Sustainability and Biodiversity Conservation

Current population status, threats, and conservation of Kashmir Markhor, in Chitral Gol National Park, Pakistan

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Abstract

Markhor (*Capra falconeri*) is the national animal of Pakistan. Five subspecies of Markhor are believed to occur in Pakistan. One subspecies, the so-called Chiltan Markhor, was found to be a wild goat (*Capra hircus*), and the other four subspecies were reduced to two, the straight and flare-horned Markhor. In Pakistan, the distribution range of Markhor extends from the mountains of Balochistan to the north of Khyber Pakhtunkhwa. Globally, the Markhor was listed as 'Endangered' in the IUCN Red List up to 2015. However, the status of Markhor was down-listed to 'Near Threatened on the IUCN Red List' in 2015. The *Capra falconer cashmiriensis* (Kashmir Markhor or Pir Panjal Markhor) and *Capra falconeri falconeri* (Astor Markhor) also known as flare-horned Markhor live in the Himalayan ranges. The main objective of our current study is to investigate the current population status, threats, and possible conservation measurements of this flare-horned Markhor in Chitral Gol National Park (CGNP). CGNP is a home of several mammals including Markhor, and *Capra falconeri* (Both flare-horned Markhor). Field surveys were conducted in winter, December 2021 during the rut session, and also data were collected through questionnaire-based interviews with wildlife rangers, local hunters, local communities, and shepherds. The current data obtained were compared with the past data of different researchers. A total of 2278 Kashmir Markhor (*Capra falconeri cashmierinsis*) individuals including kids, yearlings, females, and males were recorded as 636, 568, 804, and 270 respectively. As compared to previous studies and data, we have concluded in the current study, that the population of Markhor in Chitral Gol National Park is in good condition.

Keywords: CGNP, Conservation, Kashmir Markhor, Population status, Threats

Introduction

Pakistan has a vast variety of Caprinae, a sub-family of wild Sheep and goats. The name “Markhor” was derived from the Persian meaning snake-eating animal. However, it is generally accepted by local peoples that it derives from two Pashto words "Ma- Akhkar," where "Mar" means snake and "Akhkar" means horn. The Markhor was given this name because it has snake-like twisted horns, and it became Markhor over time (Khan, 2010). The Caprinae including the Markhor (*Capra falconeri*), is one of the most successful bovid sub-families, with 35 recognized species located in hilly areas of Asia and some other adjacent European countries. The caprinae are medium-sized hoofed mammals with compact bodies, thick legs, a sure gait, and a tolerance for temperature variations, which is a characteristic of environments with mountains. Seven caprinae species and 12 sub-species have been recorded in Pakistan (Robert, 1977; Hess et al., 1997). Two types of Markhor are recognized in Pakistan based on body characteristics and horn morphology.

a. Straight-horned Markhor: Markhor with screw horns in upright condition is known as Straight-horned Markhor. The Kabul Markhor (*Capra falconeri megaceros*) and Suleiman Markhor (*Capra falconeri jerdonii*) are included in this category. b.Flare-horned Markhor: Markhor has horns with a diverging spiral outcome known as flare-horned Markhor. Kashmir Markhor/Pir Panjal Markhor (*Capra falconeri cashmiriensis*) and Astor Markhor (*Capra falconeri falconeri*) are included in this group. The flare-horned Markhor is bigger than the straight-horned Markhor both in size and horn length (Ali, 2008; Schaller & Khan,1975). All species of caprinae (sub-family) in Pakistan are in danger due to illegal hunting, poaching, and habitat destruction due to some natural and mostly anthropogenic activities. Markhor has been classified as being in near-threatened (NT) status by the IUCN Since 2015. Khyber-Pakhtunkhwa (KPK) province has more resources for biodiversity including mammalian and avian fauna in comparison to other provinces of Pakistan due to its variation in climates and the distinctive geographical conditions. The greatest population of flare Markhor (*Capra falconeri cashmierinsis*) in the world finds habitat in Chitral Gol National Park (CGNP), which has special significance due to its geographic location and high altitude. Up until 1983, the Chitral Gol Park was considered to be the private property of the former “Mehtar” family of Chitral. It was designated as a National Park in 1984. The IUCN declared it a “Management Category II Protected Area” in 1984 to save the populations and natural habitat of threatened and endemic animals like Kashmir Markhor and Snow Leopard in this area. This park is famous for its stunning beauty, high peak and snow-covered mountain top, and natural

