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## Population assessment of Himalayan Grey Goral (*Naemorhedus goral*) in Nanser-Kohay Gamer reserve, District Buner, Khyber Pakhtunkhwa, Pakistan

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Population assessment survey for Himalayan grey goral (*Naemorhedus goral*) conducted at Nanser-Kohay- Game Reserve, District Buner, Khyber Pakhtunkhwa in February and March 2018 by using standard vantage point observation method applied double observer method. A total of 51 goral were recorded by searching of 20.1 km<sup>2</sup> area by setting of 30 vantage points, the overall ratio for male, female and fawns were recorded as 15 (29%), 20 (39%), 12 (24%) respectively while 8% (4) gorals could not be identified for their sexes. High degree of habitat disturbance was recorded with percentage of 44% highly disturbed, 50% moderately disturbed and only 6% with low degree of disturbance by extensive and unsustainable uses of resources such as stone mining and explosions, roads access to the extreme wilderness and over exploitation of available resources by nomads as well as local community. The habitat of Kohay-Nanser game reserve found highly productive for Himalayan grey goral but required immediate conservation and management plan.

**Keywords:** Himalayan grey goral, Population assessment, Nanser-Kohay gamer reserve, Buner, Pakistan.

### INTRODUCTION

Several wild species in the world facing severe threat to extinction due to human population growth, extensive and unplanned development, habitat shrinkage & fragmentation, illegal hunting and poaching. The world's forests provide habitat to almost 80% of the global biodiversity, however, deforestation and degradation of forests with alarming rate which is almost 7.6 million hectares annually, harshly effecting the population of wild species, especially

population of large species area extremely effecting and most of them are now at the verge of extinction (Sheikh and Molur, 2004; Haq, 2012; Saeed et al., 2012; FAO, 2016).

Pakistan hosting variety of wild ungulates from arid and semi-arid hot deserts to subalpine and alpine cold deserts from zero elevation to the snowline. Likewise, several other species struggling for their survival, Himalayan grey goral (*Naemorhedus goral*) is one of the ungulates that is less known, therefore, attend little attention and

therefore, hastily decreasing throughout its habitat range, the species almost locally extinct from more than 50% of its historic habitat range (Roberts, 1997; Perveen et al., 2013; Grimwood, 1969; Anonymous, 1970), consequently listed as "Near Threatened" in the IUCN red list (Duckworth and MacKinnon, 2008; IUCN redlist.org, 2020) and "vulnerable" in the national context (Sheikh and Molur, 2003), the species also placed at the Appendix I of CITES as well as protected under the Schedule III of Khyber Pakhtunkhwa wildlife act 2015.

Himalayan grey goral belongs to the family Bovidae and sub-family caprinae, sharing catachrestic with goats, sheep and antelopes (Valdez 2011), endemic to the northern straps of Himalaya that extended to the Hindu Kush mountain range. Patchy and fragmented population of the species is known from its range countries including Nepal, Bhutan, China, North India, Pakistan and may be in western Myanmar (Grubb, 2005). Pakistan is the last country of its distribution west-toward. Goral prefers rugged rocky terrain with grasses and shrub dominating sub-tropical and moist temperate scrub and conifer, evergreen and deciduous grassy forests and avoids open and less vegetated areas (Lovari and Apollonio 1993; Qureshi et al., 1999). In Pakistan the species reported from Machiara National Park (AJ&K), Murree foothills, Margalla Hills National Park, Malakand, Mardan, Nowshera, Buner, lower Swat, lower Dir, Haripur, Mansehra and Kohistan districts at the elevation of 2,000 – 12,000 feet above sea level (Roberts, 1997; Anwar and Chapman, 2000; Roberts, 2005; Ashraf et al., 2015; Shakeel et al., 2015). Recent research reveals that the species has lost most of its distribution range in the country and possibly extinct from Dir, Malakand, Swat, Nowshera and Murree foothills (Abbas et al., 2015).

Based on new classification six species of goral is existing (Hrabina, 2015) including Himalayan Brown Goral (*Nemorhaedus hodgsoni* Pocock, 1908); Red Goral (*Nemorhaedus baileyi* Pocock, 1914); Burmese Goral (*Nemorhaedus evansi* Lydekker, 1905); Chinese Goral (*Nemorhaedus griseus* Milne-Edwards, 1871); Long-tailed Goral (*Nemorhaedus caudatus* Milne-Edwards, 1867) and Himalayan Grey Goral (*Nemorhaedus goral* Hardwicke, 1825). In Pakistan *Naemorhedus goral bedfordi* exists in patchily habitats of the above-mentioned locations in northern parts of the country (Abbas et al., 2015; Ashraf et al., 2015).

