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SOCIO-ECONOMICS AND LIVESTOCK GRAZING PATTERN IN AND AROUND GREY GORAL HABITAT IN MACHIARA NATIONAL PARK, AZAD JAMMU AND KASHMIR, PAKISTAN

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ABSTRACT

Grey goral (*Naemorhedus goral*) is classified as Near Threatened by IUCN Red List. This subspecies is threatened primarily by illegal hunting and competition with livestock, resulting in small and fragmented populations in its current distribution range in Pakistan. Present study documented socio-economic structure of residents and livestock grazing pattern in and around Grey goral habitat at two locations i.e. Machiara and Serli Sacha in Machiara National Park (MNP), Azad Jammu and Kashmir, Pakistan. Socio-economic of people was assessed by questionnaire survey and livestock population in Grey goral habitat was assessed through field sampling as well as questionnaire survey. Average family size was less at Machiara (5.46) than Serli Sacha (6.48). Self-employment (84 %), government employment (16 %) and daily wages labour were identified as major economic activities in the study area. At Serli Sacha, larger proportion of inhabitants (87%) were self- employed than Machiara (84%). At Machiara, 16% of respondents were government employees while there was none in Sarli Sacha. At Machiara, 32 families owned 545 livestock heads with an average of 17 animals per family while at Serli Sacha, 47 families owned 899 livestock heads with an average of 19 animals per family around Grey goral habitat. There was a significant negative correlation between number of Grey goral observed and livestock heads both at Machiara (r= -0.388, $p < 0.05$, n = 7) and Serli Sacha (r= -0.75, $p < 0.05$, n = 9). Our study suggests that a comprehensive livestock grazing strategy needs to be developed for protection and conservation of Grey goral and its habitat in MNP.

Key words: livestock grazing, grey goral, socio-economic survey, livelihood, conservation.

INTRODUCTION

Livestock grazing and related activities are considered as main reasons for population loss of wild herbivores through habitat degradation (Kittur and Sathyakumar, 2010). Infect abundance of a species in a given area is determined by inter-specific competition. If two species competing for the same resources co-exist in an area they have to adapt for resource partitioning or niche specialization or otherwise would become extinct as a result of resource competition (Mishra *et al.,* 2002). More people need more resources which results in exploitation of natural resources in an unsustainable way. Further livestock and wild herbivores inhabiting the same area compete for food resources (Khan, 2012).

In areas, where human population expansion has laid stress on shrinking population of ungulates and their habitats, these species are at threat of extermination within few years (Michel, 2008). The reduction of inadequate forage for wildlife, degradation of habitat, transfer of disease, and decline in the breeding performance of both domestic livestock and wildlife are the latent impacts of extreme grazing through livestock (Bhatnagar and Mathur, 2001).

In the Himalayas, one of the main reasons of habitat deprivation, both within and outside protected areas, is unrestrained levels of livestock grazing (Kala and Rawat, 1999). In addition, many groups of livestock are taken by pastoralists to high elevation areas for grazing during summer season (Kittur and Sathyakumar, 2010). Such type of heavy grazing by pastoralists during growing season of vegetation can result in declines in fodder availability (Veblen, 2008).

Livestock grazing and associated activities affect on habitat of wild herbivores and their foraging behaviour, and these are changes that may also affect their survival in the future (Syed and Khan**,** 2017). Recent reviews have shown that competition for limited grazing resources is increasing and as a result the conflicts between wildlife and livestock are rapidly growing. The main factors that drive these conflicts are increasing demographic pressure, expansion of cultivation and reduction in rangeland resources. Livestock grazers are also one of the most important links in human-wildlife conflict as they often take their livestock into the forests for grazing (Nayak *et al*., 2013).