environment (Khan, 2010). The rutting season for Markhor continues in the winter season in this park from late November to the end of January, with the peak in December. During December 2021 the Markhor rut season study was conducted because the snow has covered the majority of the park's mountains, and that is why Markhors move into lower valleys in search of food, and they are confined to very small areas in valleys, where they may encounter suitable mates. Hence, it is possible to accurately determine their census, population status, health, condition, and dispersion (Arshad et al., 2012). During the past rut surveys carried out in Chitral Gol National Park by Wildlife department, 487 heads were recorded in 2003, 687 in 2004, 613 in 2005, 753 in 2006, 759 in 2007, 1033 in 2008, 1146 in 2009, 1072 in 2010, 1160 in 2011, 1364 in 2012 and 1379 in 2014 (OFFICIAL RECORD NO 496/WL CGNP; Irshad, 2016) (Fig. 1 & 2).

Chitral Gol National Park

Chitral Gol National Park (CGNP) is in the Chitral district, the nation's most northern region (KPK). This area is more attractive for national and international naturalists and ecologists due to its breathtaking scenery, beautiful splendor, and mysterious species like Markhor and snow leopard. In addition to hosting the biggest population of national animals, Kashmir Markhor /Pir Panjal Markhor, *Capra falconeri cashmierinsis*) in the wild and providing a suitable home for the National Tree (Deodar, *Cedrus deodara*), National bird (Chakor, *Alectoris gracia*), National flower (Jasmine, *Jasminum officinale*), and globally endangered snow leopard (*Panthera uncia*), Chitral Gol National Park is well-known for its panoramic views (Ahmad et al., 2022). This park covers about 7750 Ha (hectares) area in size and is located in the north-west of Chitral city, also extends to the west and east as its buffer zone contains some of the biologically rich habitats of Hindu Raj Mountain, Kalash culture, and the well-known Awarit Gol. This park is located at 35° 42° to 36° 01° N Latitude and 71° 36° to 71° 49° E Longitude, with an elevation between 1450 - 5000 m above sea level. The park includes three important valleys several glaciers, several springs, and a stream that runs 18 kilometres and flows the cold water into the river of Chitral eastward. This park receives about 462 mm of annual precipitation, the fall and spring are mostly snow-falling seasons in this area, while the summer season is moderate and pleasant.

Material and methods

Study Area

This survey was carried out in Chitral Gol National Park (CGNP), buffer zone, and Chitral Wildlife Division (Chitral WD) (Fig. 1). We surveyed with the collaboration of the teams of the Zoological Survey of Pakistan (ZSP), Ten Billion Tree Tsunami (Ministry of Climate Change),

Pakistan Museum of National History (PMNHI), IUCN Pakistan, WWF Pakistan, Pakistan Forest Institute (PFI), and Khyber Pakhtunkhwa Wildlife Department in December 2021. To observe and determine the population status of species, confirm the movements, and record the population dynamics (age and sex data) on the prescribed data sheet developed for this purpose, all the survey parties ensured early morning sightings at about 7 am and early evening sighting around 4 pm at the various vantage points. The local field watchers also helped to identify the sex and age of the Markhor. Animals were observed with the help of binoculars (Olympus 8-16X 40, DPS I) and spotting scopes (Nikon w/ 155-45X). Herds' size and composition were recorded. The composition was classified into various age-wise classes i.e. Class I, Class II, Class III, and Class IV based on the size of the horns and physique. The data were critically examined to avoid duplication in counting and the herd size and composition were examined carefully. The location, altitude, aspects, and habitat type of Markhor observation sites were recorded through GPS (Garmin).

Secondary data collection

The published literature and representatives of the wildlife department provided secondary information on Markhor numbers in the watersheds that were not the subject of the direct surveys. The goal was to map the species' entire distribution range at a single density.

