

## Short Note

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# Population status and migration trends of Marco Polo argali (*Ovis ammon polii*) in Pakistan

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**Abstract:** Marco Polo sheep (*Ovis ammon polii*) occurring in the rugged mountainous landscapes of Central and South Asia, are difficult to survey and conserve due to their straggling habits in remote and inhospitable habitats. The paper presents population estimates and migration trends of Marco Polo sheep in Khunjerab, Pakistan, over 20 years (1992–2012), determined through direct count method. During this period a total of 1069 sheep visited Pakistan, with mean annual herd size of 76.35 (SD = ± 40.87). Sex ratio in the population skewed towards females, having male:female ratio of 0.69:1 with 43 lambs to 100 ewes. Annual population density of the immigrant populations oscillated between 0.42 and 2.13 animals/km<sup>2</sup> (SD = ± 0.53). The visitation showed drastic decline over 20 years, possibly due to fencing at the Sino-Pakistan border and dietary competition with wild herbivores. Fewer lambs in summer populations is another point of concern, probably as result of predation of young cohort by avian and mammalian predators. Removing obstructions on migratory routes and reducing dietary competition with sympatric herbivores are suggested for viability of argali populations in Pakistan.

**Keywords:** border fencing; Khunjerab; Marco Polo argali; migration; population status.

Marco Polo argali [*Ovis ammon polii* (Blyth 1848)] is an iconic species of the Pamir Mountains and adjacent areas

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in Afghanistan, China, Pakistan, Tajikistan and Kyrgyzstan (Schaller 1976, Schaller et al. 1987, Roberts 1997, Schaller and Kang 2008). Its range occurs in climatically harsh habitats (3500–5200 m), situated in remote and strategically challenging locations, thus difficult to survey and conserve (Bilal 2007). This taxon has not yet been assessed for the IUCN Red List (IUCN 2017) but it has been declared as critically endangered in Pakistan (Sheikh and Molur 2004). In Pakistan the sheep were once abundant in Khunjerab (situated in upper Hunza on Sino-Pakistan border), usually frequenting the area for safe abode (Schaller 1976, Rasool 1991). The decade long rampant poaching during construction of Karakoram Highway between China and Pakistan in 1970s resulted in extirpation of Marco Polo sheep from Khunjerab (Schaller et al. 1987), and the sheep now only make summer visits from the Chinese side to Karchanai area of Khunjerab National Park (Rasool 1991, Khan et al. 2013). Previous estimates of the resident and migratory populations of Marco Polo sheep in Pakistan have been reported based on anecdotal information, personal observations and occasional field surveys (Schaller 1976, Schaller et al. 1987, Rasool 1989, 1991, Ahmad 1996, Hess et al. 1997, Roberts 1997, Shafiq and Ali 1998, Schaller and Kang 2008, Khan et al. 2013).

With a view to strategizing conservation actions it is also important to understand long-term population trends (Harris et al. 2005). Therefore, we investigated the status of immigrant population of *Ovis ammon polii* in the Khunjerab area of Pakistan over a period of two decades. The Khunjerab National Park (KNP), spanning over 6150 km<sup>2</sup> is located in the extreme northeastern corner of Pakistan between 74° 55'E to 75° 57'E and 36° 01'N to 37° 02'N, at an elevation of 2700 m a.s.l. (Figure 1). The lower catchments comprise of alpine meadows, ravines and gorges while snow-covered peaks and glaciers dominate the upper reaches of the park (Ahmad 1996). Besides Marco Polo sheep the Park harbors other rare and threatened species like the snow leopard [*Panthera uncia* (Schreber 1775)], brown bear [*Ursus arctos isabellinus* (Horsfield 1826)], grey wolf [*Canis lupus* (Linnaeus 1758)], Himalayan ibex [*Capra sibirica* (Pallas 1776)], blue sheep [*Pseudois nayaur* (Hodgson 1833)], golden marmot

