

Perceived Conflicts Between Pastoralism and Conservation of the Kiang *Equus kiang* in the Ladakh Trans-Himalaya, India

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Abstract An emerging conflict with Trans-Himalayan pastoral communities in Ladakh's Changthang Plateau threatens the conservation prospects of the kiang (*Equus kiang*) in India. It is locally believed that Changthang's rangelands are overstocked with kiang, resulting in forage competition with livestock. Here, we provide a review and preliminary data on the causes of this conflict. Erosion of people's tolerance of the kiang can be attributed to factors such as the loss of traditional pastures during an Indo-Chinese war fought in 1962, immigration of refugees from Tibet, doubling of the livestock population in about 20 years, and increasing commercialization of cashmere (*pashmina*) production. The perception of kiang overstocking appears misplaced, because our range-wide density estimate of 0.24 kiang km⁻² (\pm 0.44, 95% CL) is comparable to kiang densities reported from Tibet. A catastrophic decline during the war and subsequent recovery of the kiang population apparently led to the

overstocking perception in Ladakh. In the Hanle Valley, an important area for the kiang, its density was higher (0.56 km⁻²) although even here, we estimated the total forage consumed by kiang to be only 3–4% compared to 96–97% consumed by the large livestock population (78 km⁻²). Our analysis nevertheless suggests that at a localized scale, some herders do face serious forage competition from kiang in key areas such as moist sedge meadows, and thus management strategies also need to be devised at this scale. In-depth socioeconomic surveys are needed to understand the full extent of the conflicts, and herder-centered participatory resolution needs to be facilitated to ensure that a sustainable solution for livelihoods and kiang conservation is achieved.

Keywords *Equus kiang* · Conflicts · Pastoralism · Nomads · Livestock · Ladakh

Introduction

One of the seven equid species in the world, the kiang *Equus kiang*, occurs in parts of China and India, with small populations also reported from Pakistan and Nepal. Unlike the Asian wild ass *E. hemionus*, of which the population has declined drastically over the last century, kiang continues to have a wide distribution with fairly large populations (Schaller 1998). Within India, Ladakh (approximately 75° 50' to 75° 80' E; 32° 30' N to 32° 37' N) remains a stronghold for the kiang (Fox and others 1991; Shah 1996), where local Buddhist communities have been fairly tolerant of the species, and large herds of kiang can be relatively easily seen in eastern Ladakh. Kiang is classed

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as a Least Concern species under the IUCN Red List category; however the Western Kiang, *E. k. kiang*, which occurs in Ladakh, is classed as “data deficient” (Shah 2002).

Yet, with growing integration of the local economy of Ladakh with better developed cash markets, pastoral communities are fast losing their tolerance towards the kiang and it is increasingly seen as a competitor of livestock (Fox and others 1991). Ironically, its relatively large population and conspicuousness are becoming concerns for the continued conservation of the species. Although the species is not persecuted (except for driving them away from pastures by herders on horseback) in Ladakh largely due to the Buddhist beliefs of the local pastoral communities, this perceived conflict is currently one of the most serious issues being faced by the local district administration and the wildlife department, with vehement demands for compensation. Indeed, a decreasing tolerance for the species may lead in future to a worsening willingness to preserve it. There is a belief among the administration that Ladakh's rangelands are presently overstocked by kiang, and that they are degrading the pastures (Anon 2003). Over the last decade, as a measure to protect forage from kiang and make it available to livestock, the local government and some nongovernmental organizations have started fencing the most productive pastures, the sedge meadows near rivers and streams, thereby increasing forage availability for livestock and reducing the available habitat for the kiang (Richard 1999; Bhatnagar and Wangchuk 2001).

The purpose of this article is to document this intensifying conflict between pastoralism and conservation of the kiang in Ladakh. The kiang subspecies in question is categorized as “data-deficient” by the IUCN (Moehlman 2002). We examine the primary ecological, socioeconomic, and political aspects of kiang–human conflict, and summarize the results of our rangewide surveys of the kiang population in Ladakh. We also discuss the growing linkages between a traditional way of life and the global cashmere market, and their consequences for conservation of the kiang.