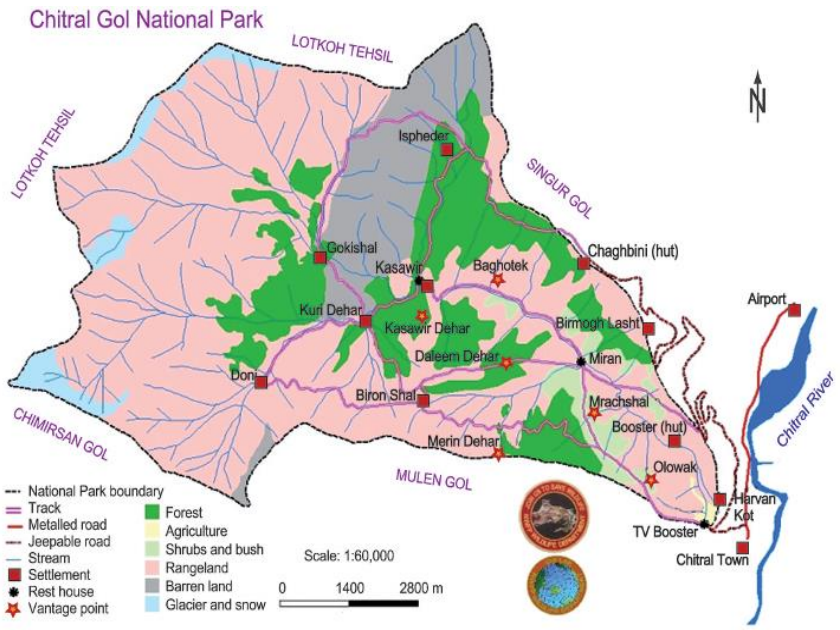

Figure1. Map of Chitral Gol National Park in Chitral, KP, Pakistan (Courtesy by: Ali, S, 2008)

Results

Systematic Position

Family: Bovidae

Subfamily: Caprinae

Genus: *Capra*

Species: *C. falconeri*

Binomial name: *Capra falconeri* (Wagner, 1839)

Sub Species: *Capra falconeri cashmierinsis*

Five sub-species of Markhor are said to occur in Pakistan. One sub-species, the so-called Chiltan Markhor, was found to be a wild goat (*Capra hircus*), and the other four sub-species were reduced to two categories, the straight and flare-horned Markhors (Ahmad et al., 2018; Lydekker, 1900; Platt, 2021; Schaller & Khan, 1975). Five sub-species have been recognized globally often based on horn configuration. These four are found in Pakistan except Bukharan Markhor (*Capra falconeri heptneri*).

- Astor Markhor (*C. f. falconeri*)
- Bukharan Markhor (*C. f. heptneri*)
- Kabul Markhor (*C. f. megaceros*)
- Kashmir Markhor or Pir Panjal Markhor (*C. f. cashmiriensis*)
- Sulaiman Markhor (*C. f. jerdoni*)

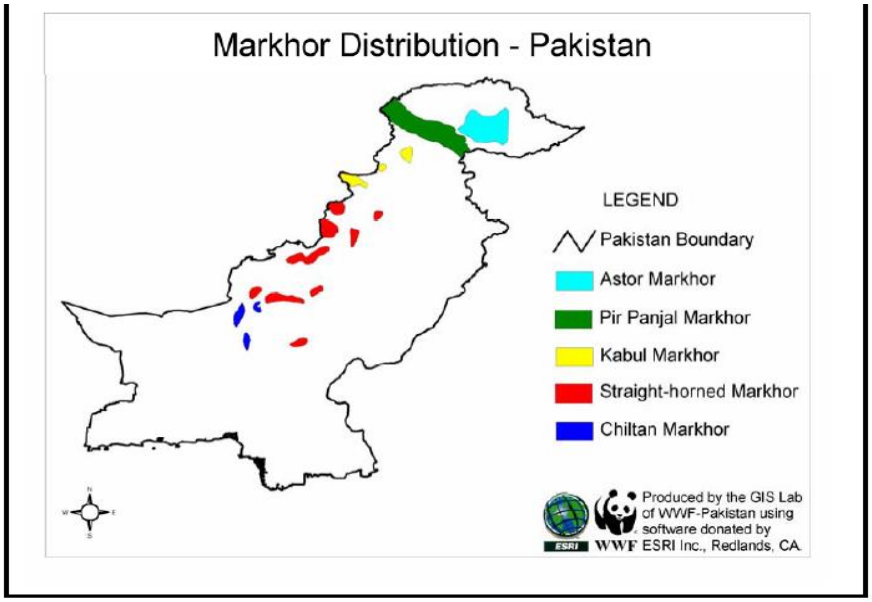

Figure 2. Markhor distribution in Pakistan. (Courtesy by. WWF-Pakistan)

Morphology

Female Markhor has a little chin tuft while male Markhor has a black beard and the chest of male Markhor has a shaggy mane of long hairs. The fore-part of the neck is made up of white and grey hairs, and the elbow of the back legs has lengthy hair. Body hair lengthens and virtually little under-wool development occurs in the winter. It sheds wool and long hairs while rubbing its body against rocks and trees in the summer season and the long hairs become shorter and trimmed. The healthies' young male coats turn dark and almost blackish in some in the autumn season. The male animals' bodies start to shrink and their horns lengthen at the age of nine, making them weaker and making them easier prey for predators, hunters, and some other natural threats like avalanches, floods, and rolling stones (Fig. 3 & 5).

