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Conservation Status of Himalayan Grey Goral *(Naemorhedus goral bedfordi* Hardwicke, 1825) in Machiara National Park, Azad Jammu and Kashmir, Pakistan

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Abstract.- Current population and conservation status of Himalayan grey goral (*Naemorhedus goral bedfordi*) was assessed in Machiara National Park (MNP), Azad Jammu and Kashmir (AJ&K), during April-December, 2011. Direct (sighting during dawn and dusk and signs) and indirect (using questionnaires) methods were used to survey three union councils (UC) and 22 localities. A population of 91 animals was recorded with a density of 1.92 goral/km^2; the highest density was recorded at Ravri (4 goral/km^2; UC Machiara). Illegal hunting of 24 goral during 2000-2011 was reported by AJ&K Wildlife Department, of which nine were reported from protected areas and two from MNP. Despite the protected status of goral under AJ&K Wildlife Act, habitat destruction, illegal hunting, poaching, over-grazing by livestock and human disturbance are the major threats to future conservation of grey goral.

Key words: Himalayan grey goral, Machiara National Park.

INTRODUCTION

The Himalayan grey goral (*Naemorhedus goral bedfordi*: family Bovidae, order Artiodactlyla, class Mammalia) is a cliff-dwelling rupicaprine (Fakhar-i-Abbas *et al.*, 2011). Goral is an oriental species and endemic to the Himalayan range. It is thought to have entered Pakistan through the northern corridor (Fakhar-i-Abbas, 2006; Mirza, 1998). The distribution range of species extends from Pakistan to north India, Nepal, Bhutan, up to Mishmi hills of Assam (Grubb, 1975; Roberts, 1997; Prater, 1980).

In Pakistan, goral is present in the Himalayan foothills; Margalla range (Federal Capital Territory), Murree foothills (Punjab), Abbottabad, Haripur, Mansehra, Mardan, Buner, Kohistan, Swat, Dir, Malakand, Nowshera (Khyber Pakhtunkhawa, KP) and Azad Jammu and Kashmir (AJ&K) (Roberts, 1997; Fakhar-i-Abbas, 2006). Roberts (1997) reported the presence of the species in AJ&K in Neelum Valley north of Athmuqam, while Qayyum (1985), Zoological Survey 1997; Fakhar-i-Abbas, 2006) Department (1986) and Fakhar-i-Abbas (2006) reported its presence in Muzaffarabad (Machiara National Park and Qazi Nag Game Reserve), Kotli and Poonch.

Goral, like other wild species of goats, is adapted to climbing rocky mountain terrains (Mirza, 1998). Himalayan goral feeds on grassy ridges and steep rocky slopes, but seeking refuge under rock overhangs and thicker forests (Hayssen and Van Tienhoven 1993). The grey goral is listed as near threatened (IUCN, 2011) and the population decline has been ascribed to habitat loss and human predation (Duckworth and MacKinnon, 2008). In Pakistan, goral is protected but enforcement of legislation is however, not effectively implemented even in the protected areas. Thus, there is an urgent need to gather information about the current distribution and status of the species throughout its distribution range, including AJ&K. Present study was designed to study the population distribution and status in the Machiara National Park (AJ&K), one of the best managed national parks of the state.

MATERIALS AND METHODS

Study area

Machiara National Park (MNP: 34°31'NL and 73°37'E) is located about 35 km north of

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Muzaffarabad and is a part of the Himalayan foothill series that branches off from Nanga Parbat (Qamar *et al*., 2008). MNP is located on the western side (right bank) of the Neelum River (Awan *et al.*, 2004). MNP has a protected area of 135.35 km^2 falling between 2,000 m and 4,700 m above the mean sea level (amsl.) (Qamar *et al*., 2008). The mean yearly precipitation is 1526.7 mm, with 84.5 rainy days, July with the highest average rainfall (327.6 mm) and November (35.4 mm) receiving the minimum (Beig, 2004; Hassan, 2004). Flora of MNP is temperate Himalayan mixed-forest/alpine-scrub-rangeland ecosystem with a huge diversity of vegetation which provides habitat to hundreds of wild animals and birds (Qamar *et al*., 2008; Minhas *et al*., 2012).

