

Original Article

Status of Suleiman Markhor: Negative Incentives and Positive Required Actions in the Torghar Range, North-Eastern Balochistan, Pakistan

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Abstract

This study examined the population dynamics of Suleiman Markhor (*Capra falconeri jerdoni* Hume, 1875) in the Torghar Hills Range, located in Western Central Pakistan, focusing on current population size, threats, and conservation strategies. The Torghar is a conservation area and one of the few habitats of this species, endemic to Balochistan and categorized as near threatened by the IUCN in 2015. Data were collected through interviews with the local inhabitants, local hunters, and Wildlife departments supplemented by relevant published literature. Results indicated that the Markhor population showed a moderate increase from 334 individuals in January 2021 to 374 individuals in the latest census conducted by the Ten Billion Tree Tsunami Program (TBTP), Ministry of Climate Change, Forestry and Wildlife Department, Balochistan. Previous censuses in 1985 and 1987 reported fewer than 100 mature individuals, while peaks of 2541 and 3158 were recorded in 2005 and 2008 respectively in Torghar Hills. The present study identifies anthropogenic activities climatic change, and habitat degradation as primary threats. This research provides updated population figures and highlights conservation challenges. Expanding the goat habitat is also advisable to conserve the feasible population of *C.f. jerdoni* in this part of the country.

Keywords: Population occurrence, Suleiman Markhor, Threats, Torghar mountains

INTRODUCTION

In Pakistan, the chaotic artiodactyl caprine like sheep and goats (Bovidae: Caprinae) are quite contrasting. According to Shackleton (2001), these animals are mostly found in small, spread groups in high mountain tracts of the country's northern parts, in the southwest desert hills and southern Sindh, and the south region of Balochistan as well. Based on horn shape, varied body size, and location of these animals, they are classified according to Mirza (1975), Hesse et al. (1977), Roberts (1997), and Chaudhry (2011) into seven species and five subspecies viz *Naemorhedus goral* (Western Himalayan goat); *Ibex sibirica* (Himalayan /Asiatic ibex); *Capra falconeri megaceros* (Straight-antlered Markhor);

and *C. f. falconeri* (flare-antlered Markhor); *Pseudois nayur nayur* (Blue sheep); *Capra aegagrus blythi* (Sindh wild goat); *Capra aegagrus chialtnensis* (Chiltan wild goat); *Ovis vignei cycloceros* (Afghan urial); *Ovis vignei blandfordi* (Blandford urial); *Ovis vignei punjabiensis* (Punjab urial); *Ovis ammon polii* (Marco Polo sheep) and *Ovis vignei vignei* (Ladakh urial).

Markhor (*Capra falconeri* Wagner, 1893) is a goat of low elevations as compared to another member of the genus *Capra* in Pakistan. They can live at elevations between 700 and 1000 meters in the valley of Chitral and between 2700 and 4000 meters along the lower slopes of the Suleiman Range (Schaller, 1977). The goat species are largely diurnal in undisturbed



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habitats (Damm and Franco, 2014). Moving and feeding are most common in the morning and late afternoon. Resting is common at noon and early afternoon (Wilson and Mittermaier, 2011). In winter they feed periodically throughout the day. (Damm and Franco, 2014). Markhors prefer southern slopes in summer and winter. During winter, at mid-day, after the valley bottoms warm, Markhors descend and forage on the slopes until after dark (Wilson and Mittermaier, 2011). Mature females associate in small herds with young males, yet they sit together in larger herds on constrained tracts. Males reach maturity by living alone; they join female herds in November and stay with them until the first spell of springtime (Schaller, 1977).

Markhors are stout animals that have strong and relatively short legs with broad hooves (Roberts, 1997). They are a highly sexually dimorphic species with males almost double the size of females (male body mass = 104 kg, female body mass = 55 kg) (Schaller, 1977). They are polygynous and gregarious. Mating and fawning occur during December, January, May, and June respectively (Schaller 1977; Masood, 2011). Female Markhor becomes mature at 30-36 months and they have straight-horned (Khan et al., 2013) compared to flared-horn Markhor which according to Aleem and Malik (1977) reproduces for the first time at the age of 24 months. The rutting period continues from late October up to the start of December (Rosser and Haywood, 1997). One lamb is typical for female Markhor ≤ 5 years old, however, twins are frequent with older females (Ghalib et al., 2019). Mammalian livestock mothers reproduce live offspring that may be one or two. They reproduce single or double kids after 135-170 days of maternity. The kids are weaned at the age of five to six months. In the wild, Markhor should live for 10 to 13 years, while in captivity, it may live up to 19 years (Schaller 1977; Ahmad, 2014). The number of rings on a Markhor's horns can be used to calculate its age (Roberts, 1977).