The actual count of Grey goral in its patchy

habitats in Pakistan is not well known, only few studies are available on the population estimation from some of their potentially known areas which indicates that between 370-1017 individuals are existing in the 20,000 km<sup>2</sup> non-continuous, fragmented and highly distrusted habitats, however reports said from its present habitat range only 5,000 km<sup>2</sup> is considering healthy and suitable habitat (Anonymous, 1988; Abbas et al., 2012; Perveen et al., 2013; Abbas et al., 2015; Ashraf et al., 2015). The guesstimated figure from their known distribution range as in Mardan (9 and 85); Buner (63 and 153); Haripur (25); Abbottabad (41); Mansehra (96 and 100); Kohistan (40 and 53) and (200-893) were estimated in AJ&K while 40-60 in Margalla Hills National Park (Qayyum, 1986-87; Maqsood 1989; NWFP wildlife 1992; Shackleton, 1997; Abbas et al., 2015).

Himalayan grey goral facing immense threats for their survival throughout its habitats within the country such as habitat fragmentation, extensive grazing, alarming deforestation either by locals for fuel-wood or through timber mafia, Pakistan losing its forest resource 3-4% annually (Haq et al., 2010; Saeed et al., 2012), all these activities noticeably degrading the remaining habitat patches of the Grey goral (Mishra and Johnsingh, 1996; Cochard and Dar, 2014), illegal hunting is one of the major drivers for their significant population decline (Anwar, 1989; Ilyas, 1998). The species may be disappeared completely from the county within few decades if there are immediate actions could not be taken.

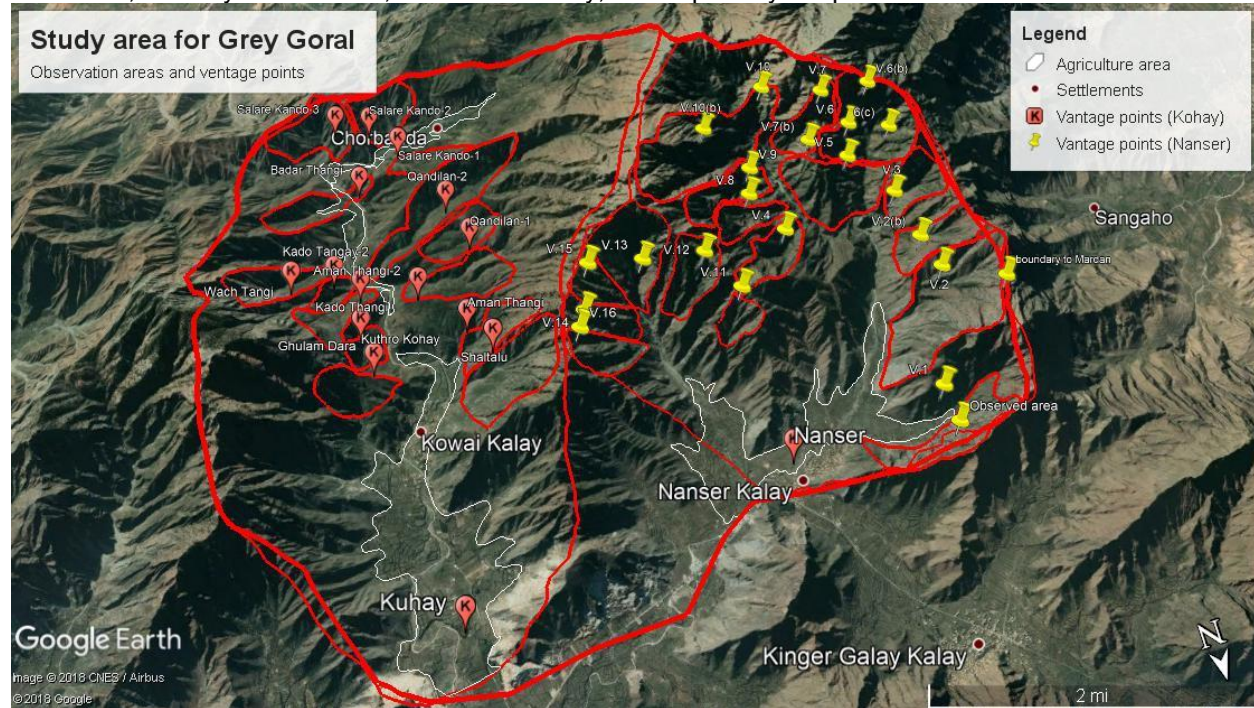
Effective management of their habitat and community-based conservation is required for the instantaneous conservation initiatives. The present detailed survey was conducted to estimate the population of Grey goral in the mountainous ecosystem of Kohay-Nanser game reserve in district Buner for future management interventions.