Methodology

Field surveys were conducted from April to December, 2011 to collect data on the conservation biology (distribution, population status, habitat utilization and conservation status) of grey goral in MNP. This information was collected through direct (sighting, foot prints, and fecal droppings) as well as indirect methods (by collecting the information from local residents, shepherds, hunters and game watchers of the park).

Line transects

On the basis of initial survey, 22 potential localities (Chakolni, Malli, Ravri, Tharian, Bagnari, Charial, Phar, Khuthyali, Ranja, Chita Pani, Jugian, Chitta Kashkar, Malki Da Par, Kahi, Kachlan Garh, Khori Wali Klan, Keelan Wala Par, Cham Kathan, Soakar Lani, Bagjhath, Khori and Kuldabber) providing potential habitats to the goral were sampled for their population; twenty two transects were laid, one each in every locality. At vantage points, direct observations were made for four hours early in the morning (0600-1000 hours) and three hours in the evening (1600-1900 hours in summer and 1400-1700 hours in winter), when this animal is more likely to utilize in grazing. The timing of observation at each site was adjusted in a way to avoid the chance of duplication of observing the same animals. The length and area of transects was analyzed in Arc GIS (ver. 9.1) through the convex polygon method based on the coordinates recorded using GPS device while moving along each transect. Population density was calculated by dividing the number of goral observed by the respective transect area (km^2).

Fecal pellets were the major indication used to decide the presence of goral in many areas. If animal signs were found, such places were observed for three to five days. For the observation of goral binoculars (Canon; 8×40mm) were used. Observations were made early in the morning and late in the evening until dark following Anwar and Chapman (2000).

Indirect methods

In order to collect secondary information about the animal, a questionnaire was also developed and tailored for the community observers. Besides, information was also collected through interviews and conversation with local people, hunters, and wildlife and forestry staff working in the park. This information was also considered for assessing the conservation status of the animal in the area.

For general habitat assessments, all dominant plant species were recorded and got identified with the help of available literature and experts from the Department of Botany University of Azad Jammu and Kashmir Muzaffarabad. Other habitat features such as GPS coordinates, forest type, habitat quality and modifications, topography, elevation above mean sea level and linked fauna were also recorded in the field.

Discussions with experts and officials of Wildlife Department and all registered cases of illegal hunting of the species with Wildlife Department from different areas of AJ&K were used to assess existing conservation status in AJ&K and MNP.

RESULTS

Distribution and population status

Grey goral was recorded from three union councils (Bheri, Machiara and Sarli Sacha) of MNP and several other localities in the buffer zone (UC Balgran and UC Kelgran) (Fig. 1). Union council Machiara holds the most potential habitat where goral was recorded in all the major localities

