10-meter area on his both sides. Thus, observers maintained a distance of 20-meter from each other during transect walk. In all, 25 Belt transects of 100 meter fixed width but of variable lengths (Table 1) were laid in the study area. These transects were walked by 35 wildlife professionals accompanied by 140 observers each day for data collection.

Since it was difficult to provide gadgets like binoculars, pedometers and magnetic compass to all observers because of logistic constraints therefore we adopted a method that addressed all these issues. In the absence of such gadgets, the best possible way was to establish belt transects and scan these transects thoroughly on regular basis. The length of transects was determined following non-conventional way of approximate estimation of distance traveled by an observer. For the purpose, we identified a known 200-meter long trail on ground. We asked each wildlife professional to walk this distance 2 to 3 times and recorded time taken by him to cover the said distance. We took mean time taken for covering the distance and extrapolated mean time taken data to walk a kilometer. The aim was to develop a census protocol, which even low ranked wildlife staff could follow easily and a method that is cost effective as compared to other census methods.

All transects were scanned on 25 March 2006 and were repeated for counts on consecutive days i.e. 26 and 27 March 2006. Animal counts was undertaken simultaneously in all transects with sunrise and ended between 1100 and 1300 hours depending upon the length of transect. The same schedule was followed on consecutive days.

We also imparted animal identification training to the observers involved in animal census. The census participants were shown pictures of Himalayan black bear (*Salenarctos thibetanous*), brown bear (*Ursus arctos*), common langur (*Semnopithecus entellus*), goral (*Nemorhaedus goral*), hangul (*Cervus elaphus hanglu*), Himalayan tahr (*Hemitragus jemalhicus*), Himalayan fox (*Vulpes vulpes*), Himalayan ibex (*Capra ibex*), Indian leopard (*Panthera pardus*), Indian porcupine (*Hystrix indica*), Indian jackal (*Canis aureus*), jungle cat (*Felis chaus*), leopard cat (*Felis bengalensis*), rhesus macaque (*Macaca mulatta*), snow leopard (*Uncia uncia*) and yellow-throated martin (*Martes flavigula*). They were also acquainted with local names of these species besides making them aware of indirect identification signs (scats /pallets / hoof marks /pug marks /scrape marks).

The observers were also trained in walking across transect at 20-meter fixed distance from each other for searching 10-meter area on both sides. They were instructed and trained to maintain as much silence as

they could have on transect walk so that all animals within transect could stay back until detected by them. The animals seen within transect were enumerated as per pre-designed data format. The total number of animal seen, time of their sighting, direction of their movement, sex of animal and their activities were the features that were recorded by the observers. Additionally, the observers were also instructed to record indirect signs of animals (e.g. pallets and hoof marks of ungulates, scats and pug marks of carnivores, etc.) during transect walk in order to confirm presence of other animal species in the study area. By recording the time of sighting and direction of movement of the animal, it made possible to reduce the total count to account for those evidently seen more than once by two different observers in the same transect on the same day.

All teams were grouped into five troops, each headed by wildlife officer as an in-charge of the major nala. These troops were posted in Kiyar Nala, Kibber Nala, Nanth Nala and Marwah Nala for undertaking census exercise simultaneously in between 25 March 2006 and 27 March 2006.

### Data Analysis

We dropped data of two transects permanently from all analysis because the quality of data from those sample areas was not satisfactory. Animal densities per unit area at a given day were calculated as the total number of individual of a species seen on all transects on that particular day divided by the total area of all transects. We produced mean densities (number of animals per $km^2$) of each species with their 95% confidence interval and multiplied average densities of each species with its confidence interval value to estimate population size in the wild. All statistical analysis tests were performed in accordance with Sokal and RohIf (1995). Through intensive exploration of Kishtwar landscape, discussion held with village people and local forest guards, and recording animal species over established transects during census exercise, a comprehensive checklist of mammals was also prepared.