## MATERIALS AND METHODS

### Study Area:

District Buner is situated at 34° 11' and 34° 43' N latitude and 72° 13' and 72° 45' E longitude, surrounded by Swat, Malakand, Mardan and Hazara district, the district spread over 1,865 km<sup>2</sup> with population of 897,319 individuals (Census report, 2017). The district is situated under the sub-tropical coniferous and scrub forest zone consist of undulating plains and step mountain with altitudinal range of 1200 – 9600 ft. asl. District Buner has noteworthy natural

resources, variety of wildlife, natural beauty, especially the precious marble stones mines.



**Figure 1: Study area of Himalayan Grey Goral in Kohay-Nanser Game Reserve**

Kohay-Nanser game reserve is one of the potential habitats for Himalayan grey goral within the district.

Kohay-Nanser game reserve is located at the extreme north-western boundaries of district Buner is one of the refuge place of Himalayan grey goral in the country, notified as community managed game reserve on 30<sup>th</sup> September, 1998 by Khyber Pakhtunkhwa Wildlife Department under the act (NWFP Wildlife Act-V of 1975), the game reserve is surrounded by Bampokha, Kingar Gali, Sar Banda, Toor Warsak and Mardan at the North, South, East and West respectively. The game reserve is spread over 40 km<sup>2</sup>, the area is highly potential for their diversity of wildlife especially has one of the higher density places for Grey goral and Rhesus monkey in the country.

### Survey Methodology

Kohay-Nanser and its adjacent areas has greater diversity of Grey goral compare to the other areas in Buner but highly distrusted by increasing anthropogenic activities, therefore, significant changes are notices in its natural behavior of the species, two different methods

invasive and non-invasive were applied to estimate population of grey goral in the area.

### Point Count

Total of 30 vantage points were selected with the help of local communities and former hunters, data were gathered during early morning (6:00 am to 10 am) and evening (4:00 pm to 6:30 pm) by examine the southern and eastern facing slopes using binoculars. Places that selected for vantage points were greater surrounding view to scan major area. At each vantage point, 2-3 persons were designated to reduce the data biasness. The team members were trained for area scanning and data collection methods. For density calculation, area under observation were measured using google earth and roughly ground measurement by counting human steps along the length of the area where possible (Vinod and Sathyakumar, 1999).

### Intensive Search

This method was applied during the mid-day timings and for the areas where the animal could not be observed during the morning sightings, local hunters were used for this purpose to search for animals, this method found more useful, as the

animals were more conscious due to high degree of disturbance and now tend to be slightly nocturnal in nature.

**Data Collection:**

Data recording formats were developed and pre-tested for collecting of count data and its relevant information such as locality name, habitat, degree of aspect, dominant plant species, associated fauna species and its signs including coordinates for every vantage point. Etrex 12 channel Garmin Global Positioning System (GPS); Olympus 7x35 DPS-I binoculars and Nikon Coolpix AW 110 were used in the survey. Total of 6 wildlife staff and 12 VCC members from Nanser and Kohay villages were trained on methodology

of selection of vantage point, goral assessment and data collection.

**RESULTS AND DISCUSSION**

**Goral Population dynamics at Kohay-Nanser Game Reserve:**

Total of 30 significant vantage points were selected 16 in Nanser and 14 at Kohay sub-valley based on greater panoramic view to cover maximum search area. Early morning and evening hours were mostly spent in those vantage points for scanning of maximum area by using binoculars. Total of 176 hours were disbursed for searching of goral from the selected vantage points.