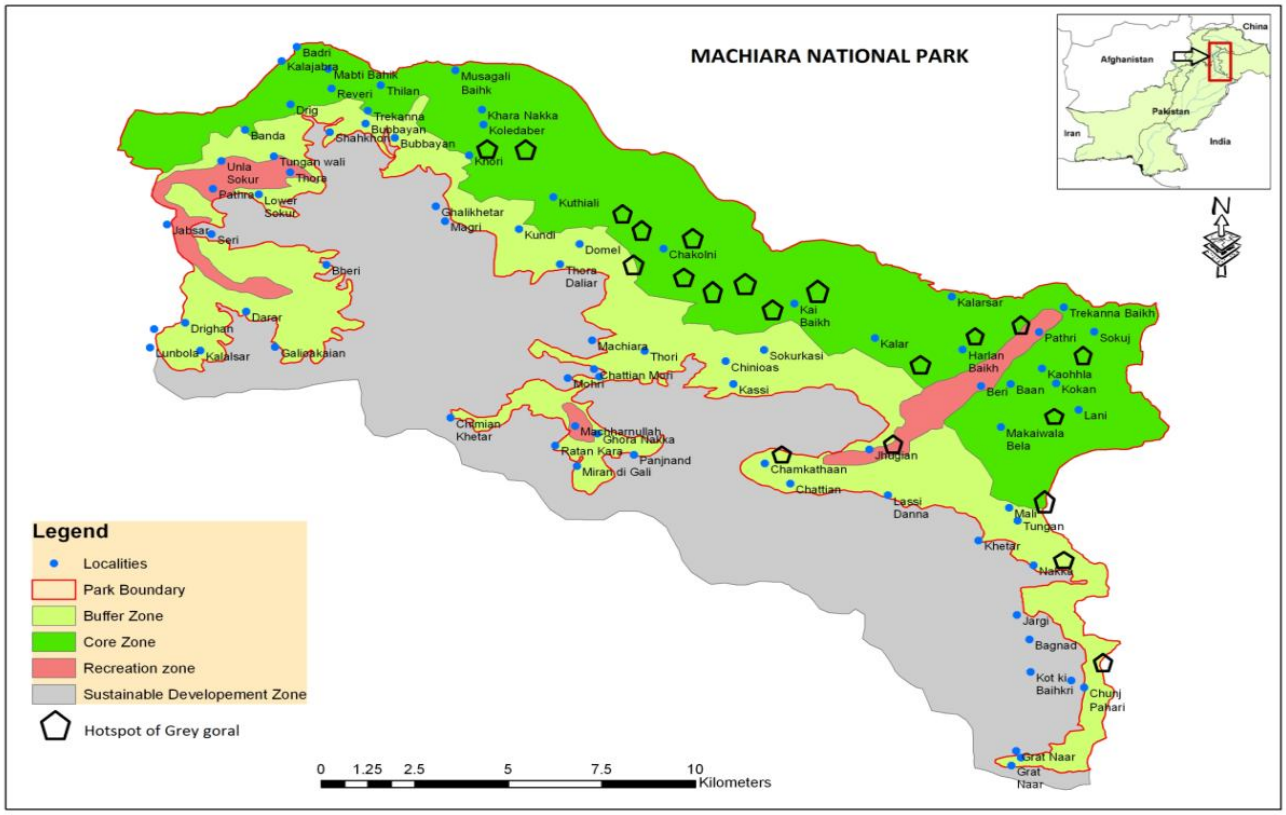

Fig. 1. Map of MNP showing grey goral hot spots

(Tharian, Malli, Chakolni, Ravri, Bagnari, Charial, Phar and Khuthyali; Table I).

Union Council Sarli Sacha held the second best potential goral habitat that was recorded in Ranja, Chitta Pani, Jugian, Chitta Kashkar, Malki Da Par, Kahi, Kachlan Garh, Khori Wali Klan, Keelan Wala Par, Cham Kathan, Soakar Lani and Bagjath. Only a few areas holding suitable habitat of goral were recorded in Bheri union council; the goral was present at Kuldabar and Khori only (Table I). Outside the MNP, in buffer zone, grey goral was recorded from different localities including Guggal Dhoap, Chotta Wala Nakka (UC Balgran) and Katha Chogali (UC Kelgran).

Ninety one grey goral were observed in the study area with an overall population density of 1.92 animals/km^2 (Table I). The highest population density (2.32 goral/km^2) of grey goral was found in union council Machiara (Forest Compartment 9b) with a population of 45 individuals which was about 49% of the total population (Table I). This area comprises of eight localities in which grey goral was distributed with the highest population at Ravri (n=8; 4 goral/km^2) and Tharian (n=8; 2.67 goral/km^2; Table I).

Likewise, presence of 39 goral (43%) was recorded in union council Sarli Sacha (Fig. 1) with 1.63 goral/km^2 population density (Table 1). This population was distributed in 12 localities of the union council with the highest density at Ranjha (n=4), Khori Wali Klan (n=4), Chitta Pani (n=4), Jugian (n=4) and Bagjath (n=4) (Table I). The goral were present in the lowest population density (1.34 goral/km^2) at locality Bagjhath.

Goral was found at two localities *i.e.*, Kulldabber (n=4) and Khori (n=3) in union council Bheri with an estimated population comprising 7 individuals (8%) and 1.56 goral/km^2 population density (Table I). Most of the population of goral (n=46) was confined to 2600-3000 m elevation range above mean sea level. Thirty seven individuals were observed at an elevation of 2100-

Table I.- Population density of grey goral in different localities of MNP during 2011.