Suleiman Markhor (*C.f. jerdoni*) is distinguished from other subspecies of wild goats in having tight, straight multi-spiral horns of males. It inhabits the Suleiman Mountain range and Toba-Kakar range (Roberts, 1997; Bazmir, et al., 2013), in Khalifat Hills Ziarat (Shah et al., 2010) and Takatu Hills north-eastern Quetta (Ahmad, 1989). The Chiltan Markhor, and *Capra falconeri chialtanensis* (Lydekker, 1913) are found only in the Chiltan hills southwest of Quetta (Roberts, 1997, Schaller, 1975). It is not a true Markhor

and is considered a crossbreed between Markhor and domestic goat (Burrard, 1925; Dollmann and Burlace 1935) or between Markhor and wild goat (Roberts 1969; Grimwood, 1969; Valdez and Bradbury, 1985). However, Schaller (1977) considered the Chiltan Markhor as a separate wild goat, *Capra aegagrus chialtanensis*.

Torghar Hills (Black Mountains) in the province of Balochistan, Pakistan is known for its rich and diverse wildlife. The approximately 1000 km² Torghar Conservation Project (TCP) lies within the northeastern part of the Toba-Kakar mountainous range (district Killa Saifullah), near the north-central border with Afghanistan (Jonson, 1997a). It lies at a distance close to 90 kilometers from the district headquarters (Killa Saifullah). The hills are renowned for enormous numbers of wild undulates notably the *Capra falconeri gerdoni* and *Ovis vignei cyclocers*. Illegal hunting rapidly decreased the number of these animals as well as the leopard, and black bears especially during the conflict (1979-1992) in Afghanistan near the border of District Killa Saifullah. The area of Torghar is moderately arid with around 8,700 feet of elevation. Summer is hot with mean temperatures between 21°C and 32°C. The wintertime is October to April with severe cold in December and January (Khan, 1993). A sizable portion of winter passed as snowfall. The winter rainfall supplies water for crops such as cereal and barley (Government of Pakistan, 1990).

For efficient conservation of Suleiman Markhor and Afghan urial sheep in Torghar hills, a project (TCP), later the STEP (Society for Torghar Environmental Protection) was founded in 1985. The status of both species is expressed as animals to be hunted only under peculiar conditions following the 3rd Plan of the Balochistan Wildlife Protection Act of 1974 (Government of Balochistan Agriculture Department, 1977). The STEP was listed in 1994 as a Non-Government Organization. STEP 1995 began the Torghar biodiversity conservation and sustainable use program with financial aid (US\$ 41854) granted by the Global Environment Facility and Small Grant Support from the UNDP (Shackleton, 2001). The TCP is predominantly, a series of three parallel ridges, separated by two northeast-running stream drainages (Jonson, 1997b). The south-facing slope of the southernmost ridge is divided by multiple deeply incised drainages and rises gradually to a peak of around 2800 meters. To construct a sequence of step-like cliffs leading to the Khaisore Valley, the

south-facing sides plunge sharply from the top (Bellon, 2008). The northern ridges are made up of sharply tilted rock strata that resemble a grid of parallel, unevenly spaced teeth (Woodford et al., 2004).

The area of Torghar is characterized by Steppe-type vegetation with varied peaks and soil types. For the most part on lower slopes (1000- 2000 m), the trees are meager while some that persist are widely dispensed including *Pistacia khinjuk* (Wild Pistachio), *Juniperus macropoda* (Juniper), and *Fraxinus xanthoxyloides* (Ash). While along stream beds the *Tamarix* sp. (Tamarisk) grows. Plants like *Acacia*, *Artemisia*, *Haloxylon*, and *Rosa* species known as xerophytic scrub vegetation dominantly established due to over-grazing in the valleys. Lesser grazing pressure persists in sturdy mountainous areas that harbor mostly clump grasses (Frisina, 2000). Our objective in the current study was to ascertain the number and survival of *C. f. gerdoni* in Torghar Hills, Pakistan. Although, census surveys of the said wild goat in

TCP (STEP) protected areas have been confirmed from time to time, but mostly have shown erroneous estimates of Markhor. This paper also highlights the opportunities for future adoption of successful conservation tools and approaches in the Torghar region benefiting both the high mountain ecosystems and dependent local communities.

MATERIALS & METHODS

Area of Study

The study site includes the Torghar Conservation Project (TCP) area ($31^{\circ}12'N$, $68^{\circ}28'E$) located in the remote north-western part of Killa Saifullah district ($30^{\circ}41'52.67''N$ and $68^{\circ}21'17.26''E$) in Balochistan province, Pakistan (Fig. 1a, b) during the rut and lambing seasons of 2023. The district is located in the northeast of the province, sharing its boundaries in the west with Pishin district and Afghanistan, in the north and northeast with Zhob district, and in the southeast with Loralai district (Figs. 1c).



Figure 1a. A map of Baluchistan province shows the position of the Torghar area in district Killa Saifullah, with an inset map of Pakistan.