## Results

### Sampling efforts

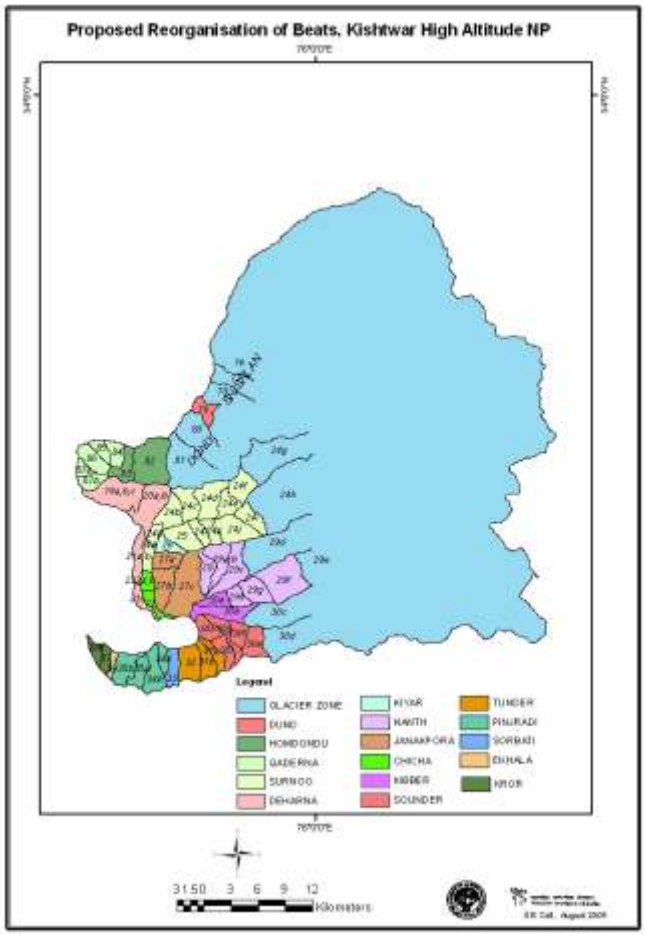
We sampled a total of 15.16 $km^2$ area in Kishtwar High Altitude National Park for estimating populations of wild animals. A total of 336 hours of effort was put in the three days population estimation exercise in active search of animals and their signs in Kishtwar High Altitude National Park. All teams travelled a distance of 151.59 km in every day in all transects during active search of animals.

### Species Richness

A rich diversity of mammalian fauna occurs within Kishtwar High Altitude National Park. So far 33 mammal

Table 1 : Details of transects walked in Kishtwar High Altitude National Park

| Transect code | Location | Compartment Number | Km length | Transect feature | |
|---|---|---|---|---|---|
| | | | | Start point | End point |
| 1 | Ekhala | 38 A | 5.00 | Ekhala | Wazeer Ghota |
| 2 | Ekhala | 35 and 36 | 5.00 | Sukh Nar | Sukh Nar top |
| 3 | Ekhala | 37 | 6.00 | Nagradi | Nar Dadu |
| 4 | Kibber Nala | 30 E and 30 F | 6.00 | Boor Har | Tung Nar |
| 5 | Kibber Nala | 30 B | 10.00 | Hang Dal | Hangdal top |
| 6 | Kibber Nala | 30 B | 5.50 | Magal Gam | Longdang |
| 7 | Kibber Nala | 30 B | 5.32 | Kharhoi | Ajnar |
| 8 | Kibber Nala | 30 B | 10.00 | Dashing Bungnarag | Hang Dul |
| 9 | Kiyar Nala | 26 | 5.00 | Ganian | Malgoot |
| 10 | Kiyar Nala | 24 C | 7.50 | Chambri | Chambri Top |
| 11 | Kiyar Nala | 24 B | 4.00 | Surnoo | Dunadi |
| 12 | Lopara | 18 | 5.32 | Tundar | Tarin Path |
| 13 | Lopara | 10 | 7.00 | Pakhel | Peth Pakhel |
| 14 | Lopara | 11 | 6.65 | Lopara | Chapji |
| 15 | Lopara | 9 | 6.00 | Hatri | Sundar Mandu |
| 16 | Marrwah | 87 | 4.00 | Bangam Qaderma | Harigoth |
| 17 | Marwah | 84 | 4.00 | Humdando | Jaur |
| 18 | Marwah | 70 | 4.00 | Rachal | Brar |
| 19 | Marwah | 82 | 4.00 | Shahlam | Rangrar |
| 20 | Nath Nala | 29 B | 10.00 | Wassen | Koth Hojea |
| 21 | Nath Nala | 29 A | 8.00 | Wassen | Kend Der |
| 22 | Nath Nala | 29 D | 7.98 | Changrian | Changrian top |
| 23 | Nath Nala | 28 | 5.32 | Han Harh | Manka Nar |
| 24 | Nath Nala | 30 A | 4.00 | Gugh Nar | Tangian |
| 25 | Nath Nala | 29 E | 6.00 | Hawal | Thartra |