The possible future threats to the populations of wild ungulates include competition for grazing by

uncontrolled number of domestic livestock, and possibility of disease transmission from livestock to the wild ungulates (Woodford *et al*., 2004). Research that analyzes the competition and relationships between wildlife and livestock has grown rapidly within the last few years. However, still there remains a great deal of controversy surrounding the characterization of relationship between wildlife and domestic livestock. The present study assessed the socio economic structure and livestock grazing pattern in and around Grey goral habitat at two locations i.e. Machiara and Serli Sacha in the Machiara National Park (MNP).

MATERIALS AND METHODS

Study Area: The study was conducted in Machiara National Park (MNP), encompasses 138 km^2 of the western Himalayan Mountains (Cochard and Dar 2014), located at about 35 km north of Muzaffarabad city of Azad Jammu & Kashmir, Pakistan. It was declared National Park in 1996 prior to which it was given a status of Wildlife Sanctuary in 1984 and Game Reserve in 1982 (GOAJK, 2005). Machiara National Park lies at 34°-31' N latitude and 73°-37' E longitude and covers an area of 13,532 ha between 2,000 m to 4,700 m elevation (Qamar *et al*., 2008).

In MNP, a minimum of 42 mammal species (Baig, 2004) and more than 100 bird species with both migratory and resident (Hassan, 2004), 25 species of reptiles and 7 amphibians have been recorded (Baig, 2004). A human population of 29,680 people were living within 4654 households in 30 villages in MNP (Dar *et al*., 2009).

Socio-Economic Survey: In the first step, a questionnaire survey was carried out in study area to collect data on different aspects of socio-economic structure of local inhabitants, including occupation, land use pattern and key economic activities. In addition, information on livestock population and grazing practices was also collected. Chief member of each family (Total 91) was interviewed to collect data on above parameters following Silori and Mishra (2001).

Grazing pressure: To characterize grazing pattern at Machiara and Serli Sacha, information about livestock grazing was also gathered through questionnaires survey. The key interest was to identify areas where livestock are grazed within potential Grey goral habitat.

Secondly, field sampling was carried out in identified grazing sites in Grey goral habitat to quantify the grazing pressure. At each site, time spent by livestock in the forest area and average distance travelled by livestock inside the forest was recorded. Presence of Grey goral at each site was assessed by scanning (Nayak *et al*., 2013). Correlation was applied to determine the significance between number of Grey goral observed and the livestock population.

RESULTS

Demography of Inhabitants around Grey Goral Habitat: At Machiara, 32 families with a population of 177 individuals were residing around Grey goral habitat with an average family size of 5.46/household (Table 1). In Serli Sacha, 47 families with population of 273 individuals were present around Grey goral habitat at the time of survey with an average family size of 5.76/household.

It was found that all families in both study sites were not permanent resident around Grey goral habitat. Livestock owners maintain their permanent homes at lower altitudes where they live for whole year. During the summer, the animals were taken to higher altitude pastures in the mountains for grazing **(Figure 1)**, with the people necessary to attend them. During mid or late May, some members of a family move to higher altitude with their livestock, where a second temporary house (huts) were located **(Figure 2)**. They stay in huts with livestock up to September and then start their return journey to lower altitudes to permanent homes.

Economic Activities: Self-employment, government employment and daily wages labor were identified as main economic activities of residents around the study sites. At Machiara, 84% reported to be self-employed and 16% government employees (Table 2). Self-employment through rearing and selling of livestock and livestock products (milk, butter, hides, etc) was the major source of their income. At Serli Sacha, large proportion of inhabitants (87 %) was self-employed while about 13% worked as laborers (Table 2).

Livestock Rearing: At Machiara, 32 families owned 545 livestock heads with an average of 17 animals per family. Goats dominated the livestock population (52.66%) followed by cows (22.75%), sheep (17.61%), bulls (6.05) and buffaloes (0.91%) (Table 3). At Serli Sacha, 47 families owned 899 livestock heads around Grey goral habitat, including cows, bulls, buffaloes, sheep and goat with an average of 19 animals. Goats were dominant (50.38%) followed by cows (20.80%), sheep (24.47%), bulls (3.22%) and buffaloes (1.11%) (Table 3).

