Herd characteristics and habitat use of a blue sheep population in the Qomolangma Nature Preserve

Full Text:

Blue sheep (*Pseudois nayaur*) habitat in the newly established Qomolangma Nature Preserve (QNP) of southern Tibet consists of rocky, mountainous hillslopes and valleys at elevations of 2000 m to over 6000 m. Tibet constitutes the core area of the blue sheep's range (Wang and Hoffmann 1987). However, except for incidental observations, field studies of this typically gregarious alpine ungulate have not been undertaken to date in Tibet (Feng et al. 1986). The authors observed 85 groups of blue sheep totaling about 846 individuals, between March and June, 1992, in the Qiangduriwu Valley, which is located in the south-eastern part of QNP. This study is part of a long-term field project aimed at investigating snow leopard ecology, behavior, and population as well as the management needs of other rare mammals in the QNP. The study also offers an opportunity to examine livestock-wildlife interactions, since blue sheep and domestic stock share rangelands on a year-round basis.

STUDY AREA

The Qiangduriwu Valley is located near Cha Village, Zha Town, Khada District in Tingri County (also known as Shegar County), at 28^{o} 20-25' N, 87^{o} 16-24' E. The main valley is about 13 km long, for a total study area of nearly 120 km^{2}, at elevations ranging between 3880 and 5478 m. Snowfall is estimated by locals to occur on approximately 20-40 days annually, mostly between December and January. Snowfalls are light to moderate, with an annual precipitation estimated at between 200 and 600 mm. Daily minimum and maximum temperatures can vary as much as 30^{o} C, even at the beginning of March. Afternoon temperatures during the period of March through early June ranged from 7-24^{o}C.

About a third of the study area consists largely of smooth, relatively steep mountain terrain. The remaining land area is moderately to very broken, with sparsely distributed cliffs occurring throughout the area. This diversity of terrain types offers suitable habitat for blue sheep feeding, escape cover, bedding and thermal cover requirements. There are two small lakes of approximately 0.025 km^{2} and 0.4 km^{2} respectively, with one being seasonal in nature, drying up during the winter. A permanent stream runs along the entire length of the Qiangduriwu Valley, providing year-round water for livestock and wildlife alike.

Located in the rainshadow of Qomolangma (Mt. Everest), the vegetation is semi-arid and consists primarily of sparsely spaced shrubs such as *Artemisia* spp., *Sabina (Juniperus) wallichiana, Ephredra* spp. and *Potentilla fructicosa*. In rocky areas, one finds such shrubs as *Cotoneaster, Rosa, Berberis*, and *Ribes*. *Caragana versicolor* and *Potentilla* spp. dominate sites above elevations of 4350 m. Except for small remnant stands of *Hippophae rhamnoides* along the lower section of Qiangduriwu stream, no trees are present in the general area. The stream supports a narrow (10-20 m) *Kobresia* sedge-meadow which provides very important forage for livestock and wildlife. Intense grazing pressures in the area has either eliminated or greatly reduced palatable native perennial and annual grasses such as *Stipa, Poa and Pennisetum*. These grass species are only seen on a few steep-sloped areas where livestock have difficulty penetrating, or under bushes and hidden beside boulders. In valley sites, one notes the dominance of less palatable grass species such as *Littledalea, Trisetum*, *Trikeraia* and *Roegneria*.

The primary land-use consists of livestock grazing, which is dominated by goats, sheep and cattle-yak crossbreeds. There are three villages, home to about 42 families, near the confluence of the Qiangduriwu stream and Dzaaku River, as well as several abandoned settlements in the valley itself. The human population density is about 2-3 persons/km^{2}, whereas the livestock population numbers are in excess of 3300 sheep and goats, about 250 cattle, 70 donkeys and a few horses.

METHODS

We used two methods to observe and count blue sheep populations: 1) Fixed-area counts, with the study area divided into 10 distinct census blocks based on topography and drainages. One to three days was spent counting and observing the blue sheep in each block from one or more fixed points, using binoculars and a 15-45 power, zoom spotting scope to search the surrounding terrain, and 2) Incidental sightings, accumulated while travelling from one part of the study area to another.

