



Full Length Article

Abundance, Distribution and Conservation of Key Ungulate Species in Hindu Kush, Karakoram and Western Himalayan (HKH) Mountain Ranges of Pakistan

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Abstract

The Karakoram, Hindu Kush and Himalayan mountain areas of Pakistan (Gilgit-Baltistan) are known to have significant populations of globally important wildlife species, ungulates being prominent of these, which have never been studied systematically before. This study was conducted to investigate current population, distribution, conservation and habitat condition of the six major ungulate species *i.e.*, Himalayan ibex (*Capra ibex sibirica*), Blue sheep (*Pseudois nayaur*), Astor markhor (*Capra falconeri falconeri*), Ladakh urial (*Ovis vignei*), Marco polo sheep (*Ovis ammon polii*) and Himalayan musk deer (*Moschus chrysogaster*) in Gilgit-Baltistan. Bi-annual census surveys using direct and indirect counting methods were held in 86 potential habitats (sub catchments) during 2005 to 2010 and questionnaire based interviews were held with local hunters and herders. Results revealed that *C. ibex* is the most common species, followed by *P. nayaur* and *C. f. falconeri* whereas Marco Polo sheep was limited to KNP, Blue sheep to Shimshal and Soqtarabad; Ladakh urial to lower reaches of Karakoram and western Himalayas. Musk deer is confined to rhododendron dominated birch forests of western Himalayas. The study also showed that population of trophy animals *i.e.*, Blue sheep, *H. ibex* and *A. markhor* has increased considerably whereas that of non-trophy animals *i.e.*, Ladakh urial and musk deer have fallen down to the verge of local extinction. The increases are attributed to overwhelming success of community base conservation program, initiated by WWF, AKRSP and GB Forest & Wildlife department in 1993 while failure to save non-trophy animals is possibly due to their low economic return and lack of community interest. Efforts to maintain balance between conservation needs of the wild resource and development needs of the dependent communities is required for sustainable management of the fragile mountain ecosystem in the region. © 2014 Friends Science Publishers

Keywords: Ungulates; Distribution; Abundance; Conservation; Gilgit-Baltistan; Pakistan

Introduction

Ungulates forming an important element of biodiversity act as key indicators of habitat quality in the mountain ranges. The Himalayas and associated mountains offer home to about 31 species (38.7%) of *Caprinae* found worldwide, the richest in any part of the world (Schakleton, 1997). However, status, distribution and abundance of many ungulate species are yet unknown. Problems in identifying and using suitable population estimates have posed a limitation in estimating species abundance in the region. In total, 19 ungulate species belonging to four families namely Moschidae, Cervidae, Bovidae and Equidae, inhabit Himalayas (Bhatnagar, 1993). Seasonal variations in habitat use are associated with seasonal changes in the availability

of food and protective cover. The abundance of predator and anti-predator strategies are also important in determining preferred habitats by mountain ungulates (Mishra, 1993; Mishra and Johnsingh, 1996).

Gilgit-Baltistan (GB) lying at the confluence of world's three great mountain ranges *viz.*, Hindu Kush, Karakoram, and Himalayas (HKH), is endowed with a variety of species, habitats and ecosystems (ICIMOD, 2010; Shaheen and Shinwari, 2012). The region has significant populations of several globally important wildlife species including 54 mammal, 230 bird, 23 reptile, 20 cold-water fish and 6 amphibian species (GoP/IUCN, 2002). HKH is among WWF's 200 global priority eco-regions and classified as Endemic Bird Area (EBA) of Urgent Biological Importance (Chettri, 2008). Snow leopard (*Uncia*

uncia), brown bear (*Ursus arctos*), black bear (*Ursus thibetanus*), Astore markhor (*Capra falconeri falconeri*), blue sheep (*Pseudois nayaur*), Ladakh urial (*Ovis vignei*), Marco Polo's sheep (*Ovis ammon polii*), Himalayan musk deer (*Moschus chrysogaster*), Himalayan ibex (*Capra ibex sibirica*), woolly flying squirrel (*Eupetaurus cinereus*) and Eurasian otter (*Lutra lutra*) are key mammals (Roberts, 1977; Schaller, 2008; Ablimit *et al.*, 2011; Khan *et al.*, 2012). Snow leopard, Brown bear, Marco Polo's sheep, Blue sheep and musk deer are protected yet not fully secure of poaching in their habitats (Rasool, 1990, Khan, 1996).

Himalayan Ibex (*Capra ibex sibirica*) is known to be the closest relative of wild goat. It is an animal of higher elevations, mainly restricted to colder climate of northern mountains (Khan *et al.*, 2008). Selection of habitat by H. ibex is mainly influenced by the gradient and extension of mountain slopes and thus is found in areas with cliffs and very steep slopes (Schaller, 1977). The species is categorized as "Least Concern" in Pakistan (IUCN, 2008). Its estimated population in upper Hunza has been 1000 (Roberts, 1977), 600 (Rasool, 1990), 1065 (Shafiq and Ali, 1998), and 899 (Khan, 2012) in literature.