Figure 3. Kashmir Markhor

Social behavior of Markhor

The mature males are solitary and only associate with females in valleys during rutting season while females are social and dwell in small herds with their young and immature males. Markhor begins feeding very early in the morning and moves upward as these are diurnal creatures and they are most active in the daytime. When the heat becomes high, they search for shade and lie down under trees or rocks where they will spend the entire day chewing their cud during the summer season. They begin moving southward once more after dusk in search of water and for grazing.

They choose a steep place to spend the night to avoid predators in the late evening. Sometimes the herds have been seen eating at night in the rutting season and under the moonlight. They graze and also browse. To access the leaves and seeds of *Quercus ilex*, Markhor stands on their hind legs. Young males take advantage of the rut while older males participate later. During the massive fight, some males lost their horns, and others even lost their lives after falling off rocks. A larger group of stronger males is present. When there is a threat, one animal in the group will emit a distinctive sound, such as "tiff," to alarm the others Markhor is sociable. Markhor is also a skilled tree climber (Ahmad et al., 2018; Lydekker, 1900; Platt, 2021; Schaller & Khan 1975; Ali, 2008) (Fig. 4).

Figure 4. A herd of Markhor drinking water.

Habitat of Markhor

Markhor is mainly restricted to steppe and dry forests, Oak, sagebrush, wild almond, and fir are common plant species that can be found in their habitat. In the Chitral Valley, Markhor is found at elevations ranging from 700 to 1000 meters (Huffman, 2004).

Ecosystem role of Markhor

By controlling the growth of specific vegetation and serving a key role in the food chain and as a source of food for significant carnivore species like the wolf, jackals, Hyaenas, snow leopard, and lynx. Animals have a significant ecological impact either directly or indirectly on communities and ecosystems, (Ripple & Beschta, 2004; Ray et al., 2005; Roemer et al., 2009). They are also a significant factor in determining the density of carnivores (Ahmad et al., 2022). Animals like carnivorous and herbivorous mammals play a key role in maintaining the integrity of the

ecosystem (Marcot & Heyden, 2001; Bakker et al., 2016). Through trophy hunting programs, mammals like Markhor (*Capra falconeri*) also bring in money for the community (Arshad et al., 2012; Ashraf et al., 2014; Nawaz et al., 2016) (Fig. 4).

Predation of Markhor

The main predators and hunters of Markhors are human beings. Numerous young markholes have been observed to be preyed on by golden eagles (*Aquila chrysaetos*). The primary predators of Markhor in the wild are Himalayan lynx (*Felis lynx*), leopard cats (*Felis bengalensis*), snow leopards (*Uncia uncia*), wolves (*Canis lupus*), and black bears (*Ursus thibetanus*).

Figure 5. A male Kashmir Markhor (*Capra falconeri cashmierinsis*) is hunted by a foreigner as a trophy hunt. (Courtesy by. Chitral Wildlife Division)

Current population trend

During the current study, information was gathered from 16 vantage points (observation points). The 28 distinct CGNP sites contained roughly 2278 Markhor of various age groups, according to the most recent counts. Based on their shape and size, the entire male population was divided into four classes: class I, class II, class III, and class IV. Female adults, yearlings, and children were divided into independent, classless categories. In all CGNP locations, the female Markhor was seen in great numbers (804) and was followed by lambs (342), the second most numerous age group. Male Markhor with age groups was most numerous when they were over 6 years old (270 heads), 4 years old (207 heads), young 294, Class I (186), Class II (175), and Class III 207 (Table 1 & fig. 6)

Table 1. Abstract of Markhor Survey Report 2021

Lamb $\frac{1}{2}$ years	Yearling	Female	Male				Total
			C-I $2\frac{1}{2}$ Years	C-II $3\frac{1}{2}$ Years	C-III $4\frac{1}{2}$ to $6\frac{1}{2}$ Year	C-IV > 6 Years	
342	294	804	186	175	207	270	2278