**Figure 2: Visual records, collected during the survey**

The adult male female ratio was recorded as 29% and 39% respectively and 8% could not be identified for their sexes, the number of fawns which are 24% of the total population was remarkable, that indicates the Natural predator for Grey goral is not harmfully affecting the new recruitment, however, the male female ratio is not significant as females are more prone to hunting as compare to males. Keeping in view the data reported by (Abbas et al., 2012), 14 adult males

and 27 adult females were counted in district Buner, therefore, it is possible that the population especially of female goral has been decline during the last six years and hunted illegally which is seriously affecting the population dynamics for the species. Keeping in view the polygamous behavior of male goral (Ginsberg and Milner - Gulland 1994), the healthy and productive population required more females as compare to the increasing number of males.

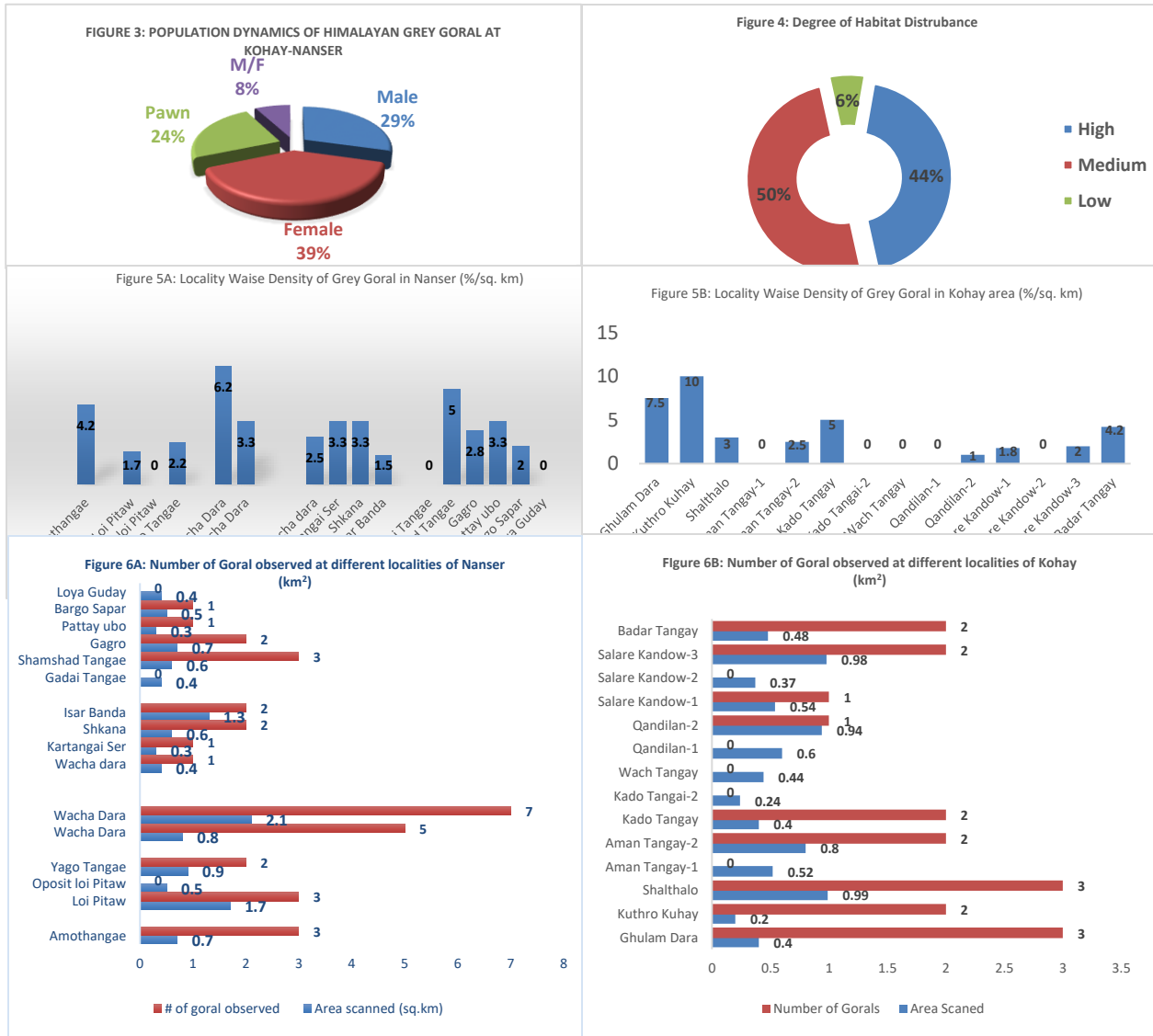


Table 1: Details of Himalayan Grey Goral Assessment

sites	Vantage Point name	Name of observation area	Area under scanning (km <sup>2</sup> )	Coordinates	Habitat Disturbance	Population Count				Total	D=n/a
					High/medium/low	Adult Male	Mature Female	Fawns	Mature m/f		
1	Amothangae	surrounding	0.7	34°29'23.49"N 72°14'02.86"E	Medium	1	1	1	0	3	4.2
2	Loi Pitaw	surrounding	1.7	34°28'38.79"N 72°13'41.49"E	Medium	1	1	1	0	3	1.7
3	Oposit loi Pitaw	surrounding	0.5	34°28'4.44"N 72°13'46.10"E	High	0	0	0	0	0	0
4	Yago Tangae	Bekaro Rag	0.9	34°28'7.82"N 72°14'41.08"E	High	1	0	0	1	2	2.2
5	Wacha Dara	Koz Kohi Ghwando	0.8	34°27'45.60"N 72°14'0.10"E	High	1	2	2	0	5	6.2
6	Wacha Dara	Bar Kohi Ghwando	2.1	34°27'32.20"N 72°13'53.10"E	Low	2	3	2	-	7	3.3
7	Wacha dara	Narai Oba	0.4	34°27'15.96"N 72°13'59.53"E	High	1	0	0	0	1	2.5
8	Kartangai Ser	surrounding	0.3	34°27'50.60"N 72°14'50.80"E	Medium	1	0	0	0	1	3.3
9	Shkana	Kar Tangai	0.6	34°27'40.60"N 72°14'46.10"E	High	0	1	1	0	2	3.3
10	Isar Banda	Gata Garai	1.3	34°27'9.20"N 72°14'26.60"E	Medium	2	0	0	0	2	1.5
11	Gadai Tangae	surrounding	0.4	34°28'24.80"N 72°15'9.24"E	Medium	0	0	0	0	0	0
12	Shamshad Tangae	surrounding	0.6	34°28'7.48"N 72°15'19.18"E	High	0	1	1	1	3	5
13	Gagro	surrounding	0.7	34°28'3.31"N 72°15'46.27"E	High	0	2	0	0	2	2.8
14	Pattay ubo	surrounding	0.3	34°28'17.15"N 72°16'18.12"E	medium	0	0	0	1	1	3.3
15	Bargo Sapar	surrounding	0.5	34°28'0.23"N 72°16'10.30"E	Medium	0	0	0	1	1	2
16	Loya Guday	surrounding	0.4	34°28'22.97"N 72°16'22.29"E	Medium	0	0	0	0	0	0
<b>Total</b>			<b>12.2</b>			<b>10</b>	<b>11</b>	<b>8</b>	<b>4</b>	<b>33</b>	<b>3/km<sup>2</sup></b>