Blue Sheep (*Pseudois nayaur*) is regarded as one of the common sheep of Trans Himalayas. Owing to its abundance, the species has been categorized as "Least Concern" in the IUCN Red data list (IUCN, 2008). Khunjerab National Park (KNP) harbors a significant proportion of Pakistan's total Blue sheep population. So far, its presence has not been reported from any other areas of the country, so the sheep is nationally endemic to KNP. The species is characterized by its sociability. Ibex and blue sheep have similar anti-predator habitat needs, as both use rugged terrain to escape predators (Namgail *et al.*, 2004) and also *H. ibex* and Blue sheep constitute the most preferred prey species of the highly endangered *S. leopard* (Oli *et al.*, 1993). Blue sheep in Shimshal is perhaps the western most isolated population of the sheep in Himalayas (Wegge, 1988).

Astore markhor (*Capra f. falconeri*) belongs to the *Caprinae* group of the *Bovidae* family (Schaller 1977; Roberts, 1977). Five sub-species are reported from Pakistan, and almost all are categorized as "Endangered" (IUCN, 2008). Astore markhor, recognized as the Flare Horned Markhor, is confined to upper catchments of Indus River and its tributaries in Gilgit-Baltistan (Hess *et al.*, 1997). Like other subspecies of *Caprinae*, A. markhor is still threatened for its genetic isolation, specialized habitat requirements, low reproductivity, habitat fragmentation, food competition and excessive hunting (Schakleton, 1997).

Ladakh urial (*Ovis vignei*) is the smallest of all wild sheep species, categorized as endangered (IUCN, 2002) with a total estimated population of <600 animals in Pakistan (Hess *et al.*, 1997). Three sub species of Urial have been reported from Afghanistan, Punjab and Kashmir. Ladakh urial, also known for its agile demeanor, is

restricted to arid and semi-arid habitats of GB (Pakistan) and Ladakh (India). It likes low elevation gentle slopes in open areas, which are often intensively utilized by mountain people. Excessive hunting for meat, hide and fun coupled with habitat conversion and competition with livestock, has driven the sheep to brink of extinction in GB (Khan *et al.*, 2011). Roberts (1997) and Khan *et al.* (2007) had estimated a total population of 700-800 in GB. Although Bunji conservation community, in the proximity of Gilgit, has banned hunting of the sheep in their Conservation Area but its poaching still continues in non-conservation areas across the region.

Marco Polo's sheep (*Ovis ammon polii*) is the largest subspecies of Argali sheep found in China, Tajikistan, Pakistan and Afghanistan. KNP and Kilik-Minteka (Misgar) are known to have remnant populations of the sheep in Pakistan (Khan, 2012). In KNP, last herd of six sheep was sighted at Khunjerab Pass (> 4700m ASL) in 1982 but now it is confined to Qarchanai valley only because of escalating human interference in Khunjerab Pass area. The sheep come to Qarchanai in May for lambing and returns to Pamir in September with lambs and young (Khan, 2012). There is an estimated population of 45-100 heads in KNP (Khan *et al.*, 2007, 2008). Schaller and Kang (2008) estimated a population of <150 sheep, visiting Khunjerab in the lambing season while Khan (2012) counted 74 and 38 sheep in Qarchanai in summer 2009 and 2010, respectively. Hunting for meat and trophy has decimated the population in all the four range countries but with better conservation plans in place, there appears to be a recent upsurge in the sheep's population on Chinese side (Schaller, 2008; Rasool, 1990; Khan, 2012).

Himalayan musk deer (*Moschus chrysogaster*) of Moschidae family is represented globally by four species viz., Siberian musk deer, Dwarf musk deer, Black musk deer and Himalayan musk deer (Grubb, 1993). Green (1985) investigated the population, ranging behavior, activity pattern, habitat use, feeding habitats and ecological relationship of Himalayan musk deer with other ungulates and reviewed the status of captive musk deer in the world from 1959-1980. Abundance and ecology of musk deer living in the forested areas of Tibet-Qinghai plateau was also investigated during 1988-1990 where its density was 2-3 animals km⁻² (Harris and Guiquan, 1993). No studies for the species have yet been conducted in its potential habitats, except Gurez (AJK) in Pakistan.

Large mammals, wild and domestic herbivores have been coexisting in Asia's high mountains since long, which has been destabilized by the ever increasing ecological imbalances between the mountain vegetation and dependent herbivores. Excessive removal of natural vegetation for grazing and domestic energy by ever increasing numbers of human and animal heads have led to widespread degradation of fragile alpine and subalpine pastures, which consequently has threatened the survival of the region's most threatened wildlife species, their habitats and the mountain ecosystem (Fox *et al.*, 1994; Jackson *et al.*, 1996).