Whenever a herd of blue sheep was encountered we recorded the total number present, as well as its sex and age composition if possible (i.e., if we were close enough and the herd remained within visual contact). Blue sheep were sexed and aged according to age-classes modified from Schaller (1977) and Wilson (1981). The following age-groups were used: lamb (born in the current year), yearling (<2 years), adult female and adult male. Adult males were further classified as Class 1 (2-5 yrs), Class 2 (3-5 yrs), Class 3 (4-5 yrs), Class 4 (5.5-7.5 yrs), and Class 5 (>7.5 years). Criteria for aging included horn length and shape, intensity of the black markings on the legs and chest, as well as body size and overall behavior.

In addition, we gathered information on habitat utilization by noting the dominant elevation, slope, aspect, position on slope, and distance to the nearest cliff, very broken terrain, moderately broken terrain, smooth terrain, major trail, permanent water, village, road, livestock herd (where possible), livestock enclosure or shelter, vegetation type and cover class.

RESULTS

Eighty-five groups of blue sheep, totalling 846 individuals, were sighted during the 83-day field study, for an average group size of 8.7 animals (Table 1). The size of groups ranged between one (n=3) and 35 (n=2). The most commonly encountered herds consisted of 3-5 animals (n=20), 6-9 (n=21), and 9-12 (n=15) animals. As Table 1 indicates, few herds of more than 20 individuals were encountered, reflecting in large part the post-rut period during which data was gathered.

Of the 846 individuals observed, 293 (34%) were either too distant or escaped too quickly to be classified with respect to their sex and age-class. The remaining sample of 543 individuals consisted of 184 adult females and 183 adult males, giving an essentially equal male/female sex ratio (Table 2). A relatively large percentage of the males classified were comprised of older age groups (i.e., a Class IV cohort of 18% and a Class V cohort of 38.8%). Lambs comprised 18.9% of the animals observed, indicating a lamb recruitment of about 56 per 100 adult females immediately prior to the birthing season. Yearlings totalled 13.7%, a ratio of 40 per 100 adult females.

TABLE 1. Group size of blue sheep in the Qiangduriwu Valley, Qomolangma Nature Preserve of southern Tibet.

Group Size	Number of observations	Percent of observations
1-2	8	9.4
3-5	20	23.5
6-8	21	24.7
9-12	15	17.6
13-16	7	8.2
17-20	4	4.7
26-32	3	3.5
33-35	2	2.3

TABLE 2. Sex and age composition of 543 blue sheep classified in the Qiangduriwu Valley.

		Adult	Adult males				
Lambs	Yearlings	females	Class1	Class 2	Class 3	Class 4	Class 5

Number classified	103	73	184	21	21	37	33	71	
Percent of total		18.9	13.4	33.9	3.9	3.9	6.8	6.1	13.0
Total percent of males						33.7			

Based upon results of the fixed area counts and incidental observations, the authors estimated that the blue sheep population of the area totalled between 800 and 1000 individuals, giving a mean density for the Qiangduriwu Valley of 6.7-8.5 blue sheep/km^2.

Preliminary results of the blue sheep habitat studies are summarized in the following paragraphs. As indicated in Table 3, most sightings occurred at elevations of 4100-4600 m (n=44), with a mean elevation of 4470 m. Blue sheep would undoubtedly utilize lower elevations during the winter and higher slopes during the summer months.

Fifty-two percent of sightings (n=73) consisted of herds utilizing slopes with easterly (45^o-135^o) and southerly (135^o-225^o) aspects, while only 10% of the groups were observed on north-facing slopes. Blue sheep selected slopes of 20-40^o angles most often for feeding, resting and bedding (n=57, 83%). Only a few groups (n=6) were

TABLE 3. Elevational range used by blue sheep during study period.

Elevational range (m)	Number of groups observed	Percent of groups observed
3800 - 4100	3	4.3
4100 - 4600	44	63.8
4600 - 4800	18	26.1
4800 - 5000	4	5.8

seen on cliffs or terrain having a slope steepness in excess of 50^o. Most blue sheep (52%) were seen on the middle third of hill slopes (n=41), whereas 26.7% were seen on ridge-tops or in the upper third of the hill-slope.