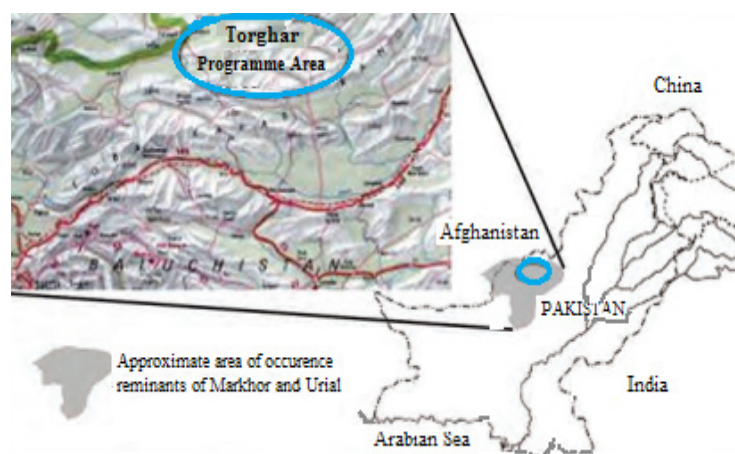


Figure 1b. Pakistan and Torghar Programme Area.

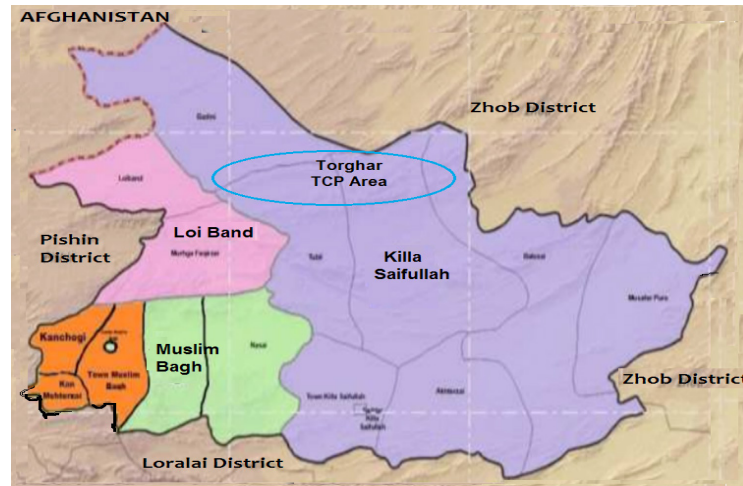


Figure 1c. Location of the Torghar Conservation Area in district Killa Saifullah.

Survey Techniques

Markhor populations were determined mostly through interviews with the local inhabitants, expert informants, International NGOs, and field staff of the district forest and wildlife department based on visual (direct) count techniques with Binoculars during the dusk (7:30 to 9:30 am) and dawn (4:30 to 5:30 pm). Secondary data, based on the information available, were obtained from published literature, and concerned game guards of TCP/ STEP (Society for Torghar Conservation Protection). Assessment of the existing flora and habitat conditions in the study area were examined using relevant published literature, and in this regard, local community members and hunters (Fig. 15b) also interacted.

Climate

The climate of district Killa Saifullah is semi-arid (steppe), generally elevated at 1500 to 2200 meters higher than the sea level. It can be situated in a “warm summer and cool winter” temperature region. The mean temperature ranges between 21°C to 32°C in summer and

minus 10°C in winter. The months of June and January are extremely hot and frigid respectively (Khan, 1993). The range of average yearly rain was found to be 125 to 500 mm. A sizable part of the winter season brings snowfall (Government of Pakistan, 1990).

The climate of the Torghar Hills range is cold semi-arid (steppe), and altitude varies between 2500 to 3300 meters (Woodford et al., 2004; Jackson and Hunter). Summers are hot and temperatures often rise to 35°C (Fig. 2), winters are cold with snowfall (Fig. 3), and the temperatures fall as low as minus 15°C (Mitchell and Frisina, 2007; Arshad et al., 2012). Average annual precipitation range between 200-250mm which falls mostly in March and April, with some summer rainfall in July and August (Chaudhry and Rasul, 2004). Fierce thunderstorms happen in the months of summertime. A remarkably harsh drought event occurred during the years 1997 to 2001 with the drought situation continuing through 2004, but tempering slightly in 2005. Periodic drought is frequent and goes on for many years according to local tribesmen (Woodford et al., 2004).



Figure 2. Shrubs/ mixed wood trees on lower slop in summer at Torghar Hills.



Figure 3. Snowfall glimpse at Torghar Hills.