Materials and Methods

Study Area

Gilgit-Baltistan (GB), formerly called Northern Areas of Pakistan, encompassing an area of about 72,496 km² in the extreme north of Pakistan (77° 41' 20.403" E and 35° 27' 24.81" N to 72° 30' 26.932"E and 35° 54' 58.338"N) bordering internationally with the Xinjiang Uygur Autonomous Region of China in north, Wakhan corridor of Afghanistan in west, and India in east (Fig. 1), is home to around 1.5 million people (Khan *et al.*, 2011). The climate varies widely from monsoon-influenced moist temperate to arid and semi-arid cold deserts in the north. Below 3000 m, precipitation is less than 200 mm per annum while there is a sharp precipitation gradient along the altitude, and over 2,000 mm annual snowfall above 6000 m ASL. Temperatures in the lower parts of valleys vary from extreme hot (+40°C) in summer to many degrees below freezing point (-10°C) during winter (Khan *et al.*, 2010). Only 2% of the total area is arable and 4% is covered with natural forests. Vegetation is classified into four distinctive zones *viz.*, Mountain Sub-Tropical Scrub Forests, Mountain Dry Temperate Coniferous Forests, Mountain Dry Temperate Broadleaved Forests and Northern Dry Scrub Forests, each having peculiar biota (Rao and Marwat, 2003). Habitats are separated primarily on the basis of terrain ruggedness and elevation, and apparently there is less distributional overlap among species inhabiting rugged terrain than for those inhabiting plain and open hills (Rao and Marwat, 2003).

Field Survey

Based on geographic conditions, the entire study area was divided into valleys and sub valleys and a total of 86 prospective habitats (valleys) were surveyed for large mammals in spring (April-May) and autumn (November-December) during 2005-2010. Fixed point direct counting method was used during field survey. Animal counts were taken at dawn and dusk when ungulates were active for feeding and drinking. Binoculars (10 × 50 (6.5°) PENTAX XCF; Pentax Co., Philippine) and Spotting scope (80 mm SWAROVSKI HABICHT ST 80) were used to scan the rugged terrain for wildlife. Hand GPS (Garmin GPSmap 76Csx) was used to record geo-references and elevation. Compass was used to measure the angle where distance to herd was estimated approximately. Data sheets and still camera (DYNAX 300si, 55mm AF zoom 100-300mm. Minolta Co. Japan) were used to record observations on the number of animals seen, sex ratio and behavior of the sighted animals. Semi structured interviews were also held with shepherds, hunters and herders in the areas where signs of presence were not found but were known once to have significant populations of a certain species. Apart from this, data collected by field staff of GB Forest and Wildlife

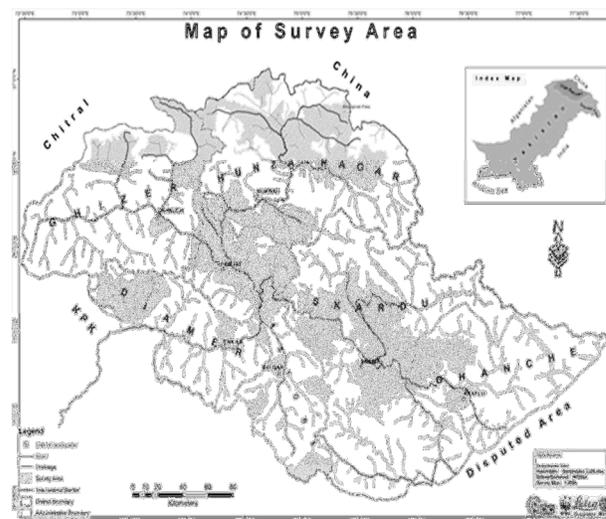


Fig. 1: Administrative map of Gilgit-Baltistan (Pakistan)

department and KNP for some of the valleys in 2005-07 were also used after validation from the field.

Statistical Analysis

Results were analyzed using MS Excel 2007 (Stanford University, 2002) and Minitab 15.0 whereas, GIS Arc View 9.0 was used to develop species distribution maps. Anderson Darling test was used to compute population means for normality. Mann-Whitney U test was applied to compare reliability of sample means between different survey timings (seasons and years). Pearson χ^2 test and two sample T test were used to compute ratios among different sex and age classes. Density was estimated using total counts and the surveyed area (Fox *et al.*, 1991).