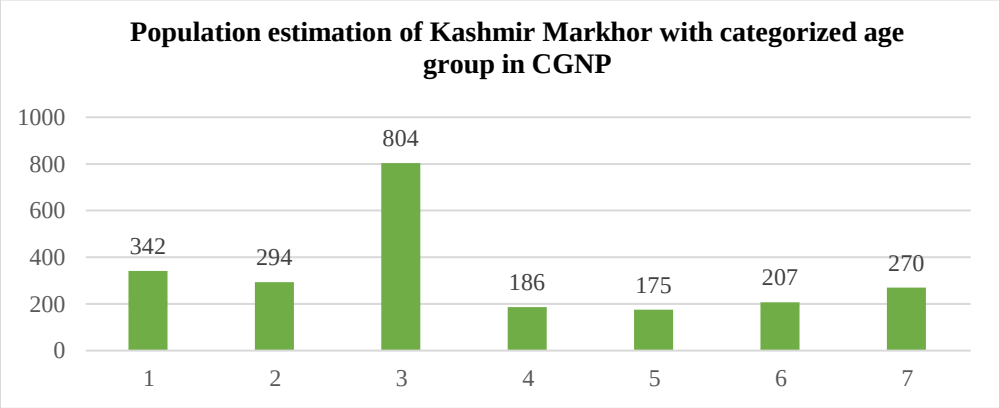

Figure 6. Population estimation of Kashmir Markhor with categorized age group in CGNP.

Population

The researcher recorded the population trend of Markhor in Chitral Gol National Park Conservancy during the year 2021 (Table 2). Over one year, the population showed an upward trend in Chitral Gol National Park. The population growth was 2278 individuals in Chitral Gol National Park.

Population of Fawn

The fawn populations showed an upward trend in Chitral Gol National Park. The fawn population increased to 636 individuals in Chitral Gol National Park (Table 3).

Population of Female

The population of young male

The population of young males increased in Chitral Gol National Park. The young male population increased by 568 individuals in Chitral Gol National Park (Table 3).

The population of Trophy size male

Trophy-size males showed an upward trend in Chitral Gol National Park. They increased by 270 individuals in Chitral Gol National Park (Table 3).

Table 2. Markhor population in Chitral Gol National Park Chitral during 2021

Area	Lambs $\frac{1}{2}$ years	Female	Young and Yearling	Class-I $2\frac{1}{2}$ Years	Class- II $3\frac{1}{2}$ Years	Class- III $4\frac{1}{2}$ Years	Class IV (>6) Years	Total
CGNP	290	714	267	176	159	190	248	2044
Wildlife Range Shoghor (Buffer zone)	28	60	9	4	10	13	14	138
Rumbur (Buffer zone)	24	30	18	6	6	4	8	96
Total	342	804	294	186	175	207	270	2278

Table 3. Age and sex-wise Abstract of Markhor Survey Report 2021.

Fawn	Female	Male Young	Male trophy size	Total
636	804	568	270	2278

If we summarize our findings, we find that 2044 in CGNP, Shoghor buffer zone 138, and Rumber buffer zone 96, make 2278 total of the population of Markhor. Our results show that the number of Kashmir Markhor is constant and growing in Chitral Gol National Park as compared to earlier surveys (Table 4 & Fig. 7).

Table 4. Markhor Population at Chitral Gol (Buffer Zone)

Chitral Gol National	Shoghor buffer zone	Rumber buffer zone	Total population
2044	138	96	2278

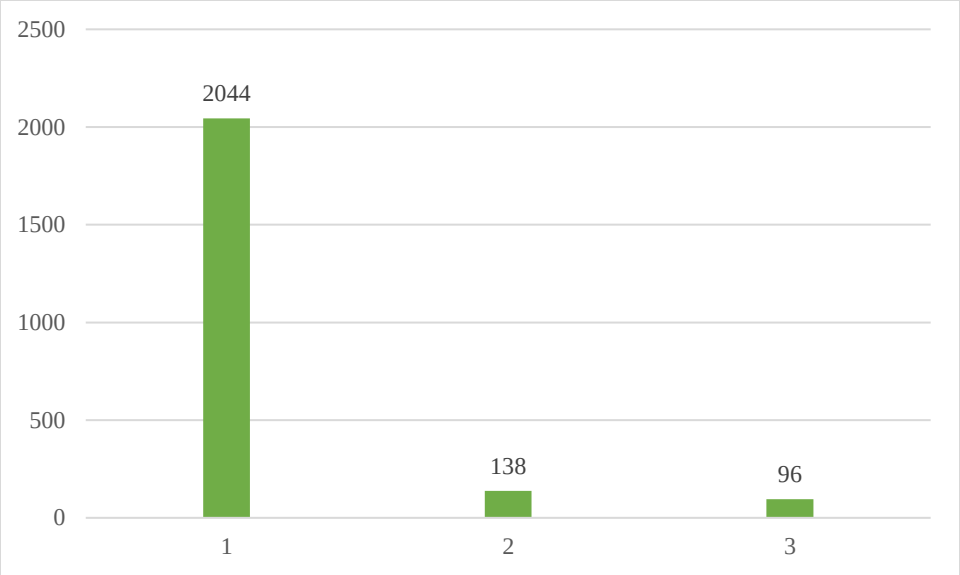

Figure7. Markhor Population at Chitral Gol (Buffer Zone)

Analysis of data

Total population analysis of the Markhor population in CGNP

The researcher recorded the population trend of Markhor in Chitral Gol National Park Conservancy during the year 2021 (Table 5). Over one year, Chitral Gol National Park's population showed an upward trend. The population growth was 2278 individuals in Chitral Gol National Park (table 6 & 7) (Fig. 8 & 9).