Flora Habitat Survey

The Torghar Conservation Project is located within the scrub forest zones (Juniper /Pistachio and dry sub-tropical semi-evergreen scrub forest) of Balochistan (Roberts, 1997). The vegetation cover during spring at higher slope is worth seeing (Fig. 4a). The semi-desert landscape of the Torghar area is dominated by the shrub-steppe plant communities (Fig. 4b) and the land flora is dispensed and low with varied elevation. The lower incline (1000-2000 m a.s.l.) of hills

possesses mostly scattered vegetation (Fig. 4C). *Pistacia khinjuk* (wild pistachio) (Fig. 5), *Junipers macropoda* (Juniper) (Fig. 6), *Prunus eburnean* (wild almond) (Fig.7), *Fraxinus xanthoxyloides* (Fig. 8) are main wooden flora in the area were once rich, and even now found with low density. Among wooden trees, *Junipers macropoda* are solely found at high altitudes (2000-3300 m a.s.l). The area's vegetation has become bare due to higher grazing, whereas the nippy slopes have little grazing pressure instead of bearing a pasture land with herbs and shrubs (Belon, 2008).



Figure 4a. Vegetation cover scenario at Torghar Hills during spring.



Figure 4b. Semi-desert habitat at Torghar Hills.

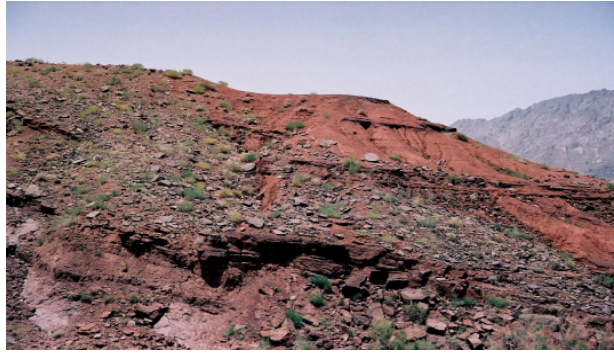


Figure 4c. Soil Types at Torghar Hills and scattered vegetation.



Figure 5. Wild pistachio, *Pistacia khinjuk*



Figure 6. Juniper (*Juniperus macropoda*)



Figure 7. Wild almond (*Prunus eburnean*)



Figure 8. Ash (*Fraxinus xanthoxyloides*)

RESULT

The population of *Capra falconeri jerdoni* (Suleiman Markhor) is restricted to the North, Central, and Western Hill Ranges of Balochistan province, Pakistan (Frisina, 1998, 2000; Woodford et al., 2004; Valdez, 2008). *C. f. jerdoni* is endemic to South Asia, and within Pakistan, its IUCN status is near threatened (Michel and Rosen, 2016; Yasmeen et al., 2022). The data on Markhor count in this study are based on estimates of local hunters (inhabitants) and game guards (TCP/STEP). The recorded Markhor population was around about 374 (± 1043) individuals (Table 1) in the following composition viz females (n=176) 47.05%, young (n=67) 17.91%, lambs

(n=45) 12.03%, males (n=72) 18.98%, and trophy (n=14 old males) 3.74% respectively compare to a recent estimate of 334 individuals consisting of 172 females, 56 young ones, 36 yearlings and 80 males were recorded in the protected area of Torghar Hills. Previous studies had shown a consecutive rise in the number of Suleiman Markhor over the time from 1997 to 2011 with the highest number of 3158 mature individuals (goats) in 2008 presented in Table 2. The data recorded on the population count of Suleiman Markhor in 2021 from Takatu Game Reserve, Torghar STEP (TCP), Ziarat National Park, Koh-e-Suleiman mountain ranges, Balochistan is presented in Table 3 for comparison.

Table 1

The population count of Suleiman Markhor in Torghar Hills Protected Area during 2023.

Survey Location	Female	Young	Lamb	Males of different age				Trophy	Total
				2 years	3 years	4-6 years	>6 years		
Torghar Hills Range	176	67	45	6	3	25	32	14	374

Table 2

Suleiman Markhor population survey conducted in Torghar Hills Protected Area. (Source: Society for Torghar Environmental Protection (STEP)).

Date /Year	Survey source / Conducted by	Markhor Population	Recommended Harvest	Report	Funding Source
1985	Local hunters' estimate	<100	NA	NA	NA
1987	Richard & Mitchel Source: local hunters' estimation	<100	NA	NA	US Fish & Wildlife Service (USFWS), TCP
November 1994	K. A. Johnson	695	3 Markhor	OK	USFWS, WWF, STEP
November 1997	Frisina & Woods	1296	8-17 Markhor	OK	USFWS, STEP
1999	M. R. Frisina	1648	12 Markhor	OK	USFWS, Houbara Foundation
2000	Rosser, Tareen, and Leader-Williams	1600	12 Markhor	OK	USFWS, STEP
2004	Zool. Surv. Pakistan (ZSP)	2500	12 Markhor	OK	SUS G-CASia
November 2005	Shafique	2541	12 Markhor	OK	STEP
2008	Arshad and Khan	3158	12 Markhor	OK	USFWS, STEP
2011	M. R. Frisina	2829	12 Markhor	OK	Personal Communication

Table 3.