species (Table 2) including 12 new species including bandicoot rat (*Bandicota indica*), common giant flying squirrel (*Petaurista petaurista*), cape hare (*Lepus capensis*), common mongoose (*Herpestes edwarsi*), five-striped squirrel (*Funambulus pinnanti*), fulvous fruit bat (*Rousettus leschenaulti*), goral (*Nemorheadus goral*), hangul (*Cervus elaphus hanglu*), Indian false vampire (*Megaderma ira*), Indian gerbil (*Tetera indica*), serotine bat (*Eptesicus serotinus*) and short-nosed fruit bat (*Cynopterus sphinx*) have been recorded from the park (Table 2). This list includes eight mammal species, specifically Himalayan black bear (*Salenarctos thibetanous*), brown bear (*Ursus arctos*), goral (*Nemorheadus goral*), hangul (*Cervus elaphus hanglu*), Himalayan ibex (*Capra ibex*), Indian leopard *(Panthera pardus)*, musk deer *(Moschus chrysogaster*), rhesus macaque *(Macaca mulatta*) and snow leopard *(Uncia uncia*) that are on IUCN Red Data List 2003 (see IUCN, 2003). During the present census exercise we recorded pugmarks of snow leopard from Hammal Batti locality, approximately 7km north of Surnoo village along Kiyar Nala in addition to signs of black bear and Indian leopard from many localities.

Table 2 : Mammal species checklist for Kishtwar High Altitude National Park

| Vernacular name | Scientific name |
|---|---|
| Bat, Fulvous Fruit* | *Rousettus leschenaulti* |
| Bat, Indian False Vampire* | *Megaderma ira* |
| Bat, Serotine* | *Eptesicus serotinus* |
| Bat, Short-nosed Fruit* | *Cynopterus sphinx* |
| Bear, Black Himalayan | *Selenarctos thibetanus* |
| Bear, Brown | *Ursus arctos* |
| Cat, Jungle | *Felis chaus* |
| Cat, Leopard | *Felis bengalensis* |
| Deer, Hangul* | *Cervus elaphus hanglu* |
| Deer, Musk | *Moschus chrysogaster* |
| Fox, Himalayan | *Vulpes vulpes* |
| Gerbil, Indian* | *Tetera indica* |
| Goral* | *Nemorhaedus goral* |
| Hare, Cape* | *Lepus capensis* |
| Hare, Himalayan Mouse | *Ochotona roylei* |
| Himalayan Ibex | *Capra ibex* |
| Jackal, Indian | *Canis aureus* |
| Langur, Common | *Semnopithecus entellus* |
| Leopard, Indian | *Panthera pardus* |
| Leopard, Snow | *Uncia uncia* |
| Macaque, Rhesus | *Macaca mulatta* |
| Marmot, Himalayan | *Marmota bobak* |
| Marmot, Long-tailed | *Marmota caudate* |
| Marten, Beach | *Martes foina* |
| Marten, Yellow-throated | *Martes flavigula* |
| Mongoose, Common* | *Herpestes edwarsi* |
| Porcupine, Indian | *Hystrix indica* |
| Rat, Bandicoot * | *Bandicota indica* |
| Rat, Common House | *Rattus rattus* |
| Squirrel, C.G. Flying* | *Petaurista petaurista* |
| Squirrel, Five-striped* | *Funambulus pinnanti* |
| Vole, Royle's | *Alticola roylei* |
| Weasel, Himalayan | *Mustela sibirica* |

* New addition to fauna of Kishtwar National Park

## Animal abundance, age and sex ratio

The animal counts for three consecutive days are given in Table 3, whereas Table 4 shows animal densities (number of animals/km$^2$) with estimated population sizes of some species in the park. The individual counts for three days for key targeted species were less fluctuating (=20%) therefore we settled with the three days exercise.