Livestock Grazing Practices: During the monitoring of grazing sites in and around Grey goral habitat, it was recorded that livestock herds enter 3-5 km deep in Grey goral habitat and spend 4-6 hours in grazing during summer season. Mostly livestock herds enter for grazing around 10.00 am and return back around 3.00 or 4.00 pm. In Machiara, five tracks and in Serli sacha four tracks were used for grazing in Grey goral habitat (Fig. 3). Grey goral was rarely observed where livestock population was

high both in Machiara and Serli Sacha (Table 3). There was a significant negative correlation between the number of Grey goral observed and number of livestock heads both at Machiara (r= -0.388, $p < 0.05$, n = 7) and Serli Sacha (r= -0.75, $p < 0.05$, n = 9).

Fodder Supply: During winter season, animals were kept under stall feeding and major feed resources were crop residues, particularly maize Stover and grass hay, which was usually harvested during August-September and stored for winter (Table 4).

Table 1. Demographic details of local residents around study sites in Machiara National Park.

Study sites	Residential sites	No. of families	Male	Female	Total	Average family size
Machiara	Mali	7	23	17	40	5.71
	Gali	4	11	9	20	5
	Chukolni	5	13	11	24	4.8
	Ban	5	18	14	32	6.4
	Domail	2	6	4	10	5
	Katha	4	13	10	23	5.75
	Taryan	5	16	12	28	5.6
	Total	**32**	**100**	**77**	**177**	**5.46**
Serli Sacha	Daper	3	7	9	16	5.33
	Chitta pani	3	6	14	20	6.66
	Chatha	7	23	22	45	6.42
	Sokhar kasi	4	7	14	21	5.25
	Ranja	6	18	15	33	5.5
	Buchian Gali	8	33	21	54	6.75
	Taryan	7	20	13	33	4.71
	Nalla	5	17	13	30	6
	Kai	4	12	9	21	5.25
	Total	**47**	**143**	**130**	**273**	**5.76**

Table 2. Occupations of local population residing around study sites in Machiara National Park.

Study sites	Localities	Labour	Self employment	Govt. employment	Total
Machiara	Mali	0	5	2	7
	Gali	0	4	0	4
	Chukolni	0	4	1	5
	Ban	0	5	0	5
	Domail	0	2	0	2
	Katha	0	2	2	4
	Taryan	0	5	0	5
	Total	**0**	**27 (84%)**	**5(16%)**	**32**
Serli sacha	Daper	0	3	0	3
	Chitta pani	0	3	0	3
	Chatha	3	4	0	7
	Sokhar kasi	0	4	0	4
	Ranja	2	4	0	6
	Buchian Gali	1	7	0	8
	Taryan	0	7	0	7
	Nalla	0	5	0	5
	Kai	0	4	0	4
	Total	**6 (12.76%)**	**41 (87.23%)**	**0**	**47**

Table 3. Livestock owned by local residents around Grey goral habitat in Machiara National Park.

Study sites	Localities	Livestock owning families	Cows	Bulls	Buffaloes	Sheep	Goat	Total	Grey goral sighting
Machiara	Mali	7	32	8	2	0	37	79	2
	Gali	4	11	4	2	18	31	66	1
	Chukolni	5	22	4	1	4	29	60	1
	Ban	5	13	6	0	59	100	178	0
	Domail	2	12	4	0	5	23	44	2
	Katha	4	18	4	0	0	34	56	0
	Taryan	5	16	3	0	10	33	62	0
	Total	**32**	**124 (22.75%)**	**33 (6.05%)**	**5 (0.91%)**	**96 (17.61%)**	**287 (52.66%)**	**545**	
Serli sacha	Daper	3	15	0	0	15	25	55	1
	Chitta pani/ Kashkar	3	9	0	0	12	30	51	2
	Chatha	7	42	2	0	18	97	159	0
	Sokhar kasi	4	14	0	0	33	49	96	0
	Ranja	6	23	9	5	21	71	106	0
	Buchian Gali	8	25	5	3	35	61	129	0
	Taryan	7	29	6	0	36	39	110	0
	Nalla	5	31	0	2	27	44	104	0
	Kai	4	22	7	0	23	37	89	0
	Total	**47**	**187 (20.80%)**	**29 (3.22%)**	**10 (1.11%)**	**220 (24.47%)**	**453 (50.38%)**	**899**	

Table 4. Seasonal calendar of fodder availability to livestock in Machiara National Park.