Table 2: Details of Himalayan Grey Goral Assessment in Kohay

sites	Vantage Point name	Name of observation area	Area under Scanning (km <sup>2</sup> )	Coordinates	Habitat Disturbance	Population Count				Total	D=n/a
					High/medium /low	Adult Male	Mature Female	Fawns	Mature m/f		
1	Ghulam Dara	surrounding	0.4	34°28'11.49"N 72°17'48.20"E	High	0	3	0	0	3	7.5
2	Kuthro Kohay	surrounding	0.2	34°27'57.46"N 72°17'49.93"E	Medium	0	0	2	0	2	10
3	Shalthalo	surrounding	0.99	34°28'14.49"N 72°16'56.99"E	Low	0	3	0	0	3	3
4	Aman Tangay-1	Surrounding	0.52	34°28'3.48"N 72°17'5.23"E	Medium	0	0	0	0	0	0
5	Aman Tangay-2	Surrounding	0.8	34°27'46.47"N 72°17'21.88"E	Low	0	2	0	0	2	2.5
6	Kado Tangay	Surrounding	0.4	34°27'40.68"N 72°17'46.31"E	Low	2	0	0	0	2	5
7	Kado Tangai-2	Surrounding	0.24	34°27'32.33"N 72°17'55.88"E	High	0	0	0	0	0	0
8	Wach Tangay	Surrounding	0.44	34°27'32.73"N 72°18'13.67"E	Medium	0	0	0	0	0	0
9	Qandilan-1	Surrounding	0.6	34°27'33.72"N 72°16'54.00"E	High	0	0	0	0	0	0
10	Qandilan-2	Surrounding	0.94	34°27'13.40"N 72°16'59.38"E	Low	0	1	0	0	1	1
11	Salare Kandow-1	surrounding	0.54	34°26'41.52"N 72°17'13.68"E	Low	1	0	0	0	1	1.8
12	Salare Kandow-2	surrounding	0.37	34°26'29.93"N 72°17'24.06"E	Medium	0	0	0	0	0	0
13	Salare Kandow-3	surrounding	0.98	34°26'25.72"N 72°17'39.11"E	Low	2	0	0	0	2	2
14	Badar Tangay	surrounding	0.48	34°26'54.08"N 72°17'35.76"E	medium	0	0	2	0	2	4.2
	<b>Total</b>		<b>7.9</b>			<b>05</b>	<b>9</b>	<b>4</b>	<b>0</b>	<b>18</b>	<b>2.6/km<sup>2</sup></b>

Table 3: List of Common Plants recorded in Goral Habitat

S.#	Scientific name	Family	Local name	Status	Used by Goral
1	<i>Acacia modesta</i>	Mimosaceae	Palusa	Common	Medium
2	<i>Acacia nilotica</i>	Mimosaceae	Kikar	Infrequent	Medium
3	<i>Agrostis canina</i>	Poaceae	-	Infrequent	High
4	<i>Ailanthus altissima</i>	Simaroubaceae	Shandai	Rare	-
5	<i>Albezia</i> sp.	Mimosaceae	-	Rare	-
6	<i>Allium</i> sp.	Alliaceae	-	Infrequent	High
7	<i>Apluda mutica</i>	Poaceae	-	Infrequent	High
8	<i>Aragrostis minor</i>	Poaceae	-	Infrequent	High
9	<i>Aristida</i> sp.	Poaceae	-	Common	-
10	<i>Asparagus</i> sp.	Asparagaceae	-	Common	-
11	<i>Bauhinia variegata</i>	Caesalpiniaceae	-	Common	Low
12	<i>Berberis lyceum</i>	Berberidaceae	Kwarae	Infrequent	Low
13	<i>Bergenia ciliata</i>	Saxifragaceae	-	Rare	Low
14	<i>Bombax ceiba</i>	Bombacaceae	-	Rare	-
15	<i>Caralluma tuberculata</i>	Asclepiadaceae	Pamankae	Infrequent	-