Results

Species Abundance

Findings of the study have been summed up in the tables below. Ibex seems to have the highest population and widest distribution followed by that of Blue sheep and *A. markhor* whereas, MPS, Ladakh urial and Himalayan musk deer seems to have small populations and comparatively narrower distribution in the study area. Likewise, a maximum number of *H. ibex* (2777) were found having attained the trophy size (>36 inches) followed by *A. markhor* (240) of >40 inches and Blue sheep (155) of >25 inches, respectively. Corrected density (*Corrected density is a multiple of the correction factor (35%) with crude density*) as suggested by Fox *et al.* (1991) appeared to be highest for Blue sheep (0.52 animals km⁻²) followed by Ladakh urial (0.27 animals km⁻²) and *A. markhor* (0.25 animals km⁻²),

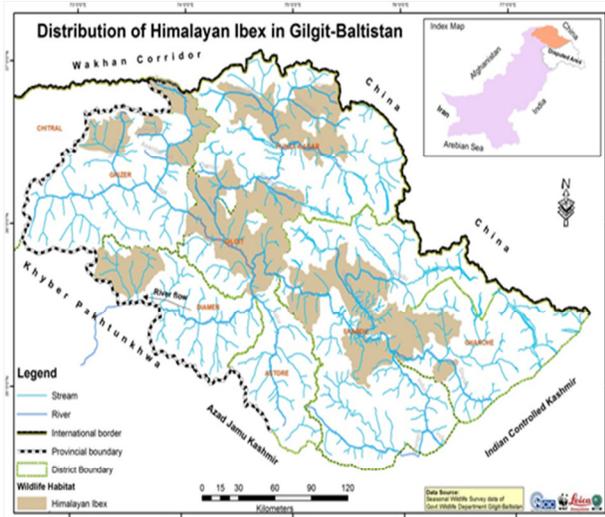


Fig. 2: Map showing distribution of Himalayan ibex (*Capra ibex sibirica*) in Gilgit-Baltistan

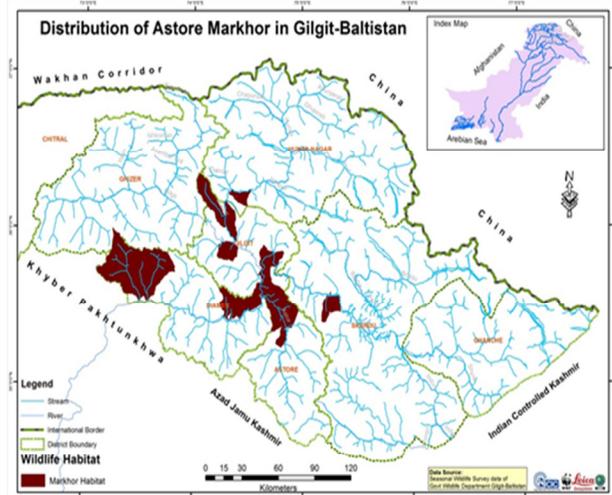


Fig. 4: Map showing distribution of Astore markhor (*Capra falconeri falconeri*) in Gilgit-Baltistan

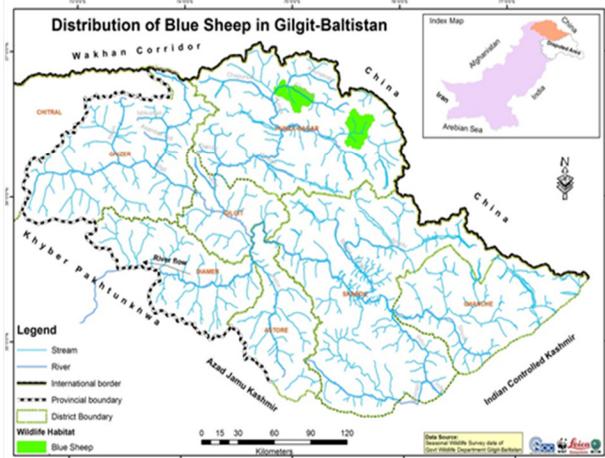


Fig. 3: Map showing distribution of Blue sheep (*Pseudois nayaur*) in Gilgit-Baltistan

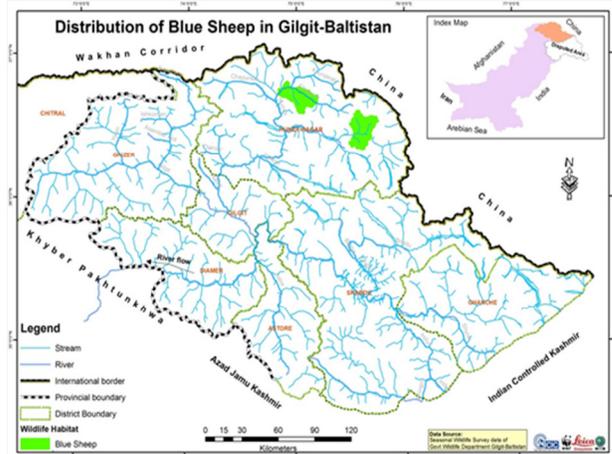


Fig. 5: Map showing distribution of Ladakh urial (*Ovis vignei*) in Gilgit-Baltistan

and lowest for *H. ibex* (0.09 animals km²) as shown in Table 1.