Feed resources/ months	J	F	M	A	M	J	J	A	S	O	N	D
Green Fodders:												
1. Grasses					■	■	■	■	■			
2. Maize							■	■	■			
3. Fodder trees				■	■	■	■					
4. Grazing in forest					■	■	■	■	■	■		
Dry Fodders:												
1. Hay	■	■	■								■	■
2. Maize Stover	■	■	■							■	■	■
3. Cake (only to milking animals)	■	■	■									■

Figure 1. Livestock grazing in and around Grey goral habitat in Machiara National Park.

Figure 2. Summer huts of local residents in Grey goral habitat in Machiara National Park.

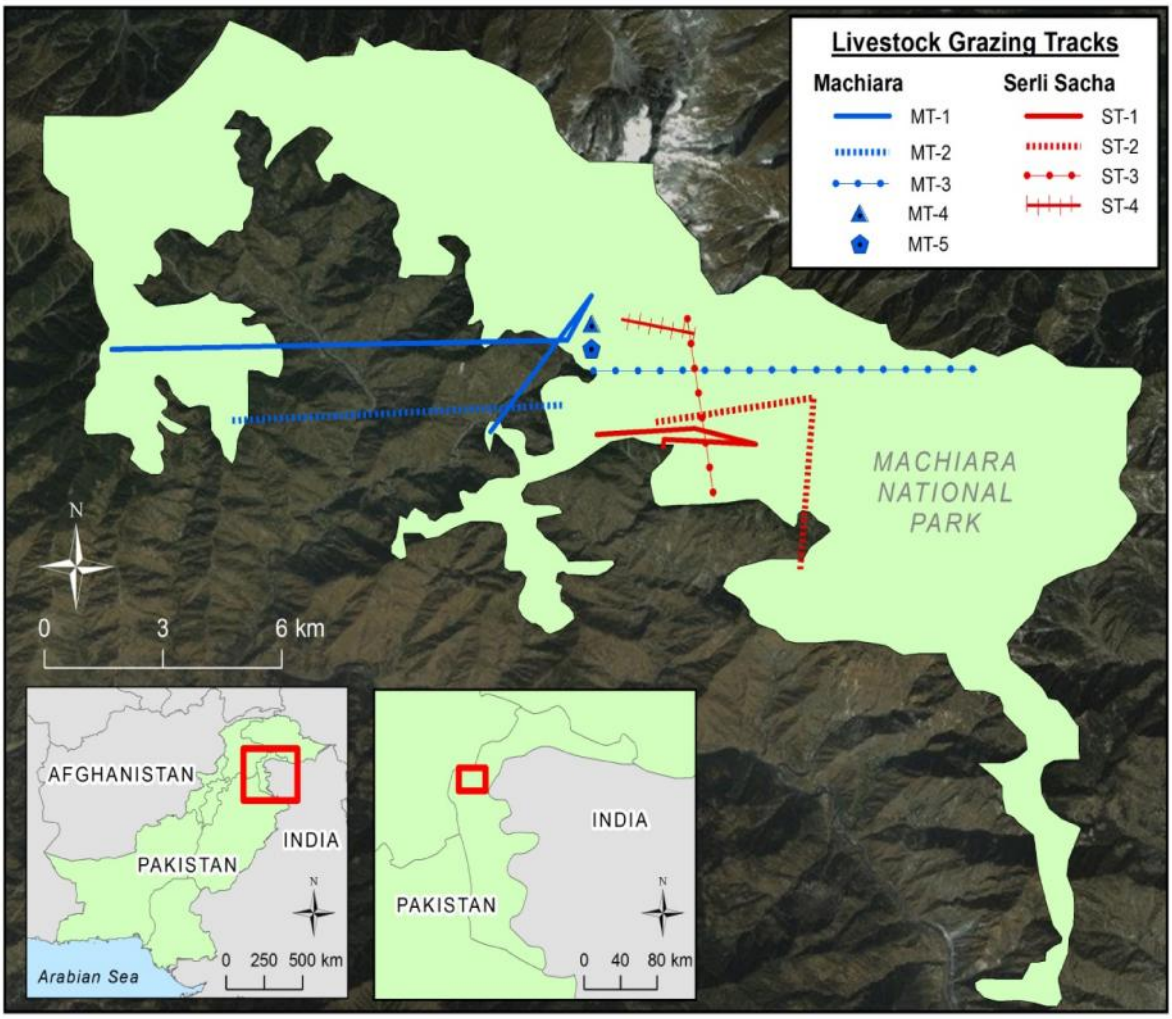

Figure 3. Livestock grazing tracks in and around Grey goral habitat in Machiara National Park.

DISCUSSION

Livestock grazing has prominent affects on resident wildlife of an area and, therefore, is a significant conservation issue globally (Syed and Khan, 2017). However, only a few attempts have been made to assess effect of livestock grazing on inhabitant wildlife.

This study analyzed grazing pressure around grey goral habitat which showed that potential habitat of Grey goral both at Machiara and Serli Sacha were overlapped by livestock. It is speculated that distribution range of Grey goral has shrunk where livestock grazing pressure is high. Grazing as well as physical presence of livestock has negative impact on grey goral distribution, as it is rare for wild ungulates and domestic livestock to graze in the same area at same time. Earlier studies by Sitters *et al*. (2009) and Zhongqiu *et al*. (2008) also suggested that patterns of livestock grazing have exaggerated abundance and distribution pattern of wild herbivores. Overgrazing of domestic livestock in the forest reduce resources of habitat accessible to wild ungulates, resulting in competition for space and food. Fankhauser (2004) reported that livestock species have a benefit over their wild competitors because their densities of herds are frequently far above than wild species, and they are also released to the best grazing ground. Consequently, the wild ungulates are likely to be competitively displaced from that area.