Methods

Study Area

Administratively, the Ladakh region in the state of Jammu and Kashmir (India) is divided into two districts: the western Kargil district and the eastern Leh district. Leh district is a high-altitude cold desert spread over approximately 45,000 km². This rain-sha-

dow region is semiarid to arid, with winter temperatures dropping to below −25°C. Western and central Leh are mostly rugged, relatively lower in elevation, and inhabited by agropastoralists. The eastern part of the district, called Changthang, on the other hand, comprises high plateaus and rolling hills (usually >4000 m) interspersed with lake and river basins that have moist patches of relatively dense graminoid vegetation. Most of the remaining arid region is dominated by medium to sparse steppe vegetation. Changthang covers approximately 20,000 km² and is inhabited by the nomadic *Changpa* community and Tibetan refugees, both of whom primarily rear goat and sheep. According to the human census in 2001 conducted by the government, the population of the Leh district was 117,637, with the majority (85%) being in the western region. The population is sparse in the Changthang (13,444) with a density of approximately 0.7 km^{−2}. Ladakh is home to a diverse assemblage of wild carnivores, ungulates, and birds (Pfister 2004).

Within Ladakh, the kiang occurs in the eastern Changthang part of the Leh district. Our survey covered most of this region, from the Pangong Tso in the North, along the eastern border with Tibet, to Hanle in the south (Figure 1). We divided the entire region into five blocks based on their location and overall similarity in terms of topography and vegetation, and surveyed each block (Table 1). Our repeated counts of kiang were conducted in the Hanle Valley. This valley (79° 0′ 45″ E, 32° 37′ 29″ N; approximately 2800 km²) extends from the Zaskar mountains in the south to the Indus Valley in the north into which the Hanle River drains at Loma. The higher reaches are primarily rolling mountains and plateaus, while the mid and lower portion is a wide valley fringed by a high range exceeding 5000 m on the east, and a lower, more gradual ridge on the west.

Data Collection and Analysis

Through archival research and field observations, we documented the intensifying human–kiang conflict in Ladakh. We describe the perceptions of the Ladakhi administration regarding this conflict, and the efforts they have undertaken to address it. Through archival research, we also examine recent land-use changes in eastern Ladakh, describe the growing *pashmina* or cashmere industry, and its fallouts for the kiang–human conflict. Literature was also surveyed for obtaining information on the past status and distribution of the kiang. We also obtained data on livestock populations from the Sheep Husbandry Departments in