Suleiman Markhor population survey conducted in Takatu, Torghar, Ziarat, and Koh-e-Suleiman, Balochistan in 2021.

Source: National Strategic Support Unit (NSSU), ZSP, Ten Billion Tree Tsunami Program, Ministry of Climate Change, Islamabad

Survey area	Female	Young	Yearlings	Male	Trophy (oldest male)	Total
Takatu	435	120	145	425	33	1158
Torghar, STEP	172	56	26	64	16	334
Ziarat National Park	3	1	—	—	1	5
Koh-e-Suleiman	0	0	0	1	1	2

Discussion

Markhor (*Capra falconeri* Wagner, 1839) are found in the hill ranges of Afghanistan, Tajikistan, Pakistan, Turkmenistan, India, and Uzbekistan

(Sultanov, 1953; Schaller, 1977; Habibi, 1977; Habibi, 1997; Weinberg et al., 1997a, 1997b; Bhatnagar et al., 2009; Michel, 2010; Michel et al., 2014; Moheb and Mostafawi, 2012; Karamazov

et al., 2022) (Fig. 9). According to IUCN Red List 2012 based on reference C1 (IUCN, 2014), Markhor is classified as Vulnerable, because, there were only 2500 mature individuals of Markhor during the last global assessment with an estimated 20% continued decline (Valdez, 2008; Michel and Rosen, 2015).

Pakistan is home to two distinct species of Markhor: goats with flared horns (*Capra falconeri falconeri* Wagner, 1839) and those with straight horns (*C. f. megaceros* Hutton, 1842). The former includes two subspecies: Pir Panjal or Kashmir Markhor (*Capra falconeri cashmiriensis* Schaller and Mirza, 1971) and Astor Markhor (*Capra falconeri falconeri*), whereas the later ones also include two subspecies: Kabul Markhor and Suleiman Markhor (Roberts, 1997). Robert (1977), Schaller, and Khan (1975) described that former Astor Markhor (*Capra falconeri falconeri*) and Kashmir Markhor (*Capra falconeri cashmiriensis*) are one species.

Suleiman Markhor inhabited the mountains of Pakistan and Afghanistan adjacent to the Toba-Kakar Range, Balochistan (Roberts, 1977) (Fig. 1a, b). In the late 1990s, fewer Markhor existed even in Afghanistan, possibly fifty to eighty animals in the Koh-e-Safi (Valdez, 2008), with some in another sporadic pocket. No reports were found on the numbers of Suleiman Markhor in Afghanistan. The goats are perhaps eliminated in the country (Valdez, 2008), but possibly they may cross into Afghanistan from Pakistan (Torghar Hills). At present, the individuals of this wild goat are only restricted to the north-east, central, and western Balochistan, their number has faded to lesser, dispensed populations on all the hill ranges, including Takhatu (north-east of Quetta), Suleiman mountain (Zhob/Sherani), and Kaliphat mountain (Ziarat). In the past, straight-horned Markhor also has been found on the Zarghun, Phil Garh, and Murdar hill ranges instantly to the northern and eastern part of Quetta (Roberts, 1969). Individuals of Straight-horned Markhor are reported yet to live in the Shinghar Hills Range near the borderline of Balochistan and South Waziristan (KPK province) (Johnson, 1994b).

Torghar is one of the world-recognized community-based management programs in Pakistan (Fig. 1b, c) that have been inhabiting important wild species, the most striking and valued are called Suleiman Markhor and Afghan Uril (Ahmed et al., 2001). Flora of the area include trees like *Pistacia khinjuk* (Fig. 5) *P. cabulica*, *Juniperus macropoda* (Fig. 6), and

Fraxinus xanthoxylides etc. In Pakistan, the TCP, now the STEP (Society for Torghar Conservation Protection) is the older and eminent community-ownership plan so tribal groups have shown interest in establishing related plans in other hill ranges of Baluchistan (Ahmed et al., 2001; Frisina and Tareen, 2009). This program area consists of 1000 square kilometers (386 square miles) within the Torghar hills (Schaller and Khan, 1975; Roberts, 1977; Johnson, 1994; Frisina and Tareen, 2009). The TCP (STEP) has reduced livestock rivalry and poaching (Johnson 1997). It is reported that since the program's inception, the Markhor population in this area has continuously increased. Suleiman Markhor was said to be present according to previous reports (Johnson, 1997a, 1997b; Frisina et al., 1998; Frisina, 2000) in the study area (Torghar hills) and other areas of its range in Balochistan according to Frisina et al. (2002), Rosser et al. (2005), Arshad and Khan (2009) and Frisina personal communication (2014). Roberts (1969) estimated a total of 1000 individuals of Suleiman Markhor restricted mainly to the province of Balochistan. In the Torghar hills, there could have been fewer than 500 individuals of Markhor, but it was seriously vulnerable because it lived in disrupted pockets set apart (Roberts, 1969). In the early 1980s, there were only 200 individuals of Suleiman Markhor in Torghar Hills according to Mitchell (1989, quoted in USFWS 2012), but in 1994 there were 695 estimated individuals of Markhor in the Torghar Hills compared to the estimate by Frisina (2000) of 1684 for 1999 represents a substantial increase.