Population Structure

Male to female ratio was highest for Himalayan musk deer followed by Blue sheep and Ladakh urial; adult female to kid ratio was highest in *A. markhor* followed by *H. ibex* and Himalayan musk deer whereas, female to yearling ratio was maximum in Himalayan musk deer followed by MPS and *H. ibex*. Over all, a highly positive correlation was recorded between male and female adults ($r = 0.999$), male adults and yearlings ($r=0.999$), adult males and kids ($r=0.9998603$), adult females and kids ($r=0.9980$), adult females and

yearlings ($r=0.999$) and adult males and trophy size males ($r=0.999$) shown in Table 2.

Distribution, Population and Conservation

Himalayan Ibex (*Capra ibex sibirica*): Distribution of *H. ibex* is fairly widespread throughout Karakoram, Hindu Kush and Western Himalayas however; largest populations inhabited the northern, southern, northwestern and eastern catchments of Hunza, Shyoke and Ghizer River. Largest populations were recorded from the sub catchments of Khunjerab, Hisper, Arindu, Hushey and Qurumber valleys (Fig. 2). A total of 15,596 animals including 5065 males, 6164 females, 2933 yearlings and 1435 kids were counted from 86 different valleys during the survey. More than 50%

of the total male population (2777) had reached to the productivity threshold level acquiring >36 inches of the horn size (> 9 years of age). On average, about 9318 animals were counted every year for the last five years (2005-2010).

Blue sheep (*Pseudois nayaur*): Herds of Blue sheep were sighted at three places viz., Khunjerab pass, Soqtarabad and Shimshal in KNP (Fig. 3). A total of 1036 animals covering 412 males, 408 females and 216 yearlings were counted in the aforementioned habitats during the survey period. About 58% of the total male population exceeded the trophy size (>25 inches of horn size). Its estimated density in Shimshal and KVO was 0.523 animals km⁻², which is considerably low, and female to lamb ratio was 1.0 during the survey period.

Astore markhor (*Capra f. falconeri*): The results showed a wider distribution of A. markhor in the Karakoram, Himalayas and Hindu Kush mountain ranges encompassing Darel, Tangir, Chillas, Sakwar, Jutial, Barmas, Kargah, Rahimabad, Jaglote, Sikandarabad, Bunji and Rundu valleys of Diamer, Gilgit, Hunza-Ngar, Asotre and Skardu districts of Gilgit-Baltistan (Fig. 4). A total of 1071 animals including 331 males, 452 females, 273 yearlings and 15 kids were recorded from 09 valleys. Considerably, larger herds were sighted in community managed conservation areas of Skoyo-Karabathang-Basingo (SKB), Bunji, and Jutial but other significant populations were also reported from Danyore, Sikandarabad and Jaglote valleys. Rahimabad and Jaglote Goor are still considered to be the potential habitats of A. markhor. Almost 47% of the total males counted exceeded the productivity threshold level (>40 inches of horn size) but female to kid ratio was unexpectedly low (30:1).

Ladakh urial (*Ovis vignei*): As shown in the Table 1, compared to other ungulate species, Ladakh urial (*Ovis vignei*) has shown lowest population with sporadic distribution in the entire Gilgit-Baltistan region (Fig. 5). The most concerning aspect of the Ladakh urial observed was a non-viable population with very few males and females, only five yearlings (animals > 6 months age) and no lambs (animals < 6 months age). Male to female ratio was 0.84 among adults but its trophy hunting is yet not permitted under Community based Trophy Hunting Programme (CTHP) in Gilgit-Baltistan (Table 2).

Marco Polo's sheep (*Ovis ammon polii*): Marco Polo sheep (*Ovis ammon polii*), an icon of Asia's highland pastures is one of the nine Argali subspecies whose long, winding horns greatly intrigued Marco Polo in 1273 and has been a cherished trophy of foreign hunters. General distribution of Marco polo sheep is limited to Qarchanai and Khunjerab Pass areas of the Khunjerab National Park (Fig. 6) where females with sub adult males usually come to Qarchanai in late May for lambing and stay there till mid-September and return to Taxkorgan (China) with lambs for wintering. Table 1 represents the average total population of 48 individuals sighted including 21 males and 26 females,