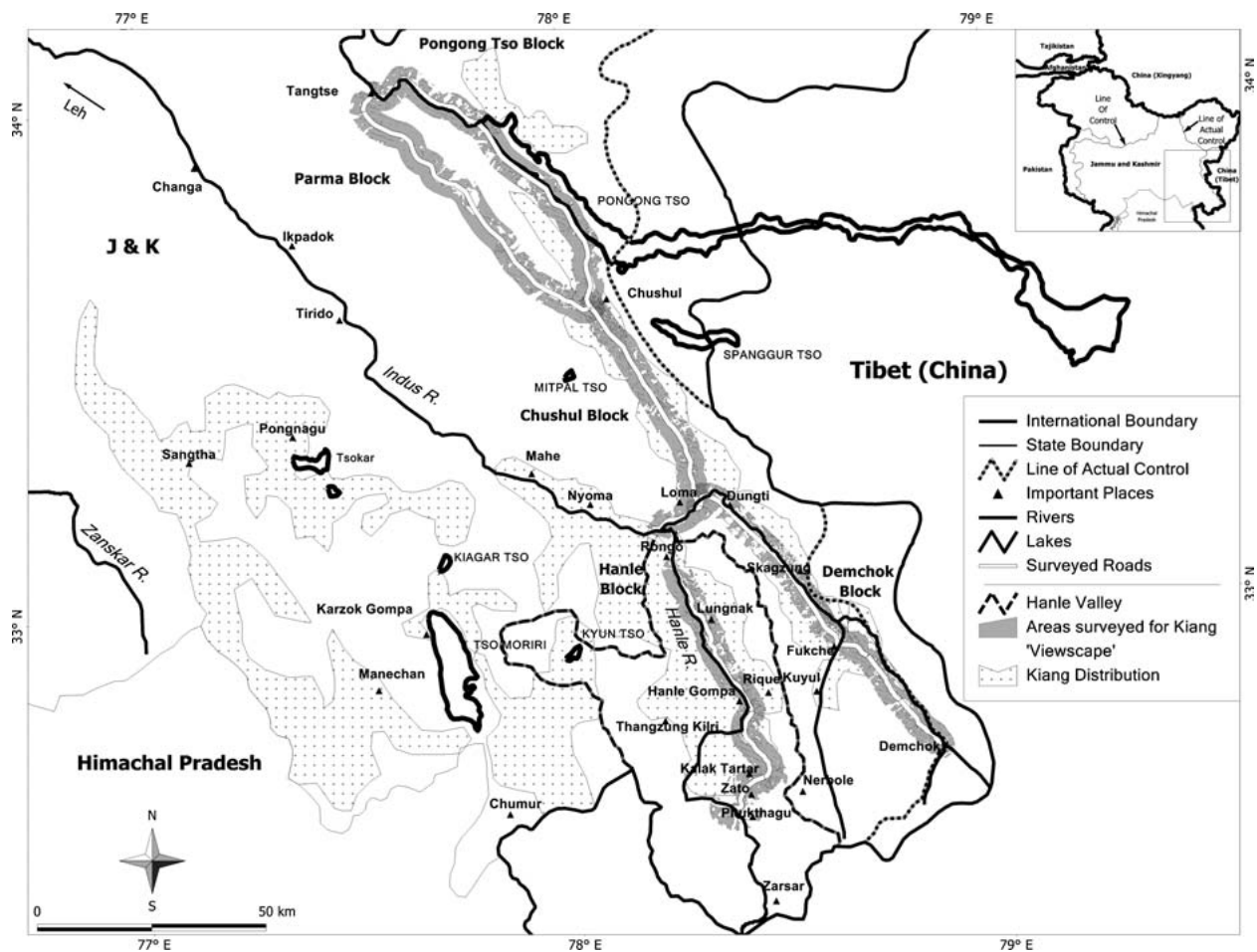


Fig. 1 The five blocks surveyed for kiang in eastern Ladakh during 2000 to 2003. The estimated “viewscope” is based on modeling for areas visible within 3 km on either side of the road (see text for details). Distribution of kiang in Ladakh is also shown (based on Chundawat and Qureshi 1999). We also surveyed some additional adjacent areas with similar habitat

Table 1 Density of kiang in the surveyed blocks of eastern Ladakh, India

Survey block	Transect length (km)	Area No. (km ²)	Kiang No.	Kiang density (km ⁻²)
Loma-Demchok (Indus)	82	288	249	0.86
Hanle Valley	66	347	78	0.23
Chushul-Loma	63	299	19	0.06
Parma Valley	74	360	9	0.03
Pongong Tso	80	359	10	0.03
Total	365	1653	365	0.24 (95% CL \pm 0.44)

Nyoma and Leh, to estimate the livestock density in eastern Ladakh. We had informal conversations with over 50 herders to learn about their perceptions regarding conflicts.

Our data on the kiang population in Ladakh come from rangewide surveys conducted in the year 2000.

The study area was surveyed from a slow-moving vehicle (traveling at 10–12 km/hour) and areas on either side were periodically scanned using an 8× binocular and/or 20× spotting scope. On every sighting, animals were counted and classified, and habitat variables such as topographic feature, elevation, slope, aspect, dominant plant species, and approximate plant cover were recorded. Classification of kiang by sex was not possible in most instances due to the similarity between the sexes, especially when seen from a distance. A total distance of 365 km was covered in the Changthang, traveling on an average 60–70 km per day. We also covered approximately 50 km on foot in the upper catchment of the Hanle Valley. Subsequently, in the spring of 2001, 2003, and 2004, we conducted repeated vehicle counts of kiang along an approximately 100-km stretch in the Hanle Valley, which had emerged as an area with moderate to high kiang density during the 2000 survey.

Density for kiang and livestock was calculated by estimating the area covered in each segment using Geographical Information System (GIS) tools. The area surveyed along the roads was estimated by creating a “viewscape” in ArcInfo, which effectively created polygons of all area visible from the road. The base map used for this estimation was the National Imagery and Mapping Agency’s Vector Map Level 0 (Digital Chart of the World) Edition: 5. This was integrated with the Digital Elevation Model (resolution 90 m or 3 arc seconds) Shuttle Radar Topography Mission (SRTM) data from the Space Shuttle mission (for the year 2000) obtained from <ftp://e0mss21u.ecs.nasa.gov/srtm/> to generate maps of the study area with numerous layers of information that included elevation, aspect, and drainage. After creating the viewscape, we used a cutoff distance of 3 km on either side of the road, within which all visible areas were calculated. This was generally our maximum sighting distance for the kiang (most Rangefinders do not work at this distance). We estimated the extent of the surveyed areas (through viewscales) for both the rangewide surveys as well as the region of our repeated kiang counts in Hanle Valley.