The sex ratio for rhesus macaque and common langur from the three days counts of these species and also animals recorded during the course of reconnaissance survey were estimated as 1 male: 2 females and 1 male: 2.5 females, respectively. We estimate adult: young ratio for rhesus macaque and common langur as 2.94 adults: 1 young and 3.23 adults: 1 young, respectively.

## Discussion

The present study is perhaps the first study that reported direct sightings of hangul from Kishtwar High Altitude National Park which is listed as critically endangered in the IUCN Red Data List. This deer has highly localized distribution in Dachigam National Park with some stray populations in the adjoining forests. We are also pioneers in systematically estimating key mammalian populations in Kishtwar High Altitude National Park with addition of several new species in the existing checklist of mammalian fauna of the park. However, we believe that our checklist of mammals is still conservative because sufficient data on mammalian communities could not be collected as a result of the scope and duration of the present study. Previous worker (Baba, undated) recorded occurrence of Himalayan tahr from the park. However, we were unable to record direct and indirect evidences of its presence from Kishtwar National Park.

The estimated goral density for Kishtwar as part of the present study is lower than Paddar Forest Division, Jammu and Kashmir (6.42 individuals per km²: Hilaluddin and Naqash, 2006), Kedarnath Wildlife Sanctuary (2.6 individuals per km²: Green, 1987) and Majathal Harsang Wildlife Sanctuary (4.6 to 10.5 individuals per km²: Lovari and Apollonio, 1993) but higher than their abundance in Nandani Wildlife Sanctuary (1.75 individuals per km²: Hilaluddin and Shawl, 2006) Daranghati Wildlife Sanctuary (1.2 individuals per km²: Pandey, 2002), Rupi Bhaba Wildlife Sanctuary (1.47 individuals per km²: Pandey, 2002), Kanawar Wildlife Sanctuary (9.0 individuals per km²: Pandey, 2002) and Kajiyar-Kalatop and Kugti Wildlife Sanctuaries (5.8 individuals per km²: Hilaluddin *et al.*, 2011). Himalayan ibex also shown their higher numbers per km² in Kishtwar than their counter parts in Kargil (0.09 individuals per km²: Maheshwari *et al.*, 2010) but lower than Pin Valley National Park (2.29 individuals per km²: Pandey, 2002). The estimated density of musk deer was much lower than their values in adjoining Paddar Forest Division (1.23 individulas per km²: Hilaluddin and Naqash, 2006). Similary, estimated hangul density is much lower than its corresponding values throughout its range in Jammu and Kashmir (2-3 individuals per km$^2$: Ahmad, 2009a and 2009b; Qureshi *et al.*, 2009). The The estimated densities of *Rhesus macaque* here are lower than reported in Nandani Wildlife Sanctuary (17.18 individuals per km²: Hilaluddin and Shawl, 2006) and Jasrota Wildlife Sanctuary (47.26 individuals per km²: Hilaluddin and Shawl, 2005), Surinsar-Mansar Wildlife Sanctuary (9.84 individuals per km$^2$: Hilaluddin, 2008) and Paddar Forest Division, Jammu and Kashmir (7.16 individuals per km²: Hilaluddin and Naqash, 2006) but higher than Kajjyar-Kalatop and Kugti Wildlife Sanctuaries (1.92 individuals per km$^2$: Hilaluddin, 2007. However, proportion of female macaque in the population are higher than Surinsar-Mansar Wildlife Sanctuary (1 male : 1.5 females: Hilaluddin, 2008) and lower than Nandani Wildlife Sanctuary (1 male : 3 females: Hilaluddin and Shawl, 2006). The estimated density of Common langur is higher than their abundance in Kajiyar-Kalatop and Kugti Wildlife Sanctuaries (2.6 individuals per km²: Hilaluddin, 2007) and Paddar Forest Division, Jammu and Kashmir (2.96 individuals per km²: Hilaluddin and Naqash, 2006).