Sr. No.	Locality	Coordinates (ºNL, ºE)	Elevation (m, above mean sea level)	Goral observed (#)	Area surveyed (km^2)	Population density (/km^2)
Union Council Machiara						
1	Tharian	N34.°31899, E73°31.956	2705	8	3	2.67
2	Malli	N34.52465, E73.61492	2790	5	2	2.50
3	Chakolni	N34.52911 E73.63618	2668	5	3	1.67
4	Ravri	N34°32.272 E73°37.711	2541	8	2	4.00
5	Charial	N34.52874 E73.63845	2607	6	2	3.00
6	Phar	N34.53861 E73.59686	2309	4	2	2.00
7	Bagnari	N34.48938 E73.67480	2751	5	3	1.67
8	Kuthyali	N34.56040 E73.55581	2816	4	2	2.00
		Sub-total (A)	**2309-2816**	**45**	**19**	**2.37**
Union Council Sarli Sacha						
9	Ranjha	N34.56096 E73.58910	2720	4	2	2
10	Khori Wali Klan	N34.50407 E73.65388	2380	4	2	2
11	Kachlan Garh	N34.55649 E73.59512	2525	3	2	1.5
12	Chita Pani	N34.49022 E73.69408	2585	4	2	2
13	Keelan Wala Par	N34°31.231 E73°44.305	2180	2	1	2
14	Kahi	N34,17.271 E73,48.451	2680	3	2	1.5
15	Chitta Kashkar	N34.50414 E73.65376	2635	3	1.5	2
16	Cham Kathan	N34.48976 E73.71274	2500	3	2	1.5
17	Jugian	N34°28.367 E73°41.148	1820	4	1.5	2.67
18	Malki Da Par	N34.48888 E73.70404	2124	2	1	2
19	Bagj Jath	N34°29.386 E73°42.764	2515	4	3	1.34
20	Soakar Lani	N34.49055 E73.66407	2583	3	2	1.5
		Sub-total (B)	**1820-2720**	**39**	**24**	**1.63**
Union Council Bheri						
21	Kuldabber	N 34°33.942 E73°35.521	3100	4	2.5	1.6
22	Khori	N34.56096 E73.58910	2660	3	2	1.5
		Sub-total (C)	**2660-3100**	**7**	**4.5**	**1.56**
		Grand total (A+B+C)	**91**	**47.5**	**1.92**	

2500 m, while only a few (n=4) individuals were observed between the elevation range of 3100-3500 m amsl.

Habitat utilization

In MNP, grey goral was recorded in moist temperate coniferous forests that included plant species such as *Pinus wallichiana* (Blue pine), *Abies pindrow* (Fir), *Picea smithiana* (Indian Spruce), *Cedrus deodara* (Himalayan cedar), and *Quercus floribunda* (Oak); shrubs *Viburnum nervosum* (Viburnum), *Indigofera heterantha* (Indigo Bush), *Berberis aristata* (Indian Barberry), *Betula utilis* (Himalayan birch), *Juniperus communis* (common juniper), and the herbs *Bergenia stracheyi* (Rockfoil), *Impatiens edgeworthii* (Himalayan balsam), *Rumex nepalensis* (Nepal Dock), *Polygonum amplexicaule* (Bistort) and *Artimisia* spp. The grasses included *Agrostis munroana* (bentgrass), *Agrostis vinealis* (brown bentgrass), *Apluda mutica* (Mauritian grass), *Aristida adscensionis* (common needle grass) and meadow grass *Poa* spp. (Table II).

Topographically, goral preferred hilly terrains having hills and slopes. Water was present throughout the preferred habitats in the form of natural springs, *nullahs* and small ponds.

Other mammal and bird species recorded in the study area included the snow leopard (*Panthera uncia*), common leopard (*Panthera pardus*), black

Table II.- Dominant plant species and topography in goral habitat in different localities of MNP.