As a preliminary exercise to understand the extent of forage consumption by kiang vis-à-vis livestock, we estimated total daily forage consumption by kiang and livestock through established relationships between body mass and daily food intake (as percent of body mass) among herbivores (Foote 1982). In the absence of population structure data for both kiang and livestock, we used adult body masses (averaged between sexes) from Mishra and others (2002). We used the established relationships for foregut fermenters (goat, sheep, cattle, yak, cattle-yak hybrids) and hindgut fermenters (kiang, horses, donkeys), as appropriate. Forage quality in the highly seasonal cold desert steppe of Ladakh is expected to vary strongly between seasons, with high-protein, low-fiber forage being available in summer, and low-protein, high-fiber forage in winter. We therefore estimated forage consumption by each species separately for winter and summer, using the relationships for low-protein, high-fiber grass hay diet for winter ($4.5\text{--}7.4\%$ crude protein and $65\text{--}70\%$ cell wall) and high-protein, low-fiber legume hay diet for summer ($17.4\text{--}22.2\%$ crude protein and $31\text{--}56\%$ cell wall) (Foote 1982). For hindgut fermenters, daily forage intake as a percent of body mass (W) in summer was estimated as $13.8W^{-0.315}$, and $6.95W^{-0.236}$ in winter. Similarly, for the ruminants (goat, sheep, cow, dzo/dzomo, yak), it was estimated as $7.31W^{-0.231}$ in summer and $4.04W^{-0.184}$ in winter (Foote 1982).

Results and Discussion

Genesis of the Conflict: Kiang Population Changes in Recent History

Kiang inhabits the open plains and rolling mountains of the Changthang plateau in eastern Ladakh at altitudes between 4000 m and 5500 m. It has a total estimated range of approximately 7400 km² in Ladakh (Chundawat and Qureshi 1999; Figure 1). The species was common in Ladakh during the earlier part of the 20th century (Stockley 1936), but is believed to have declined substantially with the buildup of armed forces in Ladakh during the war between India and China in 1962 (Fox and others 1991). There are no population estimates available for the period before or immediately following this war, but it is believed that the population had recovered by the 1980s. The only published estimate of their population comes from the late 1980s when approximately 1500 animals were estimated to occur in Ladakh (Fox and others 1991; Shah 2002).

It thus appears that for at least a decade after the war, the kiang population remained relatively small in Ladakh. The genesis of the present conflict can be traced back to the early 1980s, by which time their population had apparently recovered (Fox and others 1994). The prevalent belief in Ladakh during that time, and one that continues until today, is that the kiang population has drastically increased in eastern Ladakh because many animals have moved from Tibet to the Indian side of the border to escape persecution (Fox and others 1991; Anon. 2003). Even in the 1980s, there were complaints by herders regarding the extent of forage consumption by kiang and consequent competition with livestock, and demands that the government should “drive the kiang back into Tibet” (Fox and others 1991).

Intensification of the Conflict: Changing Face of Pastoralism in Ladakh

The Tibetan plateau was inhabited by nomadic hunting people 30,000 years ago, and nomadic pastoralists have been herding livestock on the plateau for at least two millennia (Schaller 1998). The nomads, who became Buddhists presumably in the last millennium, live in tents (*ribos*) in seasonal camps. In the past, the few nomadic groups inhabiting eastern Ladakh belonging to the *Changpa* community traveled distances exceeding 100 km during their seasonal migrations (Phuntsok 2000; Hagalia 2004). This has recently changed, and

most seasonal movements are now restricted to within 40–50 km (Hagalia 2004).