The population has risen since the formation of a community-based hunting program in 1999 by USFWS (US Fish and Wildlife Service), IUCN, and STEP (TCP). A total of 695 Suleiman Markhor were found in the Torghar Conservancy during 1994 (Johnson, 1997a) compared to 1296 in 1997 (Frisina et al., 1998) which expanded gradually to 1684 in 1999 (Frisina, 2000). Previously, in addition to the above-mentioned data, the estimates of the Zoological Survey of Pakistan (2004) showed 2500 individuals of Markhor. This data indicated a 34 percent increase between 1997 and 2005. Shafique (2006) reported the gain in Suleiman Markhor population to 2541 individuals in November 2005. An estimate of 3158 Markhor was reported by Arshad and Khan (2009) in Torghar Hills in 2008 was more than the average for the whole study area (1985 to 2004) and in any other domain of straight-horned Markhor in Pakistan. This might be an effect of

the lengthy period of shelter from poaching in the protected region. The estimate of Arshad and Khan (2009) may be biased and suggested revising this calculation to 1729 (Frisina pers. comm. 2014). The population count of 2011 from Frisina (pers. comm. 2014 quoted in Michel and Rosen, 2015) gave a total of 2829 animals. However, a true estimation of the overall count of these goat species is not doable, it may be assumed that the overall number might be slightly above 3000 animals. The Markhor population and its habitat concluded from the 2011 population study in the Torghar Conservancy are safe under the present management setting (Frisina and Rasheed, 2012).

The estimate of Suleiman Markhor in Takatu hills, Quetta was 150 in 1971 according to Schaller and Khan (1975), however, afterward Ahmad (1989) reported only 50 Markhor individuals found in the mentioned hills and around 100 in the area of Koh-i-Sulaiman. Shah et al., (2010) and Liaqat (2013) counted nine and 32 Suleiman Markhor respectively in the hill ranges of Ziarat (Balochistan). Data for 2021 estimates the number of Suleiman Markhor to be 1499 individuals with the highest ($n=1158$) at 77.25% in Takatu Game Reserve followed by Torghar Hills (STEP) at 22.28% ($n=334$), Ziarat National Park ($n=5$) 0.33% and Koh-e-Suleiman ($n=2$) 0.13% respectively (Saeed, 2021). At Takatu Game Reserve, the total estimate of 1158 includes individuals of different ages and sex classes such as 435 females, 120 young ones, 145 yearlings, and 458 males of different age classes. In Torghar Hills (STEP), 334 individuals of Suleiman Markhor including 172 females, 56 young ones, 36 yearlings, and 80 males.

There has been no recorded estimate for Suleiman Markhor after the 2011 census (Frisina pers. comm. 2014). The most recent census was conducted in January 2021, there were an estimated 334 individuals of Markhor as a whole in its entire range in Torghar hills, since a sharp decline in Markhor populations occurred up to the end of 2020s in Torghar protected areas, and other conservancies of this wild goat in Balochistan (Saeed, 2021). Therefore, a follow-up survey was conducted in 2023 to provide an updated estimate of the Suleiman Markhor population and key threats to this marvelous goat species and wildlife in general in Torghar Hills Conservancy.

The present study describes a total estimate of 374 (± 1043) individuals of Suleiman Markhor, and of those classified and aged, 174 were females,

67 young from the previous year (born in spring 2021), 45 lambs/kids (yearlings), and 86 males include 14 trophies. Photographs of a 7-year-old male Markhor, young, and lambs/kids (yearlings), and the trophy is given in figures 11, 12, 13, and figures 15a and 15b respectively. These results are comparable with those presented in Table 2 and Table 3. The results given in Table 2 indicate that the Markhor population size has enhanced gradually or is at least stable. The population has been reducing since the survey conducted in 2011 by Frisina (Perso. Comm. 2014) in the areas managed by TCP/STEP. The population size in this study (based on the game guard and local hunter's observation) took place in the rut and lambing seasons. According to literature, males and females and young are in mixed herds During the rut (Fig. 16), hence easily count and differentiate. The adult male is normally more viewable, and ventures, joining one herd then another, searching sex spouse. Adults male and female may be distinguished based on body, horn size, and coloration of Pelage (Fig. 16), and the lambs/kids (yearlings), young based on body size and horns (Schaller, 1997). The female starts to separate from the group in formulation for young lamb. The lambs (yearlings) accompanied by mothers (Fig. 14) are weaned for about 5 to 6 months (Bellon, 2008). The females once again go for herd form after the lambing period. Based on the abundant vegetative cover as a result of torrential rains in the months of the years 2022, therefore, in 2023 vegetation appeared well-grown, and the food and water were abundant may be one of the reasons the population size of Markhor has recently increased.

Previous reports shown a sharp decline in the population size of *C. f. jardonii* in the Torghar hills up to the mid-1990s (Frisina et al., 1998), and later the eventual increase in population size may be the community-based conservation efforts (Frisina, 2000; Frisina and Awan, 2004). According to the literature (Haider and Hussain, 2002; Woodford et al., 2004; Bellon, 2008) survey, the geographic location of Torghar Hills is one of the leading decline factors. It lies across several traditional migration routes that have been followed by the Torghar local herdsman, other tribes of the area, and nomads on their seasonal treks on the Pakistan side of the border with Afghanistan, where some of them spend the summer and the winter grazing in the Torghar hills to the south. A large number of these trans humans are accompanied by hundreds of thousands of heads of livestock. Almost every

adult man is armed and they hunt large and small game animals during their seasonal migrations. Secondly, the arrival of arms and ammunition during the Afghan and USSR (Russia) War (1979-1995) lead to increased hunting and poaching pressure (Woodford et al., 2004). Climate change in terms of 'unpredictable rains and droughts' has grown to become another huge challenge over the past decade.

In contrast to the above-mentioned data, Musakhel and Khan (2014) reported the status, population, and distribution pattern of Suleiman Markhor in representative central and peripheral areas from Narighur and Qaisaghar of the Suleiman mountain range. Due to different habitat types and tough terrains, different direct and indirect methods were applied including fixed point/vantage surveys, and track counts. The survey team sighted 10 Suleiman Markhor directly. Indirect signs like fresh group footprints and droppings were found at different 17 points. It is assertable that presently, this region harbors more than 40 individuals of this subspecies (Musakhel and Khan, 2014). Khan et al. (2013) reported the average group size determined during the lambing and rut study was 1.833 ± 0.752 and 2.142 ± 1.215 severally in the 2011 seasons using vantage point count methods in the Suleiman hill range having 260 Km² area. Females were highest preceded by kids and males. They also studied the outcome of feature, slope, and height i-e 6000 to 9,000 feet in the presence of Markhor. Human activities like hunting; poaching; competition for grazing of livestock and forest reduction were found to be the main reasons for bringing the Markhor number close to the brink of extermination.

Damm and Franco (2014) believed that the Torghar Conservation Project (TCP) in the Torghar Hills is arguably the most successful community-based Caprinae conservation project in Pakistan and possibly worldwide ". TCP was established in 1986 with the involvement of local tribes. US wildlife biologists provided technical input that was needed to achieve conservation goals through a sustainable-use model that would also bring measurable benefits to the local population. Persons of the locality were employed as wildlife guards using the proceeds from the sale of a select few trophy hunts, with the condition that they agreed to stop poaching. There were probably no more than 100 Suleiman Markhor left when the program started in 1985 (FAO 2006). In 2009 the population was

estimated at around 3100 Suleiman Markhor.

Similarly, the increasing trend in the population of Suleiman Markhor in Balochistan is attributed to the expanding network of protected areas and the establishment of trophy hunting reserves. The population of Markhor in Balochistan was about 1000 individuals in 1969 as mentioned above, and there could have been less than 500 Markhor in Tohghar hills (Roberts, 1969). However, due to the increased level of protection in already existing protected areas and the trophy hunting program started in 1999, the population of Markhor increased in its entire range in the province. To enhance the Markhor population need to meliorate their survival conditions (from endangered to near threatened species in 2015) in the Red List of IUCN 2018. It is important to fully restrict all forms of hunting, and poaching in all community conservation areas. However, for the local communities and the governments, the Trophy Hunting Programme is a major root of income. (Muhammad et al., 2019; Nawaz et al., 2016b, Saeed, 2021). Mass are more engaged and devoted to conservation endeavors, and their affectation toward wildlife has favorably altered (Khan et al., 2013; Khan et al., 2016, Ali, 2015).

The TCP) in Balochistan, with the planning of trophy hunting in community control areas, not only assists manage poaching and banned-hunting of Suleiman Markhor and Balochistan Urial by indigenous tribesmen and out-landers (Valdez and Bradbury, 1985; Valdez, 2008) but also reduced protection and even restored minifying numbers of the other related wild animals species in the program area (Ahmed et al., 2001; Woodford et al., 2004).

For control strategy it is vital to find whether the population of *Capra f. jerdoni* is stable, falling, or exploding through annual or biannual surveys. It is known that the Markhor population status in Torghar Conservancy needs to be further improved if local communities and authorities come forward and initiate sustainable trophy-hunting programs, and wildlife-based tourism as an alternating source of living. Concerned departments should ensure long-term observation of Markhor and other wildlife to ensure sustainability. To expand Markhor distribution, the Government should focus on reintroduction and translocation programs supplemented by an urgent strict ban on illegal poaching of goat species and other wildlife diversity. Future accent should be on knowing

the tangled socio-ecological aspects of hills ecosystems, constructing clear, comprehensive, and just benefit-sharing systems at local levels, and encouraging intelligence beyond trophy hunting programs, to construct adaptive capabilities for lively mountain societies and ecosystems.

CONCLUSION

The continued decline in Suleiman Markhor's population after the 2011 census seems to be food deficiency, dry-weather conditions, and increased hunting. Food accessibility and protection of goat subspecies have been evidenced to be significant factors for population survival and production of the animal. During the study, it was observed that favorable habitats dwell a large number of wild goats compared to miserable levels of habitats. Food quality and quantity tremendously affect the viability and natality of goats. Consequently, it is suggested to ascertain the taxonomical status of the plants and animals in the Torghar hills. The WWF (World Wide Fund) Pakistan should be involved in survey campaign management, increased hunting, proper vaccination, and exercise of the GLS database for environmental resolution. To restore and conserve the population of Suleiman Markhor in the Torghar hills and nearby areas appropriate genetic equipment for mating with common goats is necessary from a "zoological" point of view.

Recommendations

Balochistan being the largest province in Pakistan has mostly dry mountains that lack water, animal food, and other necessities. The biggest problem here is the uncontrolled hunting of wild game animals, especially the Suleiman Markhor and Afghan Urial, which are on the list of endangered species. Based on the findings of this study, regular surveys should be made to determine the population trends of Suleiman Markhor and to establish Taxonomic checklists of Torghar Hills flora and fauna. Hunting is still observable in the Torghar Hills TCP and goes on despite its being illegal in the country which can be reduced with better controlling strategies. In the study area, domestic sheep and goats share habitat with Markhor, hence chances of habitat destruction and food competition have possibly arisen (Ashraf, 2014). It is also advisable that the livestock sector should come forward and vaccinate the local herdsman caprine against pathogenic infection in the marked area at minimum twice a year to minimize

the chances of infection to Suleiman Markhor from the local sheep and goats. Today, the wild ungulates in Balochistan are endangered by the Pakistani elite and other hunters who come to the Markhor conservancies to hunt different species of animals without government consent. In these harsh conditions, Forest and Wildlife Conservation Agencies and other stakeholders must take action to protect endangered species.

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Competing Interests

The authors did not declare any competing interest.

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Appendix

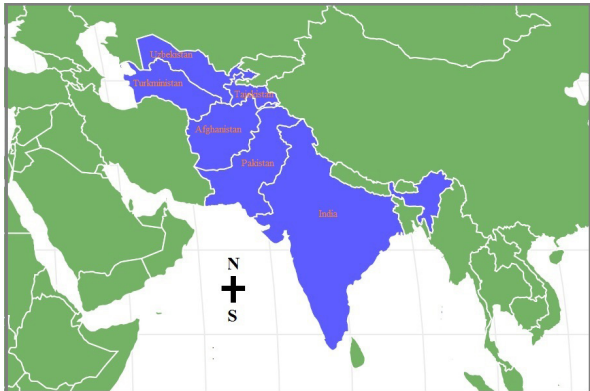


Figure 9. Regional location map of Markhor (*Capra falconeri* Wagner, 1839).

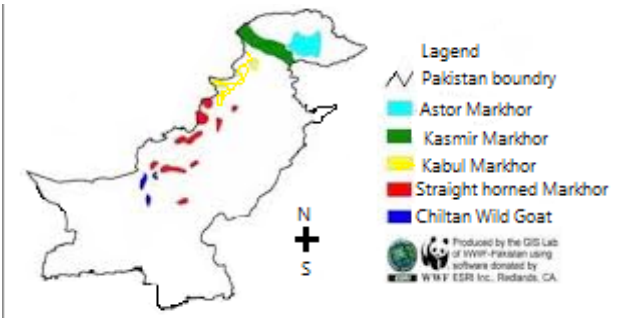


Figure 10. Markhor Sp. distribution in Pakistan.



Figure 11. Torghar Markhor male (7 years old). (Photo credit: Luce Bellon)



Figure 12. Suleiman Markhor young. (Photo credit: Luce Bellon)



Figure 13. Suleiman Markhor lambs (kids) wean around 5-6 months.



Figure 14. Suleiman Markhor lambs (kids) accompanied mother.



Figure 15a. Markhor Trophy (oldest male) at Torghar Hills main sighting points.

(Photo credit: Luce Bellon)



Figure 15b. A hunter, game guards, and a Suleiman Markhor trophy in Torghar Hills. (Photo credit: Luce Bellon)



Figure 16. Torghar Hills: Suleiman Markhor herd during rut season. (1) Mature male (2) Young (3) oldest male Markhor. 4, 5 are mature females (Photo credit: Luc Bellon/STEP)