16	<i>Carthamus oxyacantha</i>	Asteraceae	-	Rare	-
17	<i>Celtis eriocarpa</i>	Ulmaceae	Tagha	Rare	-
18	<i>Cenchrus</i> sp.	Poaceae	-	Common	High
19	<i>Chrysopogon aucheri</i>	Poaceae	-	Common	High
20	<i>Commicarpus boissiri</i>	Nyctaginaceae	-	Rare	Low
21	<i>Cotoneaster</i> sp.	Rosaceae	-	Infrequent	High
22	<i>Cymbopogon jwarancusa</i>	Poaceae	-	Infrequent	Low
23	<i>Cymbopogon martini</i>	Poaceae	Sormal	Very common	High
24	<i>Cynodon dactylon</i>	Poaceae	-	Common	-
25	<i>Daphne mucronata</i>	Thymelaceae	-	Infrequent	Medium
26	<i>Digitaria setigera</i>	Poaceae	-	Infrequent	-
27	<i>Dodonaea viscosa</i>	Sapindaceae	Gwaraskai	V. Common	Medium
28	<i>Duchesnea indica</i>	Rosaceae	Da Zmake Toth	Infrequent	High
29	<i>Eriophorum scheuchzeri</i>	Cyperaceae	-	Common	-
30	<i>Eucalyptus camaldulensis</i>	Myrtaceae	-	Infrequent	-
31	<i>Eulaliopsis binata</i>	Poaceae	Bhabbar, Sabai, Gor-kah	Common	High
32	<i>Ficus racemose</i>	Moraceae	-	Infrequent	-
33	<i>Indigofera heterantha</i>	Fabaceae	Gwareja	Infrequent	Medium
34	<i>Isodon rugosus</i>	Lamiaceae	Brotus	Infrequent	-
35	<i>Justicia adhatoda</i>	Acanthaceae	Baiker	V. common	-
36	<i>Monothecha buxifolia</i>	Sapotaceae	Gwargwara	Common	Medium
37	<i>Myosotis asiatica</i>	Boraginaceae	-	Rare	-
38	<i>Nannorrhops ritchiana</i>	Arecaceae/Palmae	Mezarae	Common	-
39	<i>Olea ferrugenia</i>	Oleaceae	Khona	V. Common	-
40	<i>Oxalis corniculata</i>	Oxalidaceae	-	Common	-
41	<i>Pennisetum</i> sp.	Poaceae	-	Rare	High
42	<i>Pergularia media</i>	Aclepiadaceae	-	Rare	-
43	<i>Periploca aphylla</i>	Asclepiadaceae	Salai	Rare	-
44	<i>Phoenix loureirii</i>	Arecaceae/Palmae	Zangali Kajoor	Common	-
45	<i>Pinus roxburgii</i>	Pinaceae	Nakhtar	Infrequent	-
46	<i>Plantago lanceolate</i>	Plantaginaceae	-	Infrequent	-
47	<i>Poa</i> spp.	Poaceae	-	Common	High
48	<i>Quercus glauca</i>	Fagaceae	Banj	Infrequent	Low
49	<i>Rosa</i> sp.	Rosaceae	Zangali Gulab	Infrequent	Medium
50	<i>Rubus ellipticus</i>	Rosaceae	Bagana	Infrequent	Medium
51	<i>Rubus fruticosus</i>	Rosaceae	Karwara	Infrequent	Medium
52	<i>Rumex hastatus</i>	Polygonaceae	Tarukae	Infrequent	-
53	<i>Saccharum</i> sp.	Poaceae	Shalghashe	Infrequent	Low
54	<i>Urtica dioica</i>	Urticaceae	Sezunkae	Rare	-
55	<i>Viburnum grandiflorum</i>	Caprifoliaceae	Beranj	Rare	-
56	<i>Zanthoxylum armatum</i>	Rutaceae	Dambara	Common	-
57	<i>Ziziphus nummularia</i>	Rhamnaceae	Zangali bera	Rare	Low