Table 5. Numbers of Markhor with categorized age groups observed at different sites of CGNP

Name of Area	Vantage Point	Lambs $\frac{1}{2}$ Years	Yearling $1\frac{1}{2}$ Years	Females	Male				Total
					C-I	C-II	C-III	C-IV	
					$2\frac{1}{2}$ Years	$3\frac{1}{2}$ Years	$4\frac{1}{2}$ to $6\frac{1}{2}$ Years	> 6 Years	
Rumbur Buffer Zone	Chchudihar Gol	5	3	5	1	2	0	1	17
	Konish	4	4	8	2	3	2	2	25
	Palaro Dehar	7	3	11	3	1	1	2	28
	Chowki Dehar	8	8	6	0	0	1	3	26
Total		24	18	30	6	6	4	8	-
Chitral Gol National Park	Ulowak	21	23	45	20	19	21	18	167
	Narkukoo Bklt	13	10	31	3	5	5	7	74
	Loho Bangut	56	40	57	21	17	17	19	227
	March Shall	49	26	43	28	26	21	14	207
	Marindhar	12	27	61	12	21	32	32	197
	Banch Shaal	2	0	2	0	1	0	6	11
	ShaDehar	43	18	95	22	13	11	46	247
	Sash Malogh	0	10	3	0	0	1	9	23
	Tonghokh Pakhturi	32	15	89	12	10	26	31	45
	Baghotek	12	5	57	4	9	13	14	114
	Chaghbini hut	0	13	25	4	1	4	3	50
	Parpato Shall	5	6	9	5	2	2	2	31
	Kryderi,Gokhsh	7	0	10	0	1	2	1	21
	Tongoh Kotor & Chu	30	22	92	16	21	22	19	222

	Shushkileh	8	9	19	7	5	6	8	62
	Daleem Dehaar	0	43	76	22	8	7	20	176
Total		290	267	714	176	159	190	248	-
Shoghor Wildlife Range	Zenadaour	6	3	10	2	2	2	1	26
	Awerit Gol	2	2	9	2	2	3	3	23
	Eidgah	4	-	12	-	-	2	1	19
	Panji	5	3	17	0	4	6	7	42
	Kalinch	11	1	12	-	2	0	2	28
Total		28	9	60	4	10	13	14	-
Grand Total		342	294	804	186	175	207	270	2278

Table 6. Markhor population at Rumbur Buffer zone

Female	Lambs $\frac{1}{2}$ years	Youngs & Yearling	Male				Total
			C-I	C-II	C-III	C-IV	
30	24	18	6	6	4	8	96