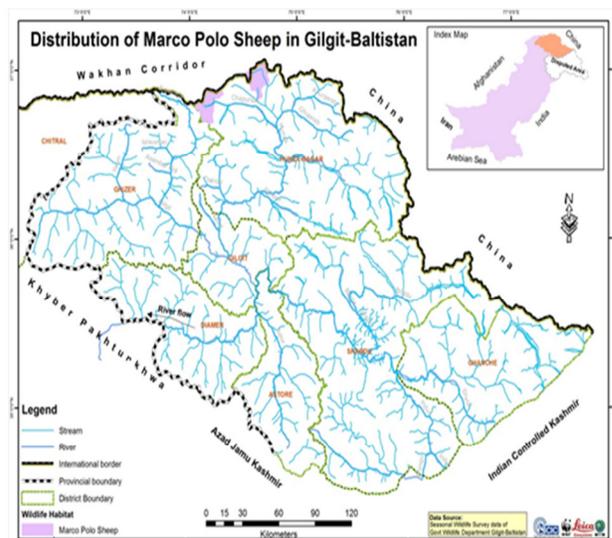


Fig. 6: Map showing distribution of Marco Polo's sheep (*Ovis ammon polii*) in Gilgit-Baltistan

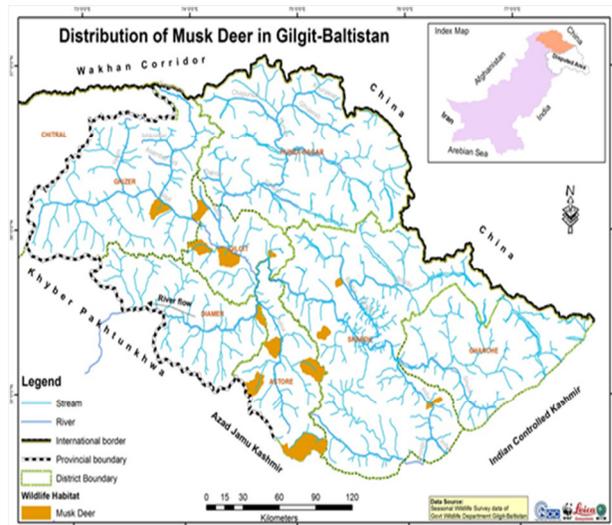


Fig. 7: Map showing distribution of Musk deer (*Moschus chrysogaster*) in Gilgit-Baltistan

along with a very small population of 10 yearlings and 9 lambs in the Qarchanai area of KNP. Some 14 animals in the herd sighted (n=48) were full grown adults.

Musk deer (*Moschus chrysogaster*): Himalayan musk deer seems to be decreasing fast in Gilgit-Baltistan. On average, a total of 10 individuals including 6 males, 2 females and 2 yearlings without any fawns were observed in all potential habitats viz., Bulashbar, Bobin, Raikot, Sakwar and Baghicha-Khomera (Fig. 7) at upper reaches in Birch (*Betula utilis*) and rhododendron mix forests during 2004-2007 (Table 1). The highest number of 18 individuals was recorded at Raikot near Fairy Meadows, in 2004. However,

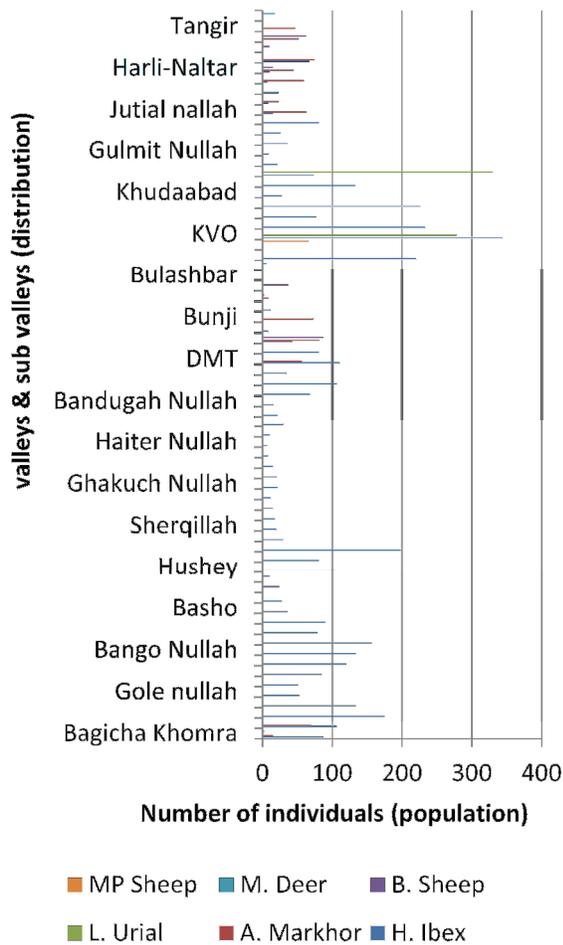


Fig. 8: Average population of key ungulate species in Gilgit-Baltistan (2005-2010)