After the 1960s, there has been a steady increase in the population of the *Changpa* and their livestock, presumably facilitated by access to better health care, provisions, and subsidies, both from the government as well as the army (Chaudhuri 2000; Phuntsok 2001; Bhatnagar and Wangchuk 2001). Supplemental forage provided by the government in the event of severe winters now offsets most of the starvation-related livestock mortality, which in the past was perhaps an important factor limiting the livestock population. The 1962 war between India and China also led to the curtailment of movement of the *Changpa* herders from eastern Ladakh into parts of Tibet, considerably reducing the availability of grazing land. Many of their pastures such as Skagzung, the primary winter pasture of the Rupshu Changpas (Figure 1), became unavailable, effectively escalating the stocking density in eastern Ladakh. Furthermore, a large number of Tibetan refugees have moved into eastern Ladakh with their livestock herds since the late 1950s, thus contributing to a substantial increase in the number of herding families and the livestock population (Bhatnagar and Wangchuk, 2001; Hagalia 2004). As per the government records, the livestock population in Ladakh (including Changthang) has doubled in about two decades, from approximately 212,500 in 1977 to 487,000 in 1999 (Richard 1999; Bhatnagar and Wangchuk 2001). In 1999, Changthang constituted 44% of Ladakh's livestock population, most of which (94%) were sheep and goats.

One of the most important livestock products from the region is the *pashmina* or cashmere, a fine luxury fiber derived from the underwool of the local *Changra* goat. Traditionally, more than 95% of cashmere from Ladakh has been used for barter with or sale to traders from the neighboring Kashmir region under a treaty with the erstwhile kingdom of Kashmir dating from 1684 (Rizvi 1999). Over the last two decades, however, cashmere production in Ladakh has been promoted by the government in a substantial way. This has included setting up of goat breeding farms, efforts at improving yield, and provisioning of veterinary services to nomads that has brought down the kid mortality rates to 2–3% from an estimated 30–40% (Jina 1995). However, the efforts at increasing the per animal cashmere yield have apparently had very limited success (Jina 1995), suggesting that increasing cashmere production necessitates an increase in the goat population. More recently, with part support from the central government of India, the International Fund for Agricultural Development and the UNDP, the Ladakh adminis-

tration has set up a cashmere de-hairing plant, expected to result in considerable added value to the cashmere from Ladakh (Joshi and Morup 2003; Mital 2004). Presently, Ladakh contributes merely 30,000 kg (0.37%) to the global cashmere production and the administration is eager to increase Ladakh's contribution in global trade.

The recent intensification of human–kiang conflict needs to be viewed against these socioeconomic and political developments. The human and livestock populations in kiang habitat have significantly increased in the last four decades due to factors ranging from better healthcare to the influx of refugees. Furthermore, promotion of production and value of cashmere has meant that livestock rearing is fast becoming a cash-based enterprise that increasingly caters directly to the lucrative global cashmere market. Herders are realizing the importance of every bit of pastureland in maximizing cashmere production and see kiang as a direct threat to pasture production. Against this background, it is perhaps not surprising that people are fast losing their tolerance of the kiang.

The Ecological Context: Current Kiang Population and Relationships with Livestock

In our rangewide survey of the kiang, we surveyed an estimated area of 1653 km², which is 22% of the total range of the kiang in Ladakh (7400 km²; Chundawat and Qureshi 1999). We recorded a total of 181 distinct kiang groups totaling 365 animals. The average density in the surveyed blocks was 0.24 (95% CL \pm 0.44) kiang km⁻², with the highest abundance along the upper Indus from Loma to Demchok followed by the Hanle Valley (Table 1, Figure 1). With an overall livestock population of 210,000 (as per unpublished records from the Nyoma office of the Sheep Husbandry Department (2004)) in the Nyoma and Durbuk blocks that comprise the Changthang region of Ladakh, the livestock density in the region was 11 km⁻². Thus, in terms of density, kiang represents only 2% of the total herbivore population (kiang and livestock together) in the Changthang, with the bulk being contributed by goats (57%).

The group sizes of kiang observed during the rangewide survey varied from 1 to 74. The mean group size was 2.8 (95% CL \pm 0.8), with most of the sightings (55%) being of solitary animals. Most kiang were seen in open wide valleys (79%, $n = 202$), followed by stony slopes (19%) and very rarely in broken areas (2%). There were no sightings on slopes steeper than 30°. We observed kiang between elevations of 4100 and 5500 m, with most sightings between 4200 and 4300 m. Most kiang groups (73%) were seen on sedge (*Carex* spp.