We could not generate sufficient data on several mammalian species, specifically black bear, brown bear, Himalayan marmot (*Marmota bobak*) and Long-tailed marmot (*Marmota caudata*). All these species undergo periodic winter hibernation. Therefore, we were unable to produce their abundances during the course of present census exercise. Several other small-bodied mammals, specifically rodents might have been missed and therefore the reported checklist is likely to increase, if further observations are made.

The survey produced density estimates with confidence interval up to around 50% of mean values for certain species (specifically common langur, goral and hangul), whilst involving participants in difficult or dangerous fieldwork. However, estimated standard error for goral is less than 20% suggesting their more even distribution in the park. The impression of the data for common langur and hangul may be the result of their

Table 3 : Animal counts in Kishtwar High Altitude National Park during March 2006

| Species | | Number of animals | |
|---|---|---|---|
| Vernacular name | Scientific name | Mean | 95% CI |
| Deer, Musk | *Moschus chrysogaster* | 2.67 | 0.65 |
| Deer, Red or Hangul | *Cervus elaphus hanglu* | 3.00 | 1.96 |
| Goral | *Nemorhaedus goral* | 26.33 | 8.57 |
| Ibex, Himalayan | *Capra ibex* | 26.67 | 3.64 |
| Langur, Common | *Semnopithecus entellus* | 52.33 | 27.17 |
| Macaque, Rhesus | *Macaca mulatta* | 107.67 | 10.51 |
| Martin, Yellow-throated | *Martes flavigula* | 4.33 | 0.65 |

Table 4 : Animal abundance and population estimates in Kishtwar High Altitude National Park during March 2006

| Species Vernacular name | Number of animals/km$^2$ | | Estimated population size | |
|---|---|---|---|---|
| | Mean | 95% CI | Min. | Max. |
| Deer, Musk | 0.18 | 0.04 | 60 | 99 |
| Deer, Red or Hangul | 0.20 | 0.10 | 4 | 20 |
| Goral | 1.73 | 0.56 | 527 | 1036 |
| Ibex, Himalayan | 1.76 | 0.24 | 684 | 900 |
| Langur, Common | 3.45 | 1.79 | 747 | 2360 |
| Macaque, Rhesus | 7.10 | 0.69 | 2884 | 3508 |
| Martin, Yellow-throated | 0.29 | 0.04 | 109 | 148 |

tendency to aggregate in relatively snow free areas, which will inevitably cause animal encounters to very more widely than their populations were more evenly disperse. Also, animals tended to move upwards during transect walk and therefore it was quite likely that few of them might have run out and remained undetected (e.g. musk deer). All these measurement problems within the survey sites make comparisons questionable. However, estimated animal abundance here are not directly comparable with abundance estimates of respective animal species reported by previous workers (e.g. Kitchloo, 1992; Parsa, 1999; Baba, 2003) from the park because we strictly adhered to scientifically recommended census method and subsequent analysis of the data.

As most of the observers were not equipped with binoculars, therefore it was not possible to determine sexes of all animals counted during the three consecutive days census exercise. Thus, we had to omit significant numbers of un-identified animals of each species from the sex ratio data estimation exercise. We also did not attempt a separate sex determination exercise for these species because of lack of proper equipments. Therefore, it is quite likely that our reported figures for some species may alter slightly if a separate sex ratio exercise is attempted inside the park in future.

In several transects, the terrain was extremely steep and rocky. Also, most of the higher reaches were under snow cover. In such areas, it was difficult to walk and maintain fixed width of belt transect. Extremely steep and rocky terrain in the higher altitude areas of Kiyar, Kibber and Nath Nalas forced teams to drive narrow belts along established transects, and therefore transect width often reduced from the assumed 100 meter. In these circumstances, more animals were probably crunch or run out of some parts of these survey sites undetected, decreasing both the precision and accuracy of densities for these transects. Moreover, the length of established transects was also difficult to measure accurately in the highly folded topography using conventional method.