Sr. No	Localities	Plant species	Topography/habitat
1	Tharian	*Taxus wallichiana, Pinus wallichiana, Asculus indica, Viburnum nervosum, Cymbopogon martini, Rumex nepalensis, Agrostis* spp. *Apluda mutica, Aristida adscensionis*	Open grassy with steep slopes
2	Malli	*Abies pindrow, Cedrus deodara, Pinus wallichiana, Berbris aristida, Betula utilis, Fragaria nubicola, Rheum emodi, Rumex nepalensis, Agrostis* spp. *Apluda mutica, Aristida adscensionis, Poa* spp.	Rocky boulder with strew slopes with ground vegetation
3	Chakolni	*Pinus wallichiana, Picea smithiana, Taxus wallichiana, Asculus indica, Indigofera heterantha, Cymbopogon martini, Polygonum amplexicaule, Agrostis* spp. *Apluda mutica, Aristida adscensionis, Poa* spp.	Open rocky covered with dense ground vegetation
4	Ravri	*Pinus wallichiana, Quercus incana, Picea smithiana, Taxus wallichiana, Cedrus deodara, Indigofera linifolia, Vibernum nervosum, Polygonum amplexicaule, Cymbopogon martini, Agrostis* spp. *Apluda mutica, Aristida adscensionis, Poa* spp.	Moist temperate with steep slopes
5	Charial	*Picea smithiana, Abies pindrow, Pinus wallichiana, Indigofera heterantha, Juniperus communis, Viburnum grandiflorum, Bergenia stracheyi, Podophyllum emodi, Agrostis* spp. *Apluda mutica, Aristida adscensionis, Poa* spp.	Rocky covered vegetation with steep slopes
6	Phar	*Pinus wallichiana, Indigofera heterantha, Berbris aristida, Viburnum nervosum, Cymbopogon martini, Agrostis* spp. *Apluda mutica*	Rocky boulder with steep gorges and strewn slopes
7	Bagnari	*Picea smithiana, Abies pindrow, Indigofera heterantha, Betula utilis, Geranium wallichianum, Euphorbia* spp. *Agrostis* spp. *Apluda mutica, Aristida adscensionis, Poa* spp.	Moist temperate with steep slopes
8	Kuthyali	*Pinus wallichiana, Abies pindrow, Quercus* spp., *Juniperus communis, Betula utilis, Berbris aristidae, Geranium wallichianum*	Moist temperate mixed coniferous forest, subalpine scrubs
9	Ranjha	*Pinus wallichiana, Picea smithiana, Ziziphus maurititiana, Indigofera heterantha, Rumex nepalensis, Impatiens edgeworthii, Artemisia* spp. *Agrostis* spp. *Apluda mutica, Aristida adscensionis, Poa* spp.	Open rocky slopes covered with dense grass
10	Khori Wali Klan	*Pinus wallichiana, Abies pindrow, Viburnum grandiflorum, Juniperus communis, Ziziphus mauritiana, Berbris aristidae, Rumex nepalensis, Agrostis* spp. *Aristida adscensionis*	Rocky boulder with steep gorges and strewn slopes
11	Kachlan Garh	*Abies pindrow, Picea smithiana, Pinus wallichiana, Berbris aristida, Betula utilis, Rumex nepalensis, Fragaria nubicola, Agrostis* spp. *Apluda mutica, Aristida adscensionis*	Open rocky slopes with shrubs
12	Chita Pani	*Pinus wallichiana, Cedrus deodara, Indigofera heterantha, Juniperus communis, Ziziphus mauritiana, Rumex nepalensis, Bergenia stracheyi, Agrostis* spp. *Apluda mutica*	Moist temperate with steep slopes
13	Keelan Wala Par	*Abies pindrow, Pinus wallichiana, Indigofera linifolia, Ziziphus maurititiana, Podophyllum emodi, Impatiens edgeworthii, Apluda mutica, Aristida adscensionis, Poa* spp.	Open rocky with steep slopes