Table 2 Herbivore density and estimated forage consumption by kiang vis-à-vis livestock in Changthang

Species	Body weight (kg)	Density (animals km ⁻²)	Total forage consumption in summer (kg km ⁻²)	Percent forage consumption in summer	Total forage consumption in winter (kg km ⁻²)	Percent forage consumption in winter
Kiang	275	0.24	1.6	10	1.2	11
Livestock						
Donkey	90	0.04	0.1	1	0.1	1
Horse	248	0.15	0.9	5	0.7	6
Cattle	191	0.16	0.7	4	0.5	4
Yak	298	0.26	1.5	9	1.1	10
Yak cattle hybrids	227	0.01	0.03	<1	0.02	<1
Sheep	34	3.98	4.4	27	2.9	26
Goat	33	6.44	6.9	43	4.5	41
Livestock total	1121	11.03	14.5	90	9.7	89
Total		11.27	16.08		10.96	

Body weights are taken from Mishra (2001) and have been averaged between sexes. Note that this will result in an overestimate of the offtake by kiang because we assumed that all kiang were adult. Livestock density was calculated only for adult animals

and *Kobresia* spp.) and grass (*Stipa* spp.) meadows in the valley bottom, which were occasionally interspersed with bushes of *Caragana* sp. These meadows appear to be critical habitat for kiang during summer and winter as also reported by Schaller (1998), but are limited in extent to narrow discontinuous strips in moist areas along valleys. The remaining sightings were in areas that had sparse to dense *Artemisia* steppe (25%; with *Tanacetum* sp. and *Sedum* sp. being the other dominant plants) and high altitude forb meadows (2%; *Saussurea* spp., *Salsola* sp., and *Polygonum* sp. as the dominant plants).

At a landscape level covering entire eastern Ladakh, of the total daily forage consumption by large herbivores, we estimated that kiang consume 10–11% and livestock 89–90% (Table 2). Among livestock, goats were estimated to consume the maximum forage (41% to 43% of the total forage consumed), followed by sheep (26% to 27%).

Our subsequent estimate of the kiang population in the Hanle Valley (the region between Rongo and Kalangtartar) based on repeated counts between 2001 and 2004 yielded a density of 0.56 kiang/km² (95% CL \pm 0.08). We estimated that on an average, kiang remove only 3% to 4% of the total forage consumed in the Hanle Valley, with the greater part being consumed by goats (45% to 47%) followed by yaks (20% to 21%) and sheep (20%) (Table 3).

Synthesis of the Conflict: Is It Real or Perceived?

Most wars in the last five decades have resulted in detrimental effects on wildlife (Blom 2000; Dudley and others 2002; Mishra and Fitzherbert 2004), and the war between India and China in 1962 was no exception, particularly from the viewpoint of kiang conservation.

Our review suggests that the kiang population in Ladakh declined drastically in the years during and after the war between India and China in the 1960s, possibly due to hunting, land mines, and disturbances associated with the war. Thus, for two decades during and after the war, a generation of herders presumably saw and became used to a very low density of kiang in Ladakh's rangelands. Not surprisingly, the genesis of kiang-human conflict in Ladakh can be traced back to the 1980s, the period by which the kiang population had recovered. It seems that the recovery of the kiang from a very low density to the current estimated density of 0.24/km² has led to the perception to a generation of nomads that Ladakh's rangelands are now overstocked with kiang. Available estimates from three regions in Tibet place the density of kiang between 0.15 and 0.39 kiang km⁻² (Schaller 1998), suggesting that the kiang density in Ladakh is comparable with those in Tibet. Furthermore, our results show that the share of forage consumed by the kiang vis-à-vis livestock is relatively small (10–11% in the whole of eastern Ladakh, and 3–4% in Hanle Valley). Thus, at a landscape level, the perception of the overabundance of kiang in Ladakh, and of kiang compromising cashmere production, is clearly unfounded.