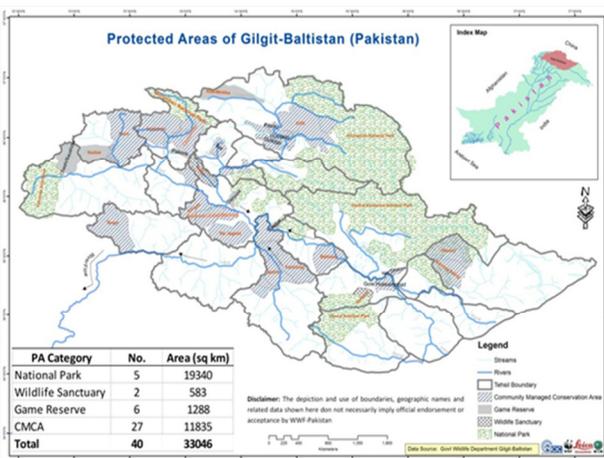


Fig. 9: Protected Area Network of Gilgit-Baltistan (Pakistan)

some 100 have recently been reported from Minimergh (Astore), adjacent to Guraiz National Park in Nelum valley (AJK) and a small herd of 17 animals in Singul valley (Ghizer), but a detailed study is yet to be conducted in other key habitats. In the surveyed areas, its density is perhaps lowest (0.03 animals' km⁻²) amongst all ungulate species studied.

Discussion

Unlike other mountainous areas of the world, Gilgit-Baltistan being at the confluence of mighty Karakoram, Hindu Kush and Himalayas has a higher concentration of wildlife species than elsewhere, including ungulates, carnivores and omnivores. The wildlife in the region especially on mountains above forest zone is surprisingly rich and diverse, with some being endangered and endemic to the region. The study revealed that population and distribution of ungulate species varies from place to place, depending on species' ecological behavior, habitat conditions, food availability, prevailing pressures and conservation measures.

Himalayan ibex is the most widely distributed species across the region followed by Astore markhor and Blue sheep. Marco polo sheep is confined to Qarchanai and Kilik-Minteka sub catchments of KNP, Ladakh urial is sparsely distributed at comparatively low elevations and barren habitats and Himalayan musk deer seems limited to eastern birch forest pockets of Himalayas (Fig. 8). Wider distribution of ibex as compared to other ungulate species is probably due to aloofness of its habitats provided by extensive concentration of high mountain ranges and the community based conservation programme, which is highly valued by locals for its social, economic and conservation benefits in the region (Hess, 1990; Schakleton, 2001). Surprisingly low females to lamb ratio in Blue sheep was possibly due to higher mortality induced by harsh climate, difficult terrain and food scarcity (Wegge, 1988, 1997) or diseases transmitted from domestic herbivores (Dagleish, 2007), characteristic of barren habitats, or due to stochastic predation of young ones by specialist predators, which may eventually lead to near extinction, when predation is systematically eliminating females (Festa *et al.*, 2006) or lower annual recruitment from a population (Haller, 1992) but fairly high proportion of trophy males can be attributed to CHTP in the buffer zone of KNP. Moreover, herds of *H. ibex* and Blue sheep coexisted and grazed in close proximity even under extremely barren conditions [like that of KNP] logically for courser grazing followed by browsing of finer biomass on the same habitat, which had been useful for their mutual protection against the common predators *i.e.*, Snow leopard, wolf and lynx (Lovari *et al.*, 2009) and shows their eco behavioral resemblance (Mallon, 1991) but a huge risk of mass mortality at the same time due to disease transmission (Dagleish, 2007).

Table 1: Average population and corrected density of ungulate species in Gilgit-Baltistan (2005 – 2010)

Species	Total Habitat (km ²)	Male	Female	Yearling	Kid/lamb	Total Population	Trophy size	Density (animals km ⁻²)	Corrected Density (Ad x c.f = Cd)
<i>Capra ibex</i>	6288.19	752	683	237	110	1782	212	0.283	0.099
<i>Pseudois nayaur</i>	350.92	216	175	93	42	525	79	1.495	0.523
<i>Capra falconeri</i>	627.13	177	166	79	29	451	42	0.719	0.252
<i>Ovis vignei</i>	185.77	53	63	25	3	144	0	0.773	0.271
<i>Ovis ammon polii</i>	209.67	21	26	10	9	14	0	0.067	0.023
<i>Moschus chrysogaster</i>	337.78	6	2	2	0	10	0	0.029	0.010
TOTAL	7999.46	1224	1114	446	193	2925	333		