Continued

Sr. No	Localities	Plant species	Topography/habitat
14	Kahi	*Abies pindrow, Pinus wallichiana, Berbris aristida, Impatiens edgeworthii, Rumex nepalensis, Polygonum amplexicaule, Agrostis* spp. *Apluda mutica, Aristida adscensionis, Poa* spp.	Moist temperate with strewn sloppy Rocky with steep gorges
15	Bagjath	*Pinus wallichiana, Picea smithiana, Indigofera heterantha, Juniperus communis, Polygonum amplexicaule, Bergenia stracheyi, Euphorbia* spp. *Agrostis* spp. *Apluda mutica*	Moist temp. mixed coniferous Forest
16	Cham Kathan	*Cedrus deodara, Picea smithiana, Pinus wallichiana, Indigofera heterantha, Ziziphus mauritiana, Impatiens edgeworthii, Juniperus communis*	Moist temperate with strewn sloppy Rocky with steep gorges
17	Jugian	*Abies pindrow, Pinus wallichiana, Indigofera heterantha, Juniperus communis, Impatiens edgeworthii, Bergenia stracheyi*	Moist temp. mixed coniferous Forest
18	Chitta Kashkar	*Abies pindrow, Picea smithiana, Pinus wallichiana, Indigofera heterantha, Betula utilis, Impatiens edgeworthii, Artemisia* spp.	Open rocky with steep slopes
19	Kill Wala Phar	*Abies pindrow, Picea smithiana, Berbris aristata, Indigofera heterantha, Geranium wallichianum, Bergenia stracheyi, Agrostis* spp. *Apluda mutica, Aristida adscensionis*	Open rocky slopes covered with dense grass
20	Soakar Lani	*Pinus wallichiana, Abies Pindrow, Indigofera heterantha, Geranium wallichianum, Euphorbia* spp. *Bergenia ciliate, Agrostis* spp. *Apluda mutica, Aristida adscensionis*	Moist temp. mixed coniferous Forests
21	Kuldabber	*Pinus wallichiana, Quercus incana, Picea smithiana, Taxus wallichiana, Betula utilis, Cedrus deodara, Indigofera heterantha, Viburnum nervosum, Polygonum amplexicaule, Cymbopogon martini, Bergenia ciliate, Agrostis* spp. *Aristida adscensionis, Poa* spp.	Moist temp. mixed coniferous Forest, sub alpine scrubs
22	Khori	*Pinus wallichiana, Quercus incana, Taxus wallichiana, Viburnum nervosum, Juniperus communis, Bergenia stracheyi, Podophyllum emodi, Cymbopogon martini, Euphorbia* spp. *Agrostis* spp. *Apluda mutica, Aristida adscensionis*	Moist temperate with strew slopes

bear (*Ursus thibetanus*), grey langur (*Semnopithecus ajax*), rhesus monkey (*Macaca mulatta*), musk deer (*Moschus chrysogaster*), kaleej pheasant (*Lophura leucomelanos*), koklass pheasant (*Pucrasia macrolopha*), monal pheasant (*Lophophorus impejanus*), western tragopan (*Tragopan melanocephalus*) and chukor (*Alectoris chukar*). Illegal hunting and poaching pose severe threat to grey goral population in MNP. The record available with MNP management indicates that during the last 12 years (2000-2011) two grey goral were illegally hunted, though major part of the hunting remains unrecorded as reported by the local community. During this period, a total of 24 grey goral were illegally hunted in different areas of AJ&K (Table III).

Table III.- Reported hunting of grey goral in different localities of AJK during different years.

Year	Location	Reported hunting (#)
2000	Salkhala, Dawarian Lari	2
2002	Salkhala, Machiara	5
2003	Machiara, Moji	2
2004	Kundal Shahi	1
2005	Patri	1
2006	Moji	1
2008	Moji, Charial, Ashkot	3
2009	Rawaita, Chor Nar (Nellum), Ashkot	4
2010	Moji	1
2011	Leepa, Qazinag, Salkhala, Kail	4
	Total	**24**