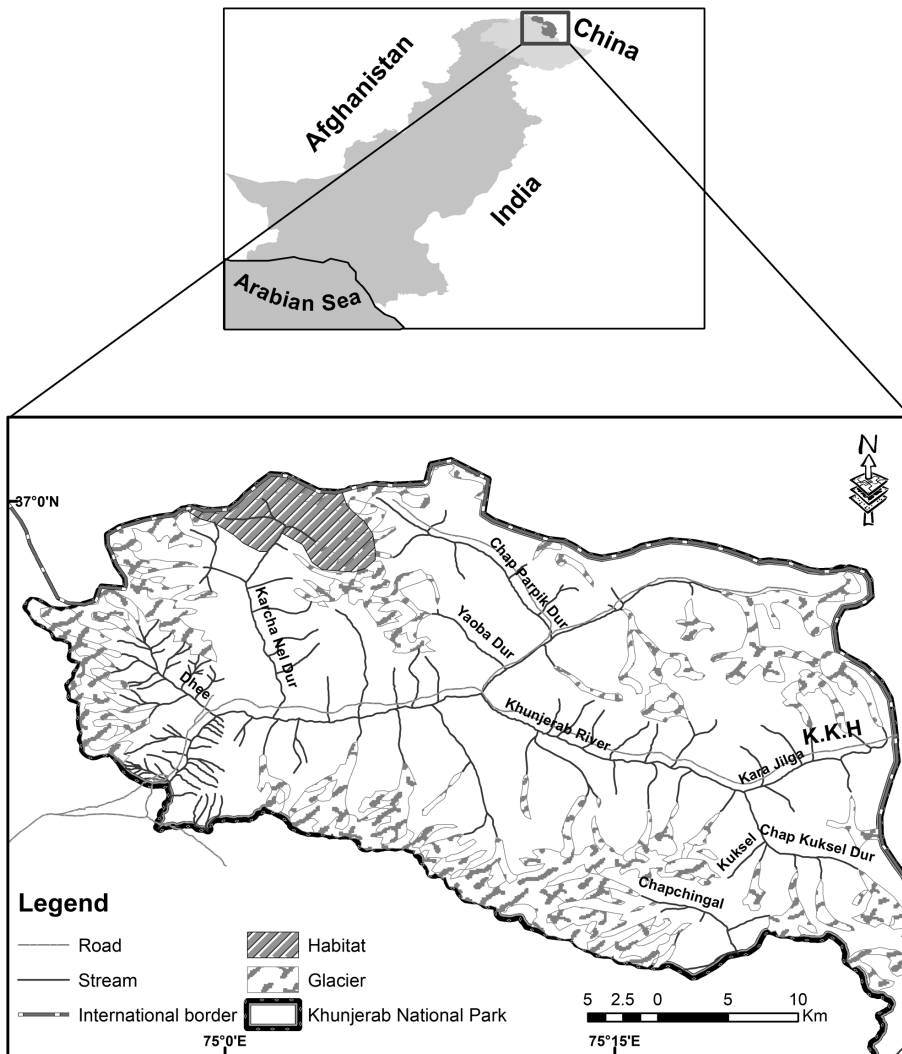


Figure 1: Habitat of the immigrant Marco Polo argali in Khunjerab, Pakistan.

[(*Marmota caudata* (Jacquemont 1844)], and cape hare [*Lepus capensis* (Linnaeus 1758)].

The data represents 20 years from 1992 to 2012, collected as part of the annual wildlife census in KNP and our own surveys, conducted from June to August each year, using fixed-point direct count method and possibly from the same vantage points. During 2010–2012 we collected the data in June–July from two vantage points situated at 4344 m and the other at 4592 m, covering an area of 78 km<sup>2</sup> in Qarchanai Nullah of the Park. In our surveys two teams, comprising of three members each, scanned the area simultaneously from each of the vantage points. The survey teams comprised of trained wildlife watchers of KNP who could easily identify various age and sex classes of the sheep. Observations were made when animals were more active for feeding at dawn and dusk, with the help of a spotting scope (20 × 60 Swarovski) and binoculars (10 × 50

Pentax XCF). On locating a herd, in addition to the total counts, the animals were aged and sexed as adult females (>24 months old), young (<24 months old), sub-adult rams (2–3 years old), and adult rams (≥4 years old) to determine young:female, and male:female ratios and to assess their abundance. After completing the observations, the teams from each point joined together to compare the data in order to avoid any bias in data collection (Sajjad 2008). We used parametric and nonparametric tests to evaluate and summarize variation among different factors in the statistical analysis software, R (R Development Core Team 2012). Corrected densities of animals were calculated with reference to the approximate total areas actually surveyed, i.e. 78 km<sup>2</sup>.

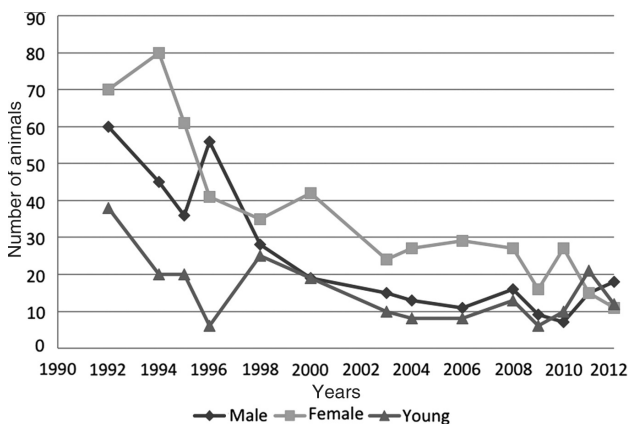
A total of 1069 sheep were observed visiting Pakistan during 1992–2012 (excluding the missing years) including 505 females, 348 males and 216 young (Table 1). The male

**Table 1:** Minimum number, age and sex classification of the immigrant population of Marco Polo argali (*Ovis ammon polii*) in Pakistan, recorded during 1992–2012.