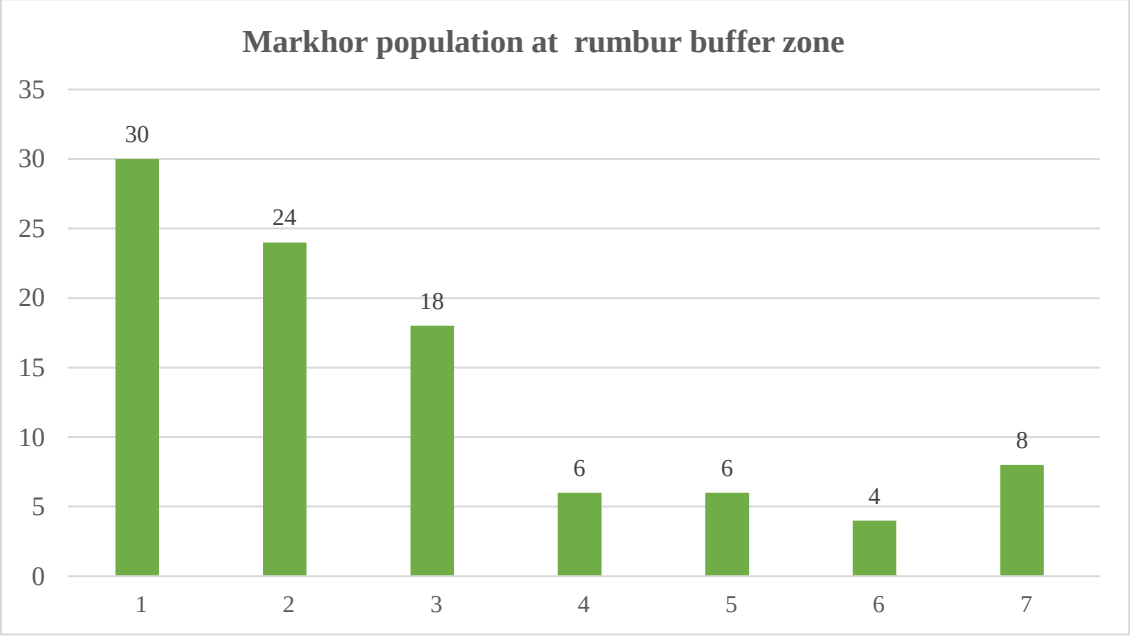

Figure 8. Markhor population at Rumbur Buffer zone.

Table 7. Markhor population at Shogor wildlife range zone.

Lambs $\frac{1}{2}$ Years	Females	Young & Yearling	Male				Total
			C-I	C-II	C-III	C-IV	
28	60	9	4	10	13	14	138

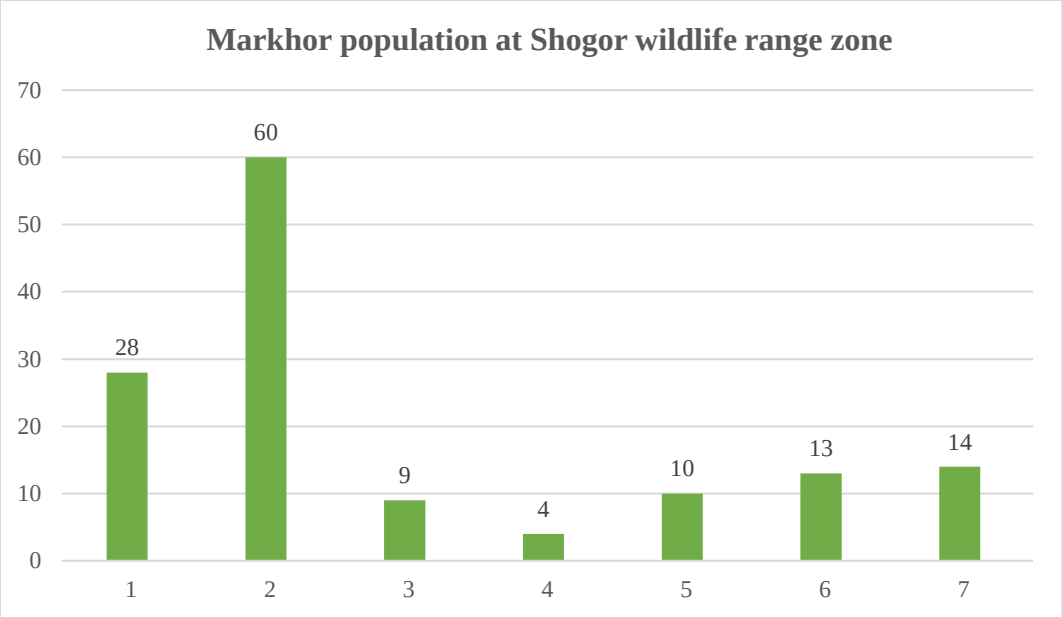

Figure 9. Markhor population at Shogor Wildlife Range zone

Discussion

CGNP has been a protected area since 1984 and gained much fame for successful conservation and increasing population of the Markhor which has now been raised to around 2000 inside the park (Kakakhel, 2020). This study provides the first-ever range-wide density estimates of Markhor in Pakistan, constructed on empirical data. The double-observer technique has been used successfully for mountain ungulates in Pakistan (Ali et al., 2019; Ahmad et al., 2020). Previous population assessments in Pakistan were carried out in limited parts of the species distribution range using the point count/vantage point method. By observing animals closely, we came to know about their morphological differences and some fascinating facts about these animals (Khan et al., 2017).

In our current study, we have estimated the population of Markhor in the surveyed area to be about 2278 individuals. The high density was documented in study blocks of Chitral (CGNP and buffer area of CGNP). The density of Markhor varies from region to region depending upon the protection level measures and quality of available habitats. Information about the Markhor population and density pattern across their range is patchy. We cannot compare our study results with the aforementioned population of Markhor from different regions due to the differences in the survey methodologies and techniques. We documented an increase in Chitral's Markhor population and attribute it to the establishment of CGNP, in addition to active protection measures

taken by wildlife departments and communities. Moreover, a proposal has been submitted for the establishment of a community-based conservancy program in CGNPs and buffer areas (DFO Wildlife Chitral).