Livestock rearing was key source of livelihood for residents of study area which consisted of cattle, buffaloes, sheep and goats basically reared for income generation through milk, meat and wool. In both study sites majority of people were poor who reported that they sell livestock all year around to fulfill their urgent needs, Households also sell livestock products such as milk, butter, yogurt and ghee to generate income to enable them to purchase staple foods and other essential daily use items. Around 83% respondents had monthly income of Rs 6000 - 8000 per month while 17% had Rs 8000-10,000 per month. During study period the milk was being sold at Rs 70 to 80 per litter, butter Rs 800 to 10,000 per kg and ghee for Rs 1200 to 1500 per kg.

Earlier studies have reported that domestic livestock compete with wildlife over natural resources (Averbeck *et al*., 2009; Low *et al*., 2009; Young *et al*., 2005). Herbs and grasses (77.25%) were the most frequently consumed food items during the summer, whereas during the winter shrubs (52.83%) formed the largest component of Grey gorals diet (Ashraf *et al*., 2017). During present study Grey goral was rarely observed at those sites in Machiara or Serli Sacha where livestock population was high. These findings are supported by Nayak *et al*. (2013) who showed that Hill forest where livestock grazing pressure is heavy (24.04 %), wild ungulates presence is less (10.71 %) and woodland where livestock grazing pressure is less (9.95 %), the presence of wild ungulate is maximum (57.14 %). The sites with higher livestock population may have resulted in low forage availability, resulting in lower Grey goral population. Bhattacharya *et al*. (2012) reported 40 % diet overlap in Nandadevi Biosphere Reserve between livestock and wild ungulates. Livestock impose a potential threat to the food resource of wild herbivores and such resource exploitation by livestock is not compatible with their conservation (Syed and Khan, 2017).