Year	Male	Female	Lamb	Total	Male:female ratio	Young:female ratio
1992	60	70	38	168	0.86:1	0.54:1
1994	45	80	20	145	0.56:1	0.25:1
1995	36	61	20	117	0.59:1	0.33:1
1996	56	41	6	103	1.37:1	0.15:1
1998	28	35	24	87	0.8:1	0.71:1
2000	19	42	20	80	0.45:1	0.45:1
2003	15	24	10	49	0.63:1	0.42:1
2004	13	27	8	48	0.48:1	0.3:1
2006	11	29	8	48	0.38:1	0.28:1
2008	16	27	13	56	0.59:1	0.48:1
2009	9	16	6	31	0.56:1	0.38:1
2010	7	27	10	44	0.26:1	0.37:1
2011	15	15	21	51	1:1	1.4:1
2012	18	11	12	41	1.64:1	1.09:1
Total	348	505	216	1069		
Mean	24.86	36.07	15.43	76.36	0.69:1	0.43:1

population mostly comprised of sub-adult animals. The number of sheep visiting Pakistan each year differed significantly ( $\chi^2 = 296.2554$ ,  $df = 13$ ,  $p$ -value  $< 0.5$ ). The annual mean of total population visiting Pakistan was 76.36 animals ( $SD = \pm 40.87$ , range = 31–168). The visitation drastically reduced over 20 years, i.e. 168 argalis in 1992 to 41 argalis in 2012 (Figure 2). The annual population density oscillated between 0.420 and 2.15 argalis/km<sup>2</sup> ( $SD = \pm 0.53$ ), which was statistically not significant ( $\chi^2 = 3.7582$ ,  $df = 13$ ,  $p$ -value  $> 0.5$ ).

Primarily the sheep were found grazing in single herd that later disintegrated to smaller herds, possibly because of noticing human presence. Thus the mean herd size was the same as the mean number of animals visiting Pakistan

**Figure 2:** Number of Marco Polo argalis visiting Pakistan over the last 20 years (1992–2012).

each year, i.e. 76.36 ( $SD = \pm 40.87$ , 31–168). Annual mean of various age-sex classes visiting Pakistan each year was: females 36.07 ( $SD = \pm 20.39$ , range = 10–80); male: 24.86 ( $SD = \pm 17.31$ , range = 7–60); and young: 15.36 ( $SD = \pm 7.61$ ). On average females dominated the herd composition constituting 47.24% while the males were 32.55% and lambs 20.21%. On average the sex ratio (male to female) was 0.69:1 with 43 lambs to 100 ewes.

The sights and signs (pellets) observed during the surveys revealed that the sheep occupied areas between 4300 and 4900 m, comprising land forms like a plateau with boulders, surrounded by rolling-hills with slope angles between 40 and 60°.

Historically, the KNP and adjacent environs in the extreme north of Pakistan were home to a thriving resident population of the argali, which started to decline and subsequently extirpate from Khunjerab pass and Misgar due to excessive hunting, mainly during construction of Karakoram Highway in 1970s (Schaller et al. 1987, Rasool 1991). The situation continued till 1975 when Khunjerab was declared as National Park by the Government of Pakistan (Schaller et al. 1987, Rasool 1991). Presently, argali in Pakistan comprise of a seasonally migrating population from China, frequenting only few areas of KNP and adjacent passes of Kilik and Mintaka (Hess et al. 1997). Migration of the sheep into Pakistan from Wakhan corridor of Afghanistan is not evident from reliable sources (IUCN 2017). Compared with historical records (e.g. Rasool 1989, 1991, Ahmad 1996, Shafiq and Ali 1998, Schaller and Kang, 2008), the present study shows declining trends in the number of migrating

argalis into the Pakistan's territories. Similarly, the population density is also much lower than the adjacent range countries, such as Afghanistan (Bilal 2007), China (Schaller and Kang 2008) and Tajikistan (Anon 2003, Fedosenko 2003). The declining density and visitation can be attributed mainly to obstruction in trans-boundary migratory routes by wire mesh fencing at international borders (Rozen 2012). The fencing, in addition to functioning as a barrier to movement, has also been observed causing death of animals due to collision while running away from fast chasing predators (Khan et al. 2013). Habitat fragmentation, competition with domestic (livestock) and wild herbivores (Himalayan ibex) cannot be ruled out as potential causes of dwindling numbers of argalis in Pakistan (Khan 2012, Khan et al. 2013).