The Markhor population in Pakistan shows a well-balanced sex ratio structure (Aryal et al., 2010). The main reason for this is active protection by relevant wildlife departments and the involvement of local communities. The high overlap in diet indicates a severe level of competition in the spatially limited pastures of Chitral and may reduce the survival, growth, and reproductive rates of Markhor. This endangered species has a significant role in the local economy by generating revenue through trophy hunting programs. Thus, its conservation ensures the well-being of rural communities and could be achieved by eliminating competition with livestock, particularly in its core habitats (Ashraf et al., 2014).

The government has fixed a Markhor trophy hunting quota of four animals per year in the Khyber Pakhtunkhwa province of Pakistan. This quota of Markhor trophy hunting should not be fixed but should be based on the population of Markhor trophy-size males. The population of Markhor in Chitral Gol National Park Khyber Pakhtunkhwa Pakistan has increased to 2926 individuals and has enlarged to the buffer zone of the National Park. At least 1% of Markhor trophy hunts in the buffer zone are recommended to support the local community for their livelihood improvement and encouragement of conservation. The community organizations should be strengthened in terms of establishing their offices, field equipment, and mobility besides protection (Kakakhel, 2020).

Double-observer surveys were conducted during 2019–2021 in nine major watersheds of Khyber Pakhtunkhwa and Gilgit-Baltistan covering an area of 4664 km2. Secondary data were collected for unassessed areas to gain a holistic overview of the Markhor population and density in the region. Results revealed a Markhor population of 7579, with a density of 0.30 animals per km2 in Northern Pakistan (Ahmad et al., 2022). A total of 146 groups of Markhors were counted, with a mean group size of 23 (3–58) individuals. There were 109 males and 108 young per 100 females in the population. Among 1936 recorded males, Class I males accounted for 27.74%, followed by Class II (26.45%), Class IV (trophy-size) (23.40%), and Class III (22.42%). The overall detection probability was recorded as 0.87 and 0.68 for the first observer and second observer, respectively. Compared with past reports, the population of Markhor in Northern Pakistan appears to be increasing, particularly in protected areas (PAs) such as national parks and community-controlled

hunting areas (CCHAs). Conservation programs, notably trophy hunting and PA networks, appear to be vital in sustaining Markhor populations in parts of the species range. Ecosystem management is well known but so many hazards are present which directly or indirectly affect the health of wetlands. Hazards may be natural or artificial and are influenced by human activities (Khan et al., 2017).

Threats to Markhor

This species faces the following common threats.

- We noticed the lack of knowledge about the conservation of wildlife including Markhor in local communities.
- Lack of Adequate Involvement of Local Communities.
- The foremost threat to Markhor is uncontrolled poaching.
- Poor implementation of Wildlife (Protection, Preservation, conservation and Management Act, 1975), of KPK province. Due to this reason, poaching and hunting of Markhor is common. They are illegally used in consumption and trade.
- Natural habitat loss is one of the major threats and it is suspected that human agricultural activities and timber cutting and grazing pressures near the national park have affected badly on this species.
- Young Markhor has been observed to be preyed upon by golden eagles (*Aquila chrysaetos*). The primary predators of Markhor in the wild are Himalayan lynx (*Felis lynx*), leopard cats (*Felis bengalensis*), snow leopards (Uncia uncia), wolves (*Canis lupus*), and black bears (*Ursus thibetanus*).
- The literacy rate is very low in most of the areas where Markhor is found. It is difficult to deal with illiterate communities about the conservation and ecological aspects of wildlife.
- Many national and international NGOs work in the area for the conservation of biodiversity through the implementation of different projects, but very little collaboration and coordination between the NGOs and Government Departments occurs.
- Markhor is found in areas where most people are poor and lack basic facilities.
- Habitat loss played a lead role in bringing Markhor to the verge of extinction. Wildlands are rapidly shrinking due to the ever-increasing human population and subsequent increase in demand for timber and fuel/wood.
- Inadequate operational Fund.

- Due to a lack of expertise and scientific approaches, research on population viability, landscape ecology, and stochastic effects does not occur.
- Domestic hunters cannot compete financially with international hunters. Such a situation creates resentment in domestic hunters who resort to poaching.
- Illegal hunting and poaching of Markhor and other wildlife species still occurs.

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