DISCUSSION

Himalayan grey goral is distributed in at least 22 localities as a sizeable population in MNP. Highest density of goral population was estimated (4 goral/km^2) in Ravri locality, because this locality has dense vegetation and tree cover and low anthropogenic disturbance. The goral were present in the lowest population density (1.34 goral/km^2) at locality 'Bagjhath' because of less suitability of the habitat and more human interference. In MNP, the goral were distributed between elevations of 1800 to 3100 m amsl. Sathyakumar (2002) also reported that goral were most commonly encountered at altitudes between 1440 m to 3600 m amsl. At the elevation range 1500-2000 m four goral were observed. Thirty seven individuals were observed at elevations between 2100 to 2500 m. Most of the population of goral (n=46) was confined to 2600-3000 m elevation range, while only a few (n=4) individuals were observed at the elevation range of 3100-3500 m. It indicated that the goral usually preferred the elevation between 2600-3000 m, in moist temperate coniferous forests with steep slopes and dense vegetation cover. The statistical analysis showed that there was non-significant difference (p=0.310) in the population distribution of grey goral with respect to different elevation classes. In summer, goral population shifted to the higher altitudes of the MNP because of the moving in of the local people and their livestock into the winter habitat of grey goral. In winter, goral shifts to lower elevations near the human habitations because of heavy snowfall at higher elevations. In MNP, grey goral was found in the population density of 1.92 goral/km^2. It was present in all three union councils of MNP with the highest population density (2.32 goral/km^2) in union council Machiara as these areas have intact forests with limited anthropogenic interference. In Sarli Sacha and Bheri union councils, its population density was 1.63 and 1.56 goral/km^2 respectively in localities providing suitable habitat, as most of the forested areas, the potential habitat of goral, have mainly been degraded due to anthropogenic activities.

According to Fakhar-i-Abbas *et al.* (2009), *Pinus roxburghii* was the indicator species for goral habitat, but in the present study area, *Pinus roxburghii* was not present and no specific association was recorded with any plant species. However, *Pinus wallichiana* was present in different goral habitats throughout the study area. Among other trees *Abies pindrow, Aesculus indica, Quercus floribunda* and *Betula utilis*, were present in different proportions in its habitat; *Viburnum nervosum, Berbris aristata* and *Indigofera heterantha* were the main shrubs. Ground vegetation in the habitat of goral in the study area included *Rumex nepalensis, Fragaria nubicola, Geranium wallichianum, Cymbopogon martini, Agrostis* spp. *Apluda mutica, Aristida adscensionis* and *Poa* spp. Presence of herbs, shrubs and trees in the list of plant species, identified in the goral habitat by Anwar (1989) and Pendharkar (1993) reflects the presence of three well defined layers *viz*., Trees and shrubs are perennial whereas herbs (and grasses), the ephemerals, sprout during spring and the monsoons and dry up during winter, as also reported by Fakhar-i-Abbas *et al.* (2009). Goral feed almost entirely on grasses (92.2% in the cold season and 98.3% in the warm season). Goral preferred open vegetation communities with good grass cover and avoided shrub-rich patches, especially those areas where shrub height exceeded their shoulder height. Goral selected patches with fresh grass sprout and were partial to steep slopes (Mishra and Johnsingh, 1996).

According to Azad Jammu and Kashmir Wildlife Act 1975, Rules 1982, grey goral is included in the third schedule of protected animals *i.e.* animals which cannot be hunted, killed or captured. Habitat degradation continues in MNP in the form of fuel wood collection, illegal timber extraction, livestock grazing and grass cutting. The park meets the forage and fodder requirements of livestock from May to September. Grazing and browsing damage young plants and seedlings. The local people with their livestock generally move to higher elevation pastures and forest areas in the Machiara National Park during summer season from May to September. During five to six months of their stay, they use the forest and rangeland resources ruthlessly; disturbing the wild animals. The goral are therefore forced to move to even higher altitudes away from the humans and their livestock.

CONCLUSIONS

Ninety one goral were recorded in the study area distributed over 47.5 km^2 area in 22 different localities of MNP between 1800 m to 3100 m amsl. The highest population density (4 goral/km^2) was recorded at Ravri in Union council Machiara which provided the most suitable habitat to the animal. Habitat destruction, illegal hunting and disturbance by human population and their livestock are still operating as main threats for decreasing its population in Machiara National Park.

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