We are of the opinion to continue animal census every year in the park as per the method adopted here and on the permanently marked transects as part of the present study. The best time for census exercise for Kishtwar High Altitude National Park is the end of April or the beginning of May because most of the park is free from biotic interferences in the form of livestock grazing as nomadic graziers along with their cattle descend down to the lower altitudes of the state during winter. Also, the lower reaches are almost free from snow allowing easy walks over transects. It would be logical to have a separate census exercise for black bear and brown bear during autumn when they are quite active in accumulating fat before undergoing winter hibernation. Abundance estimates of leopard and other carnivores should also be undertaken. This is possible on the basis of secondary signs such as scats and scrapes. The frequency of sighting of species in different areas will serve a useful index. Based on direct sightings of animals, encounter rates of animals may also be generated during the course of annual census. Additionally, a few other feature such as avian densities which were likely to be of importance to the administration from the management angle were overlooked due to limited scope of the present study. This aspect needs to be studied in future using Point Count Method outlined in Bibby *et al.* (1992).

The estimation of abundance of avian species, vegetation structure and composition and quantification of biotic interferences in the form of forest produce gatherings and livestock grazing were beyond the scope of the present study and therefore insufficient knowledge exists on all these aspects. It also remained unclear whether forest use by locals is adversely affecting vegetation structure and composition leading to detrimental impacts on animal abundances. This aspect needs immediate investigation.

## जम्मू एवं कश्मीर ( भारत ) के उच्च तुंगीय राष्ट्रीय पार्क किश्तवार में बड़े स्तनपाइयों की आबादी और घनत्व

हिलालुद्दीन तथा रशीद वाई. नकाश

### सारांश

बेल्ट ट्रॉसेक्ट काउन्ट पद्धति का उपयोग करते हुये किश्तवार उच्च तुंगीय राष्ट्रीय पार्क में बड़े स्तनपाइयों की आबादी जानने हेतु गणना की गई। बड़े स्तनपाइयों की सात सामान्य प्रजातियों के आकलित घनत्व (प्राणियों की संख्या/वर्ग कि0मी0) हमारे सर्वेक्षण के अनुसार इस प्रकार थे :- 0.2 माध्य ± 0.195% सी.आई. (लाल मृग, *सर्वस इलफेस हंग्लू*), 0.8 माध्य ± 0.04 95% सी.आई. (कस्तूरी मृग *सर्वस क्राईसोगेस्टर*), 1.73 माध्य ± 0.5 95% सी.आई. (गोराल, *रेमोरेडस गोराल*), 1.76 माध्य ± 0.24 95% सी.आई. (हिमालयी आईबेक्स, *केप्रा आईबेक्स*), 3.45 माध्य ± 1.79 95% सी.आई. (सामान्य लंगूर, *सेम्नोपाइथेक्स इन्टेलस*), 7.1माध्य ± 0.69 95% सी.आई. (रेशम मैकॉक, *मकाका मुलाट्टा*) तथा 0.29 माध्य ± 0.04 95% सी.आई. (पीले गले वाली मार्टीन, *मारटस फ्लेवीग्यूला*)। हमने 60-90 कस्तमरी मृग, 4-20 लाल हिरन, 527-1036 गोराल, 684-900 हिमालयी आइबेक्स, 747-2360 सामान्य लंगूर, 2884-3508 रेशस मैकाक तथा 109-148 पीले गले की मार्टीन का आकलन किया। रेशस मैकाक का लिंगानुपात 1 नर : 2 मादा और आयु संघटन 2.94 वयस्क : 1 युवा। इसी प्रकार 3.23 वयस्क : 1 युवा के अनुपात में प्रत्येक नर के लिये 2.5 मादायें उपलब्ध थी।

### References

Ahmad, K. (2009a). *Aspects of ecology of Hangul in Dachigam National Park*. Ph. D. thesis. Forest Research Institute, Dehradun.

Ahmad, K. (2009b). Conservation status of the last surviving wild population of Hangul or Kashmir Deer Cervus elaphus hanglu in Kashmir, *J.B.N.H.S.*, 106 (3): 245-255

Baba, M.M. (undated). Management Plan of Kishtwar High Altitude National Park. Chenab Division, Kishtwar, Department of Wildlife Protection, Govt. of Jammu and Kashmir.