Total of 20.1 km<sup>2</sup> area searched and counted 51 gorals with 20 females; 15 males and 12 fawns, while four animals could not be identified for their sexes. The fawn ratio indicating significant recruitment rate, which is one of the key components for the healthy population of goral in the game reserve. In Nanser, 12.2 km<sup>2</sup> area were searched and observe total of 33 goral including 10 males; 11 females; 8 fawns and 4 gorals could not assessed for their sexes. Densities were calculated for each vantage area by dividing number of counted goral by the observation area using formula ( $n/a=d$ ). Higher density was recorded at "Wacha Dara" with 6.2 animals/km<sup>2</sup>, followed by "Shamshad Dara" with 5 animals/km<sup>2</sup> and "Amothangae" with 4.2 animals/km<sup>2</sup>. One of the highly potential location named "Kashmir Smas" could not be observed due to its highly dense vegetation cover where animal observation could not be possible. In the Kohay area total of 7.9 km<sup>2</sup> (35.9%) highly potential area was searched for goral assessment and counted total of 18 goral including 4 fawns, 9 females and 5 males. In "Kohay" sub-valley the higher density was recorded at "Kuthro Kohay" with 10 animals/km<sup>2</sup>, "Ghulam dara" with 7.5/km<sup>2</sup>, "Kado Tangay" with 5/km<sup>2</sup> and "Badar Tangay" with 4.2 goral per km<sup>2</sup> area, however, the animals generally move in search of food therefore, its density pattern changes in different season effecting by various factors such as agriculture fields, rainfall, drought, grazing pressure as well as other significant anthropogenic and environmental factors.

Most of the goral individuals observed during the survey was active for grazing and browsing on shrubs and trees during dusk and dawn and resting under the rocky outcrops covered with dense shrubby vegetation, social behavior could not be observed which generally occurs during rutting and matting season.