Nevertheless, there is variation in kiang density locally (0.03 to 0.86 kiang km⁻² recorded in our surveys). Kiang occasionally congregate in large herds and can together remove considerable forage from the low-productivity Trans-Himalayan pastures. Using the data in Table 2, a group of 70 kiang (the largest group seen during the survey was 74) can be estimated to potentially consume 199–254 kg dry forage in a single day. The peak standing biomass in sedge meadows, which seem to be important kiang habitats, has been estimated in the adjoining region of Spiti at

Table 3 Herbivore density and estimated forage consumption by kiang vis-à-vis livestock in the Hanle Valley

Species	Body weight (kg)	Density (animals km ⁻²)	Total forage consumption in summer (kg km ⁻²)	Percent forage consumption in summer	Total forage consumption in winter (kg km ⁻²)	Percent forage consumption in winter
Kiang	275	0.56	3.6	3	2.8	4
Livestock						
Donkey	90	0	0	0	0	0
Horse	248	1.57	9.5	8	7.4	9
Cattle	191	0.66	2.7	2	1.9	2
Yak	298	3.91	22.8	20	16.5	21
Yak cattle hybrids	227	0	0	0	0	0
Sheep	34	21.52	23.7	20	15.5	19
Goat	33	50.69	54.5	47	35.5	45
Livestock total	1121	78.34	113.2	97	76.7	96
Total		78.90	32.4		79.6	

857 kg ha⁻¹ (Mishra 2001). These habitats seem critical for both kiang and livestock, but cover a small fraction of the landscape, with an estimated 150 km² in the entire approximately 20,000 km² of Changthang. Illustratively, this means that in a single day a large group of 70 kiang can potentially consume more than a quarter of the standing biomass from 1 ha of a key resource area. This consumption is also very similar to the estimated daily forage consumption by a herd of 200 goats (approximately 215 kg). Because of the long winters (November to April) and short summers (July–August), the potential for regrowth during summer is low, aggravating the impact. Considering the potential of large kiang herds to remove significant amounts of forage, together with the fact that grazing areas have been reduced and the livestock population in Ladakh more than doubled in the last 30 years, it is not difficult to see that at a localized scale of the valued sedge meadows, some herders must be facing serious forage competition from the kiang. Given the intensifying commercialization of cashmere production in Ladakh and its integration with global markets, this localized forage competition is, perhaps understandably, no longer tolerated, and the conflict needs to be addressed immediately. However, it must be borne in mind that the problem seems to be evident at local scales, and will need to be addressed at that scale.

In the absence of any scientific understanding of the conflict so far, or efforts to document it, this local conflict has already begun to take on a serious political dimension. The politicians and the district administration in Ladakh are blaming the kiang for compromising cashmere production, and the wildlife department is being looked upon to provide a solution. The only on-ground reaction of the district administration has been to fence large productive sedge and grass meadows

from the kiang. In the Hanle Valley alone, an estimated 120 ha of meadows have been fenced already. Three fourths of our total kiang sightings during the rangewide surveys were in such meadows, suggesting that this is an important habitat for the species, and continued fencing of this habitat may cause a decline in the kiang population of Ladakh.

How can this conflict be managed? Although our review of the recent history of political and socioeconomic developments in kiang habitat and our estimates of density and forage consumption of kiang and livestock bring to light interesting dimensions of the kiang–human conflict, the current level of understanding of the kiang’s ecology and its relationships with livestock is still very preliminary. Intensive research needs to be promoted to assist in better management of the species, and its conflicts with humans. Monitoring programs need to assess kiang and livestock density, as well as the land use changes in kiang habitat. Our article shows that the problem of kiang–human conflict is locally concentrated in the key resource areas that contain the sedge meadows, and management strategies need to be devised at that local scale. Surveys are needed to identify all high-conflict areas, and adequate compensatory mechanisms need to be worked out for herders who face genuine forage competition from the kiang. It needs to be examined whether the fact that herders share the forage with kiang could actually be used for adding value to the cashmere produced in Ladakh. The kiang is a striking and conspicuous wild animal that may provide a potential for ecotourism. Finally, after taking up the above interventions, it is important that fences on the sedge meadows to exclude kiang be removed and the practice of fencing discontinued because they lock out key resource areas from the kiangs’ range. Without access to key resource areas, kiang and other wild herbivores, such as the Tibetan gazelle, *Procapra*

picticaudata, may face severe population declines in Ladakh.