Baba, M.M. (2003). *Annual animal census report of Kishtwar High Altitude National Park 2002-03*. Chenab Division, Kishtwar, Department of Wildlife Protection, Govt. of Jammu and Kashmir.

Bibby C.J., Burgess N.D. and Hill, D.A. (1992). *Bird Census Techniques*. Academic Press, London.

Champion, H.G. and Seth, S.K. (1968). *A Revised Survey of the Forests Types of India*. Government of India Press, New Delhi.

Green, M.J.B. (1987). Ecological separation in Himalayan ungulates. *Journal of Zoology,* 1: 693-719.

Hilaluddin and Shawl, T. (2005). *Survey and census report of Jasrota Wildlife Sanctuary. Jammu East Wildlife Division*, Department of Wildlife Protection, Government of Jammu and Kashmir.

Hialuddin and Naqash, R.Y. (2006). *Survey and census report of Kishtwar High Altitude National Park*. Chenab Wildlife Division, Department of Wildlife Protection, Govt. of Jammu and Kashmir.

Hilaluddin and Shawl, T. (2006). *Survey and census report of Nandani Wildlife Sanctuary*. Jammu East Wildlife Division, Department of Wildlife Protection, Government of Jammu and Kashmir.

Hilaluddin (2007). Impact of large mammal and pheasants hunting on their populations in the western Indian Himalaya. Oriental Bird Club, U.k. and Wildlife Conservation Society, Bangalore.

Hilaluddin (2008). *Survey and census of Surnisar-Mansar Wildlife Sanctuary. Jammu East Wildlife Division*, Department of Wildlife Protection, Government of Jammu and Kashmir.

Hilaluddin, Khan, D.N. and Abbassi, F. (2011). Impact of hunting on large mammal densities in the west Indian Himalaya. *Indian Forester*, 137(10): 1141-1146.

IUCN (2003). IUCN Red Data List of Animals. IUCN, Gland, Switzerland.

Kitchloo, N.A. (1992). *Census report of Kishtwar High Altitude National Park*. Chenab Division, Kishtwar, Department of Wildlife Protection, Govt. of Jammu and Kashmir.

Lovari, S. and Apollonio, M. (1993). Notes on the ecology of gorals *Nemorhaedus* sp. in two areas of South Asia. *Revue d'Ecologie,* 48: 365-374.

Maheshwari, A., Takpa, J., Kujur, S. and Shawl, T. (2010). *An investigations of carnivores – human conflicts in Kargil and Dras area of Jammu and Kashmir*. Department of Wildlife Protection, Govt. of Jammu and Kashmir.

Pandey, S. (2002). Status and distribution of some caprids in Himachal Pradesh. In: *ENVIS Bulletin: Wildlife and Protected Areas (Sathyakumar, S. and Y.V., Bhatnagar eds.)*, pp. 30-33. Wildlife Institute of India, Dehradun.

Parsa, M.A. (1999). *Census report of Ibex in Kishtwar High Altitude National Park*. Chenab Division, Kishtwar, Department of Wildlife Protection, Govt. of Jammu and Kashmir.

Qureshi, Q., Shah, N., Wadoo, A.R., Naqash, R.Y., Bacha, M.S., Kitchloo, N.A., Shah, J.N., Suhail, I., Iqbal, S., Ahmad, K., Lone, I.A., Mansoor, M., Zargar, R.A., Hussain, S., Baba, M.M., Parsa, M.A., Latoo, A.R. and Deewan, I. (2009). Status and distribution of Hangul *Cervus elahus hanglu* Wagner in Kashmir, India, *J.B.N.H.S*, 106 (1): 63-71.

Sokal, R.R. and Rohlf, F.J. (1995). *Biometry: Principals and Practice of Statistics in Biological Research*. W.H. Freeman and Company, New York.

Sutherland, W.J. (1996). Why census? In: *Ecological Census Techniques*: a Handbook (Sutherland, W.J. eds.), pp. 1-9. Cambridge University Press, Cambridge, U.K.