Kohay-Nanser game reserve provides healthy habitat for goral in the form of sufficient food and shelter, feeding behavior of goral avoids the food shortage throughout the year, the habitat has highest carrying capacity due to variety of palatable grasses, plenty of evergreen shrubs and trees, therefore, goral could not experience food scarcity, although the number of livestock that own by nomads is major threat to its habitat. Gorals can also survive in persistent drought as they are reported to drink water only once a week in winter and slightly greater during summer due to greater availability of water in shape of seasonal rains. The habitat was also assessed for

its degree of disturbance (Fig. 4).

#### Habitat Condition and Floral Diversity:

Sub-tropical evergreen mix deciduous and broad leaf forested mountains has significant diversity of flora with substantial cover that provide healthy habitat and fantastic variety of food and shelter to goral and its associated species. The most dominant species that recorded are *Dodonia vescosa*; *Justicia adhatoda*; *Olea ferrugonea*; *Quercus glauca*; *Berberis lyceum*; *Acacia modesta*; *Zanthoxylum armatum*; *Pinux roxburghii*; *Nannorrhops ritichiana*; *Asparagus* sp; *Bauhaenia verigata* and *Phoenix loureirii*. Detailed list of plant species is given in table#2.

#### DISCUSSION

Kohay-Nanser is one of the fragmented habitats of Himalayan grey goral with significant population, the recent data reveals that the area possess second largest density of Himalayan grey goral in country with more than 25 adult breeding pairs existing only in a small area spread over 40 km<sup>2</sup>. However, the habitat for the species exposed to variety of anthropogenic factors.

The high degree of disturbance altering the natural behavior of the species, as compare to the results and habitat use seasonal preference by Grey goral. We found gorals in Kohay-Nanser with the slope of more than 60° even during the winter months. The results are totally different from the findings of (Lovari and Apollonio 1993; Mishra 1993 , Pendharkar 1993 , Sathyakumar 1994; Ashraf et al., 2015). We found that the goral more restricted in its patchy habitat to the highly isolated and hard terrains in more and frequently disturbed areas which indicating the goral movement restriction within the area due to gradually increasing disturbance.

Usually female with their fawns lives in small to medium group of 2-12 individual and male generally solitary in nature (Lovari and Apollonio, 1993) but in case of the recent survey such large groups could not be observed accept solitary male and female with single fawn. It may be for the reason of high degree of human interference in its natural and potential habitat faced by goral, either in the form of hunting pressure or ecological degradation through over grazing, deforestation, unmanaged and mass tourism and more effectively due to explosions for stone mining, heavy traffic and increasing machinery use. It is also possible that the herd size in winter is may be comparatively lesser due to food scarcity (due to

long drought and increasing nomadic movement to the area with their large number of livestock and guard dogs) as compare to the spring and early summer months which required spring and early summer monitoring and regular census surveys.

(Saeed et al., 2012) reported that the population of Grey goral in the district gradually declining, he reported 20 individuals from Nanser and 35 from Kohay, while (Abbas et al., 2012) reported 14 adult males and 27 adult females from the entire district. However, the present data indicates viable population of Grey goral is still existing in Kohay-Nanser due to highly productive habitat but substantial and sustainable management is required to reduce further habitat devastation and population decline of Grey goral.

## CONCLUSION

Grey goral population is declining in its habitat range throughout the country, although viable population is existing in Pakistan. Kohay-Nanser game reserve has significant population of Grey goral and includes in one of the higher density areas for goral among all of their fragmented habitats in the country. Goral facing immense ecological and anthropogenic pressure in Kohay-Nanser game reserve which required effective and long-term sustainable management. Conservation without community is almost not possible, therefore, goral conservation in Nanser is required enthusiastic level of community participation. Trophy hunting program is the possible and viable way to involve community in conservation and it may be the only way to protect the species and its habitat, otherwise, will be extinct from the area in near future if there are adequate conservation and management initiative could not be taken immediately.

## CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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## AUTHOR CONTRIBUTIONS

SFBK supervised the study, support in manuscript writing, designing and proof reading. SI conduct the field study, design, write and proof read the manuscript, correspondence author. SAS provide guidance for conducting the study. MI participate in the field study, provide access to the field area, facilitate the entire study, support in developing manuscript and proof reading. SKH and RN guide in designing and conducting the survey. All the authors read and finalized the manuscript.

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