Table 2: Sex ratio and population structure of key ungulates in Gilgit-Baltistan

Species	Sex and age class ratio			
	M-F	F-K	F-Y	M-Tm
<i>Capra ibex sibirica</i>	1.10	6.21	2.88	0.42
<i>Pseudois nayaur</i>	1.24	0.00	1.89	0.41
<i>Capra falconeri</i>	1.06	5.78	2.11	0.39
<i>Ovis vignei</i>	0.84	0.00	2.51	0.37
<i>Ovis ammon polii</i>	0.81	2.89	2.60	1.50
<i>Moschus chrysogaster</i>	3.60	0.00	0.83	0.62

Populations of *A. markhor* outside the protected areas, especially community managed conservation areas (CMCA) are still negatively influenced by illegal hunting, habitat degradation, slow reproductivity and genetic isolation (Hess *et al.*, 1997; Schakleton, 1997) but an apparent increase in number of trophy size animals might be due to high economic value of the species for local communities even if excessive exploitation is the original cause of the species' decline (Lindsey *et al.*, 2007; Roberts, 1988) but lower female to kid ratio is probably due to higher mortality and predation on younger crop (Haller, 1992) and may also be due to low reproduction and over harvest of productive males for trophies inside CMCA (Khan, 2011; Loveridge, 2006). The decreasing trend in remaining population of Ladakh urial is due to high hunting, poaching pressures, habitat degradation and food competition with livestock, exerted both by local hunters, herders as well as outsiders mostly because of its non-trophy value and thus low interest of local communities in its protection (Khan *et al.*, 2011).

Marco Polo's sheep is not a resident of KNP but often moves across international borders. Although movement patterns of males are not clear; they may migrate into Wakhan corridor or possibly into Kilik-Minteka area of Pakistan for safety during summers when they are subject to hunting by Chinese herders at higher elevations (Jackson, 1998; Khan *et al.*, 2012). Although all pastures are seasonally grazed by domestic stock (Schaller and Kang, 2008) and MPS forage on a large variety of graminoids, forbs and dwarf shrubs just do like the livestock do (Fedosenko, 2000) and thus there is an increasing competition for limited food with wild herbivores. Since the subspecies is categorized as Vulnerable (IUCN, 2008), so its

hunting is strictly prohibited in GB. Its population in China, Afghanistan and Pakistan has decreased greatly in recent decades, as have other wildlife in the region because of unsustainable hunting by local herders, the military and others, for meat and trophies (Schaller, 2007). With their habitats harsh, remote, and difficult to access, MPS roam back and forth across the frontiers of Pakistan, Afghanistan, Tajikistan and China (Schaller, 2008). The four countries already have a scattered network of protected areas along their borders, which could be interconnected to create an International Protected Area where different conservation approaches appropriate to prevailing socio-ecological, cultural, economic and geo-political considerations can be applied for species conservation, habitat restoration and sustainable development (Schaller, 2007; Khan *et al.*, 2012). Though Snow leopard, Wolf and Lynx are the major predators of Himalayan musk deer but its excessive hunting and poaching, especially for musk, is the biggest threat to the species that has emerged due to increasing price of natural 'musk' in national and international markets. One of the successful approaches towards protection of this illusive species is community based conservation engaging local people and sharing conservation benefits with them through co-management of wildlife (Thompson, 1997; Khan, 2011), compensating the cost of conservation they pay for being nearer to the Protected Areas (Lamarque, 1995).

There is a dire need for effective enforcement of protection laws till the time when small isolated populations of rare and unique species become viable and reach threshold level for sustainable harvest. It is interesting to note that in terms of average annual populations only *H. ibex* and Blue sheep crossed 500 individuals while that of all other species remained far below. Total population of Ladakh urial and Himalayan musk deer never exceeded 20 during the past five years. The government of Gilgit-Baltistan with the support of WWF, IUCN and other conservation organizations has thus established a strong network of around 40 Protected Areas including 5 National Parks, 2 Wildlife Sanctuaries, 6 Game Reserves and 27 Community Managed Conservation Areas (CMCA) covering almost 45.8% of the total area to protect precious wildlife resource of the region (Fig. 9).

In conclusion, the HKH mountain areas of Pakistan (Gilgit-Baltistan) still have significant populations of

globally important wildlife species, for which a strong network of legal and administrative protected areas has been established. WWF initiated Community based Trophy Hunting Programme (CTHP) is largely in place for ungulate species, which has not only helped avert the declining populations of rare and threatened trophy animals *i.e.*, Ibex, Blue sheep and Astore markhor but has also helped the government and local communities earn revenue to cater for their social, economic, administrative and environmental development needs. Eighty percent of the revenue from CTHP goes to local communities, whereas, 20% is taken by the custodian department for vigilance and regulation. Nonetheless, some of the species such as Ladakh urial and Himalayan musk deer, apparently being non-trophy species, are least cared for by local communities and so are still hunted excessively and are on the brink of local extinction. Habitat degradation especially illicit cutting of birch forests is another major threat to remaining populations of Himalayan musk deer that needs an immediate effective conservation action for its survival and viability.

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