Females dominated the immigrant population in Pakistan followed by males, but lambs were considerably less than ewes and rams. Similar male:females ratios with fewer lambs to ewes have also been reported from other areas, e.g. Afghanistan and China (Schaller et al. 1987, Schaller and Kang 2008). But fewer lambs in summer populations in Pakistan is a point of concern, because a larger young cohort is expected in a viable population, e.g. in Tajikistan in summer the lambs constituted the second largest category followed by females (Valdez et al. 2015) and Harris et al. (2010) observed 93% natality during summer in Pamirs. The smaller young cohort in Pakistan's population weakens the statement of their visit to Pakistan for lambing as claimed by Schaller et al. (1987) and Schaller and Kang (2008). Other factors possibly responsible for such a population structure could be an excessive predation on the young cohort by avian and mammalian predators, which are quite abundant in the environs of KNP (Khan 2012).

*Ovis ammon polii* were observed visiting Pakistan in a single congregated herd. Living in large herds is a common phenomenon for argalis. Harris et al. (2010) tallied 119 individuals in a single congregated herd in the greater Pamirs. This congregation would result in higher mean annual herd size than reported in China ( $43 \pm 7.8$ ) by Schaller and Kang (2008).

The immigrant populations of argalis in KNP were found to prefer sedge meadow forming a plateau like habitat, with plenty of boulders and barren rolling hills slope angles between 40 and 60°. Altitude of the occurrence ranged from 4300 to 4900 m. Similar habitat features were described for Marco Polo sheep in Afghanistan, Tajikistan, China and Russia (Schaller et al. 1987, Fedosenko 2000, Mishra and Fitzherbert 2004, Habib 2007, Schaller and Kang 2008). The floristic composition of the argali habitat in Khunjerab (Qarchanai Nallah)

comprised of *Artemisia*, *Acantholimon*, *Caragana*, *Astragalus* and *Oxytropis* species. Schaller et al. (1987) also mentioned of these plant species to be important vegetation of the argali habitat in plains and flat areas of Taxkorgan Reserve, Xinjiang, China. Bilal (2007) reported sedge meadows and *Artemisia* as an important vegetation of Marco Polo sheep habitat in Afghanistan.

Illegal hunting, poaching, habitat fragmentation and competition with domestic livestock have been identified as major threats to argali populations in range countries like Afghanistan, China and Tajikistan (Schaller et al. 1987, Mishra and Fitzherbert 2004, Bilal 2007, Schaller and Kang 2008). However, in Pakistan the areas of its occurrence fall within the Protected Area namely Khunjerab National Park, where illegal hunting is banned and grazing has been limited as part of management plan (Khan 1996). Thus there could be two major threats to the argali population in Pakistan, i.e. fencing at Sino-Pakistan border limiting movement of argalis into the country (Schaller and Kang 2008) and dietary competition with Himalayan ibex during their stay in Pakistan. Resource competition among wild herbivores in shared habitats has been identified as a major threat to the ungulates population (e.g. Bagchi et al. 2004, Qureshi et al. 2011). Abundance and distribution of large predators in Khunjerab areas (Khan 2012) may also be responsible for limiting population of argalis in Pakistan as the immigrant population of the sheep largely consists of females and young. The females and young cohort in ungulates populations are more susceptible to predators attack (e.g. attack by snow leopards and wolves on Himalayan ibex in Central Karakoram mountains of Pakistan; Khan et al. 2017). Predation by wolves and snow leopards has also been reported as a limiting factor of mountain ungulates population (Schaller et al. 1987, Fedosenko 2000, Bilal 2007, Schaller and Kang 2008).

The population status of Marco Polo argali in Pakistan has become a critical conservation concern. The sheep have been extirpated from most of its distribution ranges in Pakistan and presently it comprises of only a few individuals seasonally migrating into a specific grazing area within Pakistan's territories. The number of migrating animals has declined to less than half over a period of two decades. Habitat fragmentation and obstructed movement of the sheep among range countries in the highlands of South and Central Asia can be blamed for this situation. Other causes of the declined population could be human disturbances and dietary competition with domestic as well as wild herbivores in shared habitats. The trans-boundary nature of threats requires collaborative efforts among range countries.



Improved linkages and networking among the Protected Areas of range countries and trans-boundary efforts to facilitate wildlife corridors are suggested to promote a viable population of *O. among polii* in Pakistan and adjacent range countries.

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