Habitat and food resource overlap between domestic livestock and wild ungulates are mostly cited as the key instrument by which competition arises. Regardless of the importance of this matter for conservation futures of an area, there has been slight scientific development for considering the nature and type of competition between livestock and wild ungulates (Butt and Turner, 2012). The main factors that drive these conflicts are increasing demographic pressure, expansion of cultivation and reduction in rangeland resources. Livestock grazers are also one of the most important links in human-wildlife conflict as they often take their livestock into the forests for grazing (Nayak *et al*., 2013).

The growing season of vegetation in MNP is limited to summer season i.e. from May to September. During winter, the leaves would dry off and grazing areas turn into unreachable for ungulates species because of snow cover. Reimers *et al*. (2005) reported that for species of ungulates, nutrition during summer season is known to be important for population performance and winter survival. On the basis of questionnaire survey, personal observations and informal discussion with herdsmen, it was found that during summer season livestock were almost dependent on grazing. Besides free grazing, fresh grass and leaves from trees were also harvested by residents as livestock fodder. It was observed that in summer, when livestock were taken for grazing around Grey goral habitat, they moved to higher elevations. Local people reported that during summer season livestock depend on grazing and during winter season they have shortage of fodder from November to March, when grazing season are dormant and key fodder crop (maize) of summer is over. During winter season, livestock were shifted to lower area separating them from Grey goral altitudinally and thereby minimizing habitat overlap. Extreme grazing through livestock during summer season might limit the accessibility of graminoid plants for wild ungulates during summer season and thus direct to inter-specific competition (Shrestha, 2007; Reimers *et al*., 2005). Mysterud (2000) reported that when species of herbivore do struggle for food, the level of food resource overlap can be predictable to reduce during unfavorable season.

The population of buffaloes was very small at both locations i.e. Machiara (0.91%) and Serli Sacha

(1.11%) and no buffaloes were observed during grazing. This could be because only single crop (maize) is grown in study area on small area and thus not capable to hold large number of cattle especially during winter season when fodder is deficient. Kittur and Sathyakumar (2010) reported that in Kedarnath Wildlife Sanctuary India, double - cropped areas produce greater amounts of crop remains and are therefore able to support a large number of cattle. Single-cropped farms tend to retain only flocks of sheep and goats.

The tremendous growth in livestock population in MNP could be the result of poverty and lack of other sources of income. Livestock was contributing to income in two ways, firstly by cash through selling of livestock and secondly through selling of livestock products i.e. milk and milk products. Because of poverty and lack of alternate subsistence revenue, people maintain large number of livestock for agriculture, domestic and commercial purposes.

Besides grazing pressure, livestock grazers were indulged in illegal activities in study area such as cutting of the trees and grass, which was frequently recorded around Grey goral habitat during summer season. Such a practice could put negative impact on wild ungulate (Shresftha and Wegge, 2008). For construction of traditional mud houses, local residents use timber for poles in floor, walls and roofs. They also use wood for fuel. During study both men and women were observed doing wood collection. WWF (2008) also reported that local people in MNP use fire wood in great quantity; a household uses daily at least 20 kg of wood in normal season and about 70 kg in inter season. People of the area were still practicing the traditional way of cooking by using fuel wood. Similar scenarios have also been reported in MNP by Cochard and Dar (2014) that clear-felling of trees for timber extraction, often followed by grazing of opened areas with livestock and/or wood cutting, poses major threats to forests in and around MNP. Park management aims to conserve natural resources in MNP, however, our results indicate that habitat of Grey goral is overlapping with domestic livestock, hence, effective management strategy is required to minimize this overlap in order to maintain and expanding existing Grey goral population in MNP.

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