Blue sheep utilized smooth, moderate or heavily broken terrain, usually occurring within several hundred meters of a landform edge (Table 4). On average sheep were located within 325 m of permanent water, and never more than 1.1 km away, reflecting the high availability of this resource rather than a preference on the part of blue sheep for close proximity to it. Our observations indicate that blue sheep usually drink every two or three days, often foraging on rangelands far from a water source. By contrast, the degree of human disturbance was a far more significant element in their use of habitat; blue sheep usually occurred far from a road or village, compared with a trail or livestock enclosure (Table 5).

TABLE 4. Spatial use of terrain types by blue sheep.

	Maximum distance	Average distance

Terrain type	of observation (m)	observed (m)
Cliff	1100	172
Very broken	1400	234
Moderately broken	115	8
Smooth	850	165

TABLE 5. Distance (km) of blue sheep herds from various human-use areas.

Feature	Maximum distance	Minimum distance	Average distance	Number of observations
Village	9.0	0.13	4.09	76
Road	8.9	0.06	4.28	74
Trail	2.0	0.015	0.525	28
Livestock Corral	1.8	0.03	0.57	55

DISCUSSION

Blue sheep density in our study area is high compared to that of the Dhorpatan Hunting Reserve (2.7/km^2) and Lapche Valley (1.4/km^2), but similar to populations from the Shey (8.8-10.0/km^2), Manang (10/km^2), and the Langu Valley (4-8/km^2, with pockets as high as 20/km^2), all in areas of Nepal (Jackson and Ahlborn 1989, Wilson 1981, Wegge and Oli 1988, Schaller 1977). Chundawat et al. (1991) reported densities of 3.0-3.5/km^2 in the ecologically similar, although less productive Hemis National Park of Ladakh, India. Recruitment in this blue sheep population appears to be satisfactory. Somewhat lower rates (lamb : adult female ratio's of 26:100 and 40:100 for a comparable time of the year) have been observed by Chundawat et al. (1991) and Schaller (1977), respectively, in two similar semi-arid areas of the trans-Himalaya that are also subject to livestock grazing. By contrast, Schaller reported a significantly higher lamb : female ratio (88:100) for the Lapche Valley, reflecting its more productive grassland habitat and less severe hunted pressure. Lamb and yearling ratios of 73 and 55 per 100 adult females, respectively were recorded in the Manang area of Nepal (Wegge and Oli 1988).

The Qiangduriwu herds exhibit an essentially equal sex ratio, unlike blue sheep in the more heavily hunted sections of Nepal's Dhorpatan Hunting Reserve, which exhibited ratios as low as 44 males per 100 adult females (Wilson 1984). The relatively high proportion of adult males in our study population suggests less impact due to hunting by humans or snow leopard, assuming snow leopards preferentially prey upon male sheep as reported by Schaller (1977). According to villagers, blue sheep in the area are subject to light levels of hunting by humans, primarily outsiders from nearby administrative centers. On the other hand, our male ratios are not as high as those reported for the Shey-Phoksundo National Park (134:100), although our sample could be biased due to the time of year and possible male segregation from the female herds or use of more remote areas (Schaller 1977). Furthermore, age composition and herd structure are dependant upon a complex of environmental factors, including winter storm severity, forage quality during winter and post-natal (lactation) periods, availability of alternative prey for predators, and extent of hunting by local people. More data are needed to establish these parameters in the study area.

The presence of suitable escape, resting, feeding and thermal cover are important to sustaining a blue sheep population. They seem to show a preference for moderately broken terrain in close proximity to escape cover, primarily cliffs and other rocky or well-broken areas (Chundawat et al. 1991, Wegge 1979, Wilson 1981). The Qiangduriwu blue sheep tended to use the middle and upper positions on mountain slopes, a similar pattern to that shown by blue sheep in Ladakh (Chundawat et al. 1991). Wegge (1979) argued that group size decreases as landscape becomes more grainy, or broken by cliffs and other steep sloped areas with less abundant forage. In this context, the study area seems to provide a favorable mix of terrain conditions, thus enabling relatively dense blue sheep herds and an attendant snow leopard population to exist in close proximity to human settlements, all within the rain-shadow of the world's highest mountain.

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