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References

- Anon. 2003. Evolving policies for sustainable livestock grazing & conservation practices in Ladakh: Consultation for effective integration of sociological and ecological aspects in action research on pastoralism and livestock–wildlife interactions. Proceedings. 11–15 November 2002, Leh. Report submitted to the Ladakh Autonomous Hill Development Council, ICIMOD and Wildlife Institute of India
- Bhatnagar, Y. V., R. Wangchuk, 2001. Status survey of large mammals in eastern Ladakh and Nubra. Pages 108–135 in Anon. 2001, Conserving biodiversity in the Trans-Himalaya: New initiatives of field conservation in Ladakh. First technical report (1999–2000), Wildlife Institute of India, International Snow Leopard Trust, and US Fish and Wildlife Service
- Blom, E. 2000. Nature in War: Biodiversity conservation during conflicts. The Netherlands Committee for IUCN and the Netherlands Foundation for International Nature Protection
- Chaudhuri A. 2000. Change in Changthang: to stay or to live. *Economics & Political Weekly*. 35(1 and 2):52–58.
- Chundawat R. S., Q. Qureshi. 1999. Planning wildlife conservation in Leh and Kargil districts of Ladakh, Jammu and Kashmir. Report submitted to the Wildlife Institute of India, Dehradun
- Dudley J. P., J. R. Ginsberg, J. A. Plumptre, A. J. Hart, and L. C. Campos. 2002. Effects of war and civil strife on wildlife and wildlife habitats. *Conservation Biology* 16:319–329.
- Foose T. J. 1982. Trophic strategies of ruminant vs. non ruminant ungulates. Ph.D. thesis, University of Chicago
- Fox J. L., C. Nurbu, S. Bhatt, A. Chandola. 1994. Wildlife conservation and landuse changes in the Trans-Himalayan regions of Ladakh, India. *Mountain Research and Development*. 14:39–60.
- Fox J. L., C. Nurbu, R. S. Chundawat. 1991. The mountain ungulates of Ladakh, India. *Biological Conservation* 58:167–190
- Hagalia W. 2004. Changing rangeland use by the nomads of Samad in the highlands of eastern Ladakh, India. M.S. Dissertation. Agriculture University of Norway, Oslo
- Jina P. S. 1995. High pasturelands of Ladakh Himalaya. Indus Publishing Company, New Delhi
- Joshi S., T. Morup. 2003. Ladakh—All stones turned. *Down To Earth*. 12:27–38
- Mishra C. 2001. High altitude survival: Conflicts between pastoralism and wildlife in the Trans-Himalaya. Doctoral thesis, Wageningen University, The Netherlands
- Mishra C., S. E. Van Wieren, I. M. A. Heitkönig, H. H. T. Prins. 2002. A theoretical analysis of competitive exclusion in a Trans-Himalayan large-herbivore assemblage. *Animal Conservation* 5:251–258
- Mishra C., A. Fitzherbert. 2004. War and wildlife: a post-conflict assessment of Afghanistan's Wakhan Corridor. *Oryx* 38:102–105
- Mital R. 2004. Textiles ministry, UNIDO project to improve pashmina quality in Ladakh–Mumbai. *Express Textiles*, issue: 22nd January. 2004, <http://www.expresstextile.com/20040122/newsviews01.shtml>
- Moehlman P. D. (ed.) 2002. Equids: Zebras, asses, and horses status survey and conservation action plan. IUCN, Gland, Switzerland
- Pfister O. 2004. Birds & mammals of Ladakh. Oxford Publishers, New Delhi
- Phuntsok T. 2000. Implementation of phase I Activity Plan for Regional Rangeland Programme for Ladakh, India. Report submitted to ICIMOD, Kathmandu, Nepal and Ladakh Environment & Health Organization, Leh
- Richard C. 1999. Rangelands and livestock as a niche opportunity for Ladakh. Sectoral report in volume II: Developing strategies for agriculture and related sectors in Ladakh. Submitted to the Leh Autonomous Hill Development Council by ICIMOD
- Rizvi J. 1999. Trans-Himalayan caravans: Merchant princes and peasant traders in Ladakh. Oxford University Press, New Delhi
- Schaller G. B. 1998. Wildlife of the Tibetan steppe. University of Chicago Press, Chicago
- Shah N. 1996. Status and distribution of Western kiang (*Equus kiang kiang*) in Changthang Plateau, Ladakh, India. Report M.S. Univ. of Baroda and Gujrat Nature Conservation Society, Baroda, Gujrat
- Shah N