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Hunting and Trapping Pressures on the Himalayan Goral, *Naemorhedus Goral* (Hardwicke) (Artiodactyla: Bovidae) in Kohistan, Pakistan

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Abstract The Himalayan goral, *Naemorhedus goral* (Hardwicke) (Artiodactyla: Bovidae) is classified as endangered worldwide and vulnerable in Pakistan due to high hunting and trapping pressures. The hunting and trapping pressures on *N. goral* was determined during 24 May-10 July 2010 in the Pattan and Keyal Valleys, Kohistan, Pakistan. The questionnaires were distributed in 2 valleys, 90 in Pattan with 8 and 75 in Keyal with 7 study sites, respectively. The local people and hunters of the valleys are mostly involved in both farming and livestock. They have the highest numbers of goats and then cows in their livestock. In both valleys, *N. gorals* are normally docile animals, i.e., they tamed in sites without hunting pressure. The local people and hunters perceived them by direct sightings, fecal materials, sounds and footprints. The animal has not raided their crops; however, people and hunters hunted and trapped them for recreation and food, only few people hunted and trapped for a living. In both valleys, the methods for hunting and trapping were mostly applied of camouflage, whistled by mouth, used of special little yellow dogs. The actual killing methods including gunfire and bullet shoots but injured by pellet bow. In Pattan valley, the local people and hunters have hunting permit but in Keyal, they have not it. They were hunted and trapped an average of 6-10/year/30 persons (a total average of 180-300/year) in Pallas and 6-10/year/23 persons (a total average of 138-230/year) in Keyal. To reduce hunting pressure on *N. goral*, requires additional well trained wildlife staff to protect and manage the protected areas in Pakistan like Kohistan.

Keywords: *hunting and trapping pressure, Keyal valley, Kohistan, Naemorhedus goral, Pattan valley, vulnerable*

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1. Introduction

District Kohistan, Khyber Pakhtunkhwa (KP), Pakistan is the steep mountainous land of 7,492 Km^2 with a population of 472,570. It forms the border of Azad Kashmir extended from the eastern Afghanistan province of Nuristan in the west [1]. The Pattan and Keyal valleys of Kohistan, were selected for the present research, as there is comparatively large population of *N. goral*. Pattan is linked with Karakorum highway through a 20 km long road and it found right side of river Indus. Altitude of the valley varies from 3000'-11000' above the sea level. Variations and elevation of the mountains have been resulted in climatic diversity; therefore, sub-tropical, temperate, sub-alpine and alpine with prevailed scrubs are found there (Figure 1) [2]. In Pattan, the population of *N. goral* was decreased during last 5 years due to over hunting and unawareness; while in Keyal the same was increased due to prevention of hunting and awareness created by Wildlife Department Pakistan (WDP) [3,4].

The goral, *Naemorhedus goral* (Hardwicke) (Artiodactyla: Bovidae) are cloven-hoofed mammals [5] characterized by having slender legs, terminating in 2 weight bearing functional central toes, enclosed in horney hooves of roughly equal size and given the appearance of single hoof split down in middle on each foot [5,6]. It is sharing characteristics of both goats and sheep, therefore, it is a true antelope included in the suborder Ruminantia. The members of this suborder have selenodont teeth, specialized for grinding food having a multi-chambered stomach with digestive process involving regurgitation of partly digested food and cud-chewing [7,8,9]. The breast and belly are lighter gray with a white spot in the throat and 1 or 2 white spots on the lower muzzle and cheeks [10].

They belong to the sub-family Caprinae is characterized by sturdy built species adapted for climbing on mountains [11,12]. The population of *N. goral* has been divided into 3 sub-species, i.e., the goral, *N. goral goral* (Hardwicke); the brown goral, *N. goral hodgsoni* (Pocock); and the grey goral, *N. goral bedfordi* (Roberts). Their numbers are declining due to hunting, habitat loss and direct-indirect

competition with livestock. As a result their distribution range decreased [13,14], measured threatened by the IUCN [15,16] and assigned a status of vulnerable in Pakistan [17].

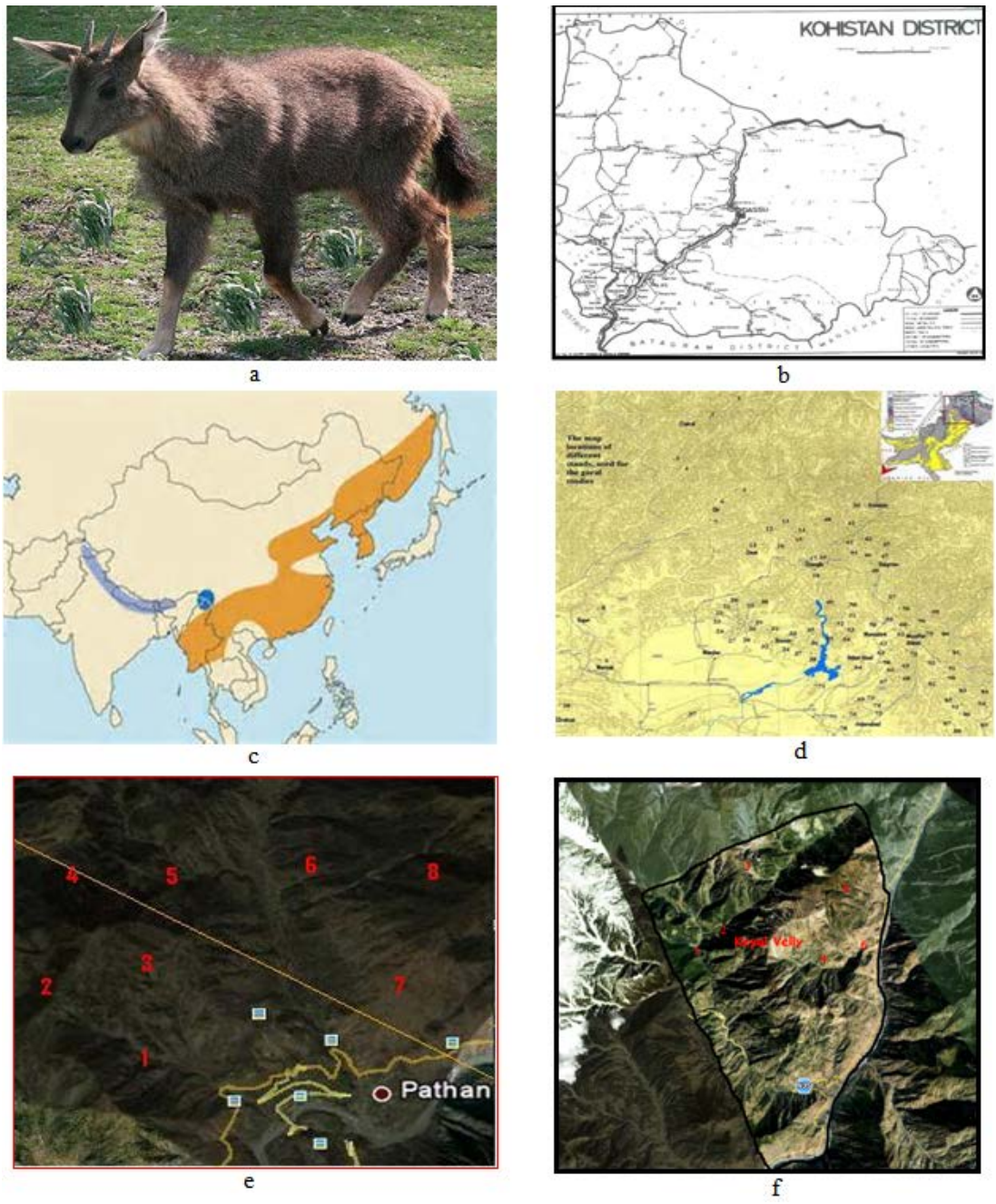

Figure 1. Distribution map of grey goral, *Naemorhedus goral* (Hardwicke) (**a**); map of Kohistan district within Khyber Pakhtunkhwa, Pakistan (**b)**; map of the East Asia Subcontinent, blue color shows distribution of global population of *N. goral* (**c**) (Shackleton, 1997); distribution map, blue color shows the distribution of *N. goral* in Kohistan and Margalla Hills, Islamabad, Pakistan (**d);** Pattan Valley, 1: Tankor Janchil; 2: Rasta Dong Janchil; 3: Barho Kandogay; 4: Landai Sar Bohil; 5: Hawery Kamar Bohil; 6: Barho Bohil; 7: Barho Gulkand; 8: Nabaz (**e**); Keyal Valley, 1: Baroon Nala Fagaiel; 2: Galto Fagaiel; 3: Shaig Bhapobanda; 4: Keero Keyal; 5: Balkhun; 6: Rodair (highlighted in red) (f); [4].

In Khyber Pakhtunkhwa (KP), *N. goral* range extends from Abbottabad, Mansehra, Mardan, Kohistan, Swat, Dir, Malakand and Nowshera that might form the western border of its distribution range. The main surviving population in Pakistan is probably in the area, Indus and Kohistan, Swat valley and watershed Kunhar [18,19]. Abbas [20] suggested that of *N. goral* persisted at favourable altitudes of Mardan, Buner, Central Kohistan, Abbotabad, Western Mansehra, Margalla Hills and the central and southern parts of the Azad Kashmir. Only 2 valleys, Pattan and Keyal, Kohistan, Pakistan were selected for the present survey showed *N. goral* was also found in the most of places of Kohistan.

Perveen and Hussain [3] reported the methods of hunting and trapping of *N. goral*, which were used by the people and hunters of Pathan and Keyal valleys: first, camouflage in which white cloth of one meter was encircled around *N. goral* then the hunters easily trapped them. The color of cloth had been changed with yellow in summer while dark brown in winter. Second, whistling by mouth was also a technique to trap *N. goral*. Third, little yellow specially trained dogs were used to hunt them, when they see them they have not fled. These dogs hunt *N. goral* until they become exhausted.

If hunting and trapping have been performed according to rules and regulations, as they are established; therefore,

these practices have little or no impact on those wildlife populations that do not cause damage. However, these may cause great effects on wildlife populations when these have been performed by violating rules and regulations. Hunting and trapping may be reduced wildlife damage by 1) reducing wildlife populations below the environmental carrying capacity, 2) removing animals from the population before they would otherwise die, or 3) changing behavior of wildlife. It also can increase landowner tolerance of wildlife damage. Use of hunters and trappers is the most cost-effective method available to society to reduce wildlife populations, especially over large areas when food competitors do not hunt it. However, hunting and trapping can reduce damage to crops from species, which are intensively hunted and trapped. For other game and furbearer species, hunting and trapping may alleviate wildlife damage, but do so primarily by changing animal behavior. Finally, hunting and trapping may increase wildlife value and willingness of landowners to tolerate damage from wildlife [21]. The objective of present research is to determine the hunting and trapping pressures on *N. goral* in Pattan and Keyal valleys of Kohistan, Pakistan and identify possible threats to their population and suggest recommendations for their conservation.

2. Materials and Methods

Two potentially similar biodiversity rural valleys in Kohistan of Pakistan, i.e., Pattan with 8 study sites, i.e., Barho Bohil, Barho Gulkand, Barho Kandogay, Hawery Kamar Bohil, Landai Sar Bohil, Nabaz, Rasta Dong Janchil and Tankor Janchil; and Keyal with 7 study sites, i.e., Balkhun, Baroon Nala Fagaiel, Galto Fagaiel, Lotos, Keero Keyal, Rodair and Shaig Bhapobanda were randomly chosen for the present survey of the Himalayan goral, *Naemorhedus goral* (Hardwicke) (Artiodactyla: Bovidae). Data were collected during 24 May-10 July 2010. Field survey, direct sighting, informal discussion, interviews with local communities and use of the questionnaires were the major tools for data collection [3, 4]. Through questionnaire [18], the local people and hunters were asked 32 questions (categorical variables) open or closed-ended, which explained all about the *N. goral* hunting. A random sampling was used in which 90 and 75 questionnaires (numerical variables) were filled in 8 and 7 study sites in Pattan and Keyal valleys, respectively [3]. The goal of the questionnaire was to explain the local hunters about *N. goral* and it was meant to produce information on hunting and trapping pressures. To determine the different aspects of hunting and trapping of *N. goral*, % and Computer Program Microsoft Excel (CPME) have been used [19] for data analysis.

3. Results

In Pattan valley, 90 questionnaires were filled by the local people and hunters in 8 study sites. They were engaged in different professions and business, which are as following: both livestock and farming: 42% > livestock: 28% > farming: 21% > others: 9%. Only 8 of them have different occupations like business, government servant, labors and transporters etc. In Keyal valley, 75 questionnaires were filled by the local people and hunters in 7 study sites; their profession were: both livestock and farming: 44% > livestock: 21% > farming: 13% > others: 8%; other occupations were the same as for Pallas valley (Table 1). In both valleys, livestock in descending order are: Pallas valley (total: 1036): goats: 64% > cows: 22% > buffaloes: 8% > donkeys 6%; and Keyal valley (total: 975): goats: 68% > cows: 16% > buffaloes: 10% > donkeys 6% (Figure 3a).

Figure 2. Watering spot of the Himalayan goral, *Naemorhedus goral* (Hardwicke) (Artiodactyla: Bovidae) in Pattan valley was being observed during the survey, 24 May-10 July 2010

Table 1. Occupations of the local people and hunters in Pattan and Keyal valleys of district Kohistan, Pakistan among them questionnaires were distributed during the survey, 24 May-10 July 2010

SNo	Valleys[1]	Sites	n[2]	Farming (%)	Livestock (%)	Both (%)	Others (%)	M±SD[3]
1.	Pattan	8	90	21	28	42	9	23±10
2.	Keyal	7	75	13	21	44	8	19±03

[1]Pattan valley with 8 study sites: Barho Bohil, Barho Gulkand, Barho Kandogay, Hawery Kamar Bohil, Landai Sar Bohil, Nabaz, Rasta Dong Janchil and Tankor Janchil; Keyal valley with 7 study sites: Balkhun, Baroon Nala Fagaiel, Galto Fagaiel, Lotos, Keero Keyal, Rodair and Shaig Bhapobanda where questionnaire were distributed

[2]n: number of peoples and hunters in Pattan and Keyal valleys from which data were collected; %: percentage

[3]M±SD: Mean± standard deviation; data were analyzed by t-test and $P < 0.05$; 2 populations were not significantly different.

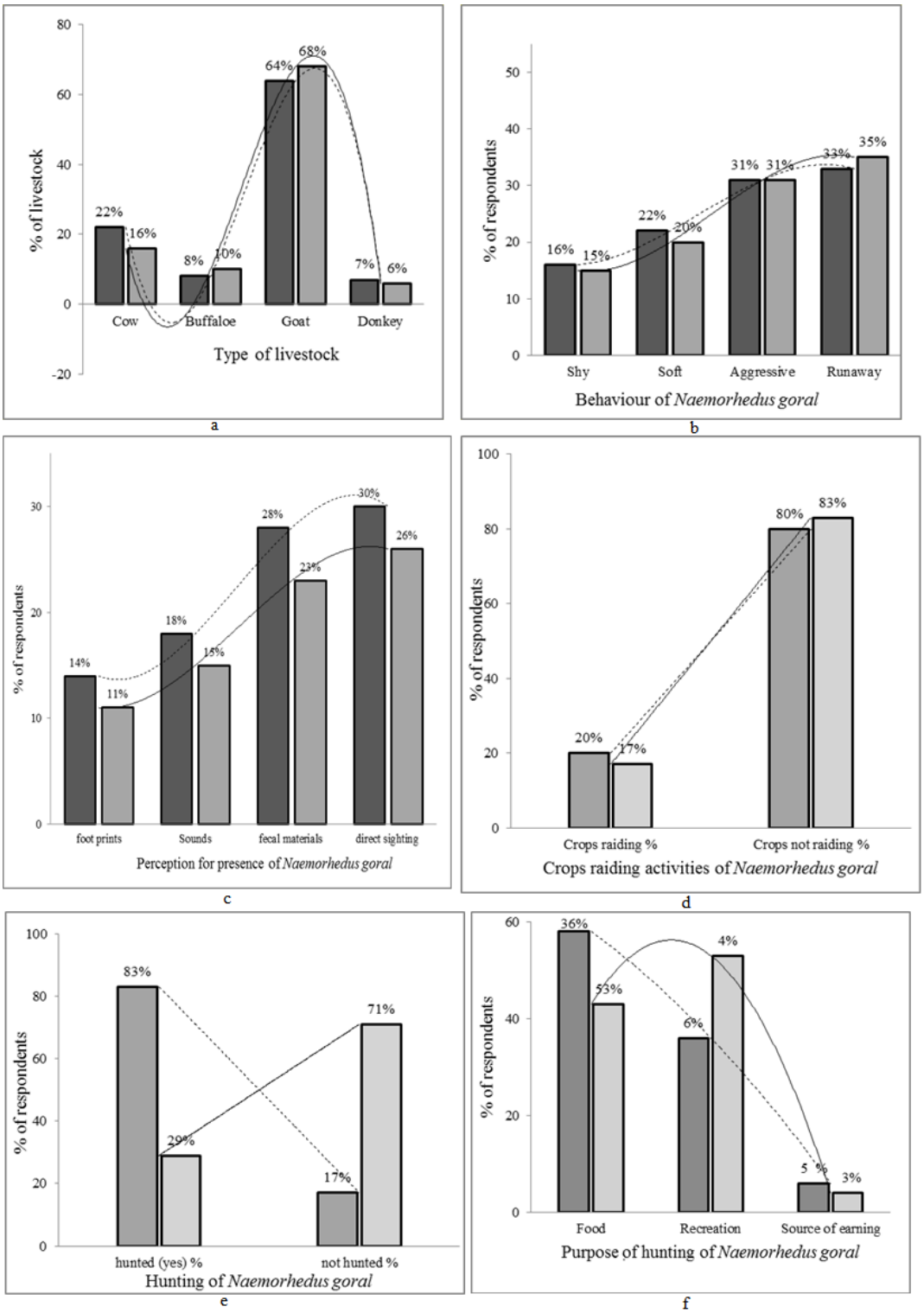

Figure 3. The survey for investigation about the Himalayan goral, *Naemorhedus goral* (Hardwicke) (Artiodactyla: Bovidae) in 2 valleys of Kohistan, Pakistan during 24 May-10 July 2010; type and numbers of livestock were possessed by people of 2 valleys: a; behavior of *N. goral*: b; perception of *N. goral*: c; crops raiding activities of *N. goral*: d; hunting of *N. goral*: e; purpose of hunting [4]: f; ■: Pattan valley with 8 study sites, i.e., Tankor Janchil, Rasta Dong Janchil, Barho Kandogay, Landai Sar Bohil, Hawery Kamar Bohil, Barho Bohil, Barho Gulkand and Nabaz; □: Keyal valley with 7 study sites, i.e., Baroon Nala Fagaiel, Galto Fagaiel, Shaig Bhapobanda, Keero Keyal, Balkhun and Rodair); n: number of questionnaire filled by local people and hunters; n=90 in Pattan; n=75 in Keyal, Kohistan, Pakistan; polynomial trend line for Pattan valley: ---; for Keyal valley:—

In both valleys, according to the most of the local people and hunters, whenever *N. goral* saw or perceived human being, these showed different behaviors such as: runaway > shy > soft (tolerant) > aggressive (Figure 3b). In both valleys, according to the local people and hunters, they perceived the presence of *N. goral* by different perceptions. These are given in descending order: direct sighting > fecal materials > sound > footprints (Figure 3c). In Pattan valley, the same were observed on the watering spot, where *N. goral* came to drink water (Figure 2). In both valleys, it was found that the number of people who claimed that their crops were raided by *N. goral*, were lesser compared with people not claimed (Figure 3d).

In Pattan valley, it was found that more local people and hunters hunted and trapped *N. goral* compared with those have not do so. However, in Keyal valley, the situation was reversed, more local people and hunters have not hunted and trapped compared with those have do so (Figure 3e). In both valleys, it was found that the most of local people and hunters hunted and trapped *N. goral* for recreation, food and fur but only few people hunted for a living / means of existence. However, no one or very few were shot them by gun as hobby (this was not recreational hunting) (Figure 3f).

Different methods of hunting strategy were used in both valleys. In Pallas valley: coloring cloth used as camouflage: 49% > whistling by mouth: 30% > special little yellow dogs: 16% and in Keyal valley: coloring cloth: 45% > whistling by mouth: 33% > special little yellow dogs: 15%. The actual killing method including in Pallas valley: gun and bullet shoots: 3% > pellet bow: 2% and in Keyal valley: gun and bullet shoots: 4% > pellet bow: 3% (Figure 4a and Figure 4b).

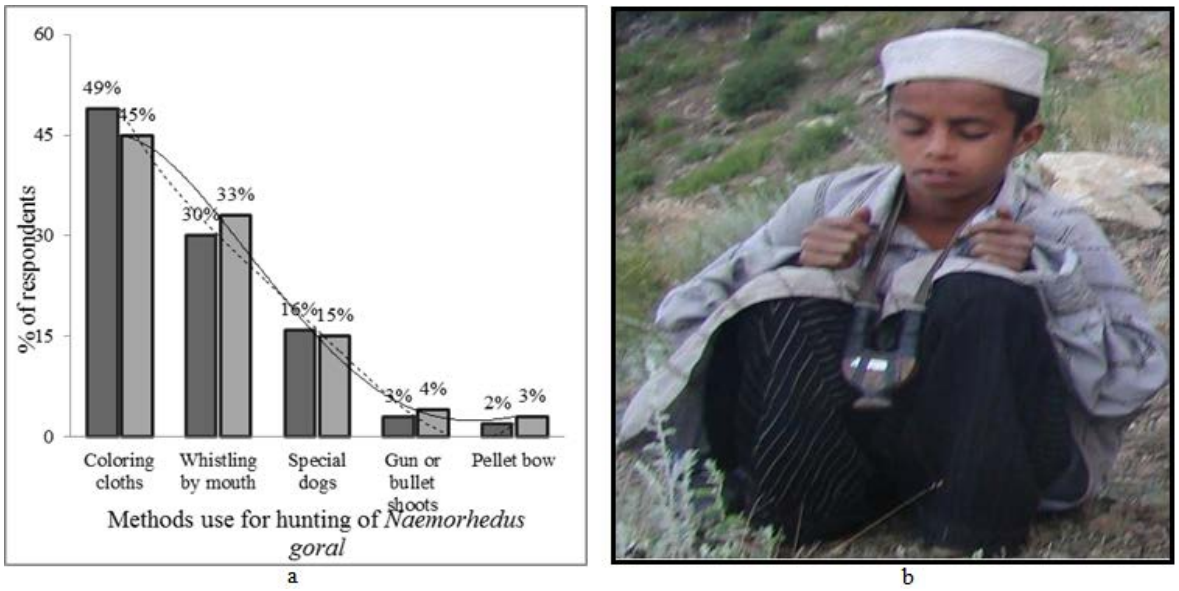

Figure 4. (a) Methods of hunting of the Himalayan goral, *Naemorhedus goral* (Hardwicke) (Artiodactyla: Bovidae) found in 2 valleys of Kohistan, Pakistan during 24 May-10 July 2010; ■: Pattan valley with 8 study sites, i.e., Tankor Janchil, Rasta Dong Janchil, Barho Kandogay, Landai Sar Bohil, Hawery Kamar Bohil, Barho Bohil, Barho Gulkand and Nabaz; □: Keyal valley with 7 study sites, i.e., Baroon Nala Fagaiel, Galto Fagaiel, Shaig Bhapobanda, Keero Keyal, Balkhun and Rodair); n: number of questionnaire filled by local people and hunters; n=90 in Pattan; n=75 in Keyal, Kohistan, Pakistan; polynomial trend line for Pattan valley: ---; for Keyal valley:—; (b) a Pellet bow is hanging in the neck of little child who is ready to injure *N. goral*

Table 2. Possession of Wildlife Department, Kohistan, Pakistan (WDKP) permits for hunting of the Himalayan goral, *Naemorhedus goral* (Hardwicke) (Artiodactyla: Bovidae) investigated during the survey, 24 May-10 July 2010

SNo	Valleys	Sites[1]	n[2]	Yes (%)	No (%)
1.	Pattan	8	90	84	16
2.	Keyal	7	75	00	100

[1]Pattan valley with 8 study sites: Barho Bohil, Barho Gulkand, Barho Kandogay, Hawery Kamar Bohil, Landai Sar Bohil, Nabaz, Rasta Dong Janchil and Tankor Janchil; Keyal valley with 7 study sites: Balkhun, Baroon Nala Fagaiel, Galto Fagaiel, Lotos, Keero Keyal, Rodair and Shaig Bhapobanda where questionnaire were distributed

[2]n: number of peoples and hunters in Pattan and Keyal valleys from which data were collected; %: percentage

[3]WDKP issued *N. goral* hunting permits in both valleys. They were unlimited but there restrictions to one animal, which can be shot with per permit in per season.

The Wildlife Department, Kohistan, Pakistan (WDKP) granted *N. goral* hunting permits in both valleys. These permits were unlimited but there restrictions to one animal, which can be shot with one permit in one season. In Pattan valley, it was found that more hunters were having permits from WDKP compared with those not having ones (illegal hunting), while in Keyal valley, no one was having permit, therefore, all hunters had illegal hunting (Table 2).

According to numbers of local people and hunters, killing of *N. goral* / year are given in descending order: for entire Pattan valley: 44 persons said: 6-10 *N. goral* killed / year > 28 persons said: 1-5 *N. goral* killed / year > 18 persons: 11-15 *N. goral* killed / year (a total average of 180-300/year); however, for entire Keyal valley: 56 persons said: 1-5 *N. goral* killed / year > 12 persons said: 6-10 *N. goral* killed / year > 2 persons said: 11-15: 2 *N. goral* killed / year (a total average of 138-230/year) (Table 3).

Table 3. Hunting of the Himalayan goral, *Naemorhedus goral* (Hardwicke) (Artiodactyla: Bovidae) in each year was investigated during the survey, 24th May-10th July 2010

SNo	Valleys	Sites[1]	n[2]	No of *N. goral* killed / year			respondents (*N. goral* killed / year) (M±SD)[3]
				1-5	6-10	11-15	
1.	Pattan	05	90	28	44	18	30±11 (10±5)
2.	Keyal	07	75	56	12	02	23±24 (10±5)

[1]Pattan valley with 8 study sites: Barho Bohil, Barho Gulkand, Barho Kandogay, Hawery Kamar Bohil, Landai Sar Bohil, Nabaz, Rasta Dong Janchil and Tankor Janchil; Keyal valley with 7 study sites: Balkhun, Baroon Nala Fagaiel, Galto Fagaiel, Lotos, Keero Keyal, Rodair and Shaig Bhapobanda where questionnaire were distributed

[2]n: number of peoples and hunters in Pattan and Keyal valleys from which data were collected; %: percentage

[3]M±SD: Mean±standard deviation; data were analyzed by t-test and $P < 0.05$; 2 populations were not significantly different.

4. Discussion

Hunters and people of Pattan and Keyal valleys hunted and trapped *N. goral* for meat, hides, wool and bones. They also trapped them to sell alive animal. Therefore, some people hunted and trapped them for a living and means of existence. Its blood is also used medicinally in some Asian cultures, although its efficacy is not proven. Therefore, they have great importance as natural food resource, source of recreation and wildlife material for research. The present survey was conducted to determine hunting and trapping pressures on *N. goral* in the Pattan and Keyal valleys, Kohistan, Pakistan during May-July 2010. Due to lack of education, the most of hunters and people of both valleys have not known about the importance of *N. goral* in wildlife. Therefore, the purpose of the survey was to educate and create awareness for *N. goral* conservation in local people.

Naemorhedus goral are diurnal but most active during the early morning and evening (crepuscular). After grazing in the early morning, they spend the day relaxing in caves or on cliffs. They are gregarious, but adult males live in solitude until the breeding season. Females and juveniles graze in herds of 4-12 individuals [4]. They make small altitudinal migrations seasonally. During winter season, *N. goral* migrated towards populated areas, i.e., lower altitudes, to escape from cold temperature, hunters, predators and in search of food. If they migrated due to predators, then they never returned to its native habitat. During warmer months, i.e., May-July, due to hot season in summer, *N. goral* migrated higher altitudes, i.e, upward in the hills where the climate is cold [3]. Therefore, due to their continuous migration, accurate population status of *N. goral* cannot be estimated.

Perveen [4] reported that the population of *N. goral* was increasing during last 5 years due to prevention of hunting by Wildlife Department, more food and shelters were available in both valleys. Perveen and Hussain [3] reported that although, more vantage points were selected in Pattan compared with Keyal. However, numbers of *N. goral* were more in Keyal than Pattan. Because the main difference between 2 valleys was their height but no more differences in physical, geological and ecological characteristics. Therefore, higher places are more favorable due to protection, more natural foods and biodiversity resources were available for them. However, lower places are not desirable because they were easily hunted and trapped there.

Hunters and people in both valleys trapped them by using white cloth of one meter as camouflage, oral whistling and yellow-trained dogs. However, gun or bullet shoots were prohibited. Children and very few adults of both valleys used a pellet bow as game, which they hung in their neck, they threw stones on them with power by pellet bow, which injured but not killed *N. goral* (Figure 4). The hunting and trapping methods influenced the behavior of *N. goral*. The situation, e.g., near village, roosting site, season, high and low altitude also influenced animals as well as hunters.

In winter, many of *N. gorals* were died due to attack of diseases and parasites. The eyes disorder was more prevalent, in which they could not open their eyes and could not see, therefore, they could not search for food, water and shelter; and they lost their functions. They were died, therefore, their population is depleted. If they survived, it was very easy to hunt and trap them. Hunters and people brought them in ill condition. According to them, this disease was not transmitted to *N. goral* meat eaters (informal discussion with community). The increase trend of their habitats destruction due to deforestation, to construct of houses, to build roads and urbanization in vicinity of their habitats are reasons to deplete their population, however, over hunting and trapping, predators, parasites, diseases and natural disasters are other reasons for declining of their population. Due to poverty and illiteracy, hunting and trapping pressures on *N. goral* is increasing in Kohistan, Pakistan.

The concept of the people about wildlife is that, in Islam, it is allowed to hunt halal animals and birds. Therefore, they hunted them for their hunger. The hobby of the children of both valleys was to use guns for shooting targets, it may be a bird or *N. goral*. Therefore, their natural attachment with guns also play great role to deteriorate the wildlife. The hunters and peoples of both valleys were very innocent and guiltless, therefore, they told everything very clearly and honestly. They said when they saw or heard about herds of *N. goral* which was consisting of 12-18 numbers. Every hunter hunted at least 4-5 *N. goral* (interviews and discussion with community). District Kohistan, Khyber Pakhtunkhwa (KP), Pakistan consists of 3 valleys. Each valley is with ca. average population of 250000 persons. According to the present survey, if in which about 1/3 population is interesting in hunting and trapping of *N. goral*. When 30 persons hunted and trapped an average of 6-10 *N. goral* /year, then about 85000 persons hunted and trapped an average of 8500-25000 *N. goral* /year. This is the great hunting and trapping pressures on *N. goral*. This should be reduced by making new wildlife rules and regulations and particularly their implementation is prime importance.

5. Conclusions

Hunting and trapping pressures on *N. goral* have been increased during last several years because people and

hunters have not followed wildlife rules and regulations; therefore, its population is decreasing all over the world. Different hunting and trapping strategies were applied through which they killed, injured and trapped them. Many rules and regulations have been established for controlling hunting and trapping pressures by Wildlife Department but still need to implementation in these hilly, tough and rocky places like Kohistan, Pakistan.

6. Recommendations

The habitats of *N. goral* are hilly and accessible; therefore, the wildlife watchers and hunters have been increasing day by day. However, for their protection, the Government of Kohistan, Pakistan should be taken the following steps: 1) the small altitudinal seasonally migratory areas of *N. goral*, should be declared "protected areas" and hunting, killing and capturing of *N. goral* should be completely banned in these areas; 2) hunting, killing or trapping of *N. goral* by means of fire arms or any other device should be prohibited; 3) Dealing in *N. goral* hunting, trade or business should be declared illegal; 4) hunting should be allowed only in the seasons when observed population abundance by wildlife department; the fee for hunting per camp should be charged Rs. 50000; 5) the fee for possessing a license is Rs. 25000 per *N. goral* to discourage possession of *N. goral* for any business purpose; 6) a fee of Rs. 25000 to prohibit the export of *N. goral* from the province within the country should be charged and Rs. 50000 per *N. goral* for outside the country; 7) to discourage *N. goral* hunting and trapping by the young people, hunting licenses are issued only to persons over 18 years of age.

In order to protect and restore the endangered/ vulnerable *N. goral* population and its habitats, the following specific suggestions for protection at the local level must be taken: 1) the rules regarding hunting of *N. goral* in Kohistan, Pakistan need to be revised and oriented more towards protection; 2) *N. goral* breeding stations should be established with improve techniques of breeding populations; 3) study the factors behind poor reproduction and rates of recruitment in *N. goral* populations with an effective reintroduction of *N. goral*; 4) expand cooperation and collaboration among mammalogists, conservationists and those working in the breeding range of *N. goral* populations; 5) take eco-tourism measures and extend public education programs involving foresters and farmers; 6) their habitats should be protected from deforestation and agro-industrial chemical pollution; 7) To control hunting, requires additional well-trained wildlife staff to protect and manage the protected areas; 8) Local committees should be monitored the population, hunting and trapping of *N. goral* in protected areas, Kohistan, Pakistan.

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Statement of Competing Interests

The authors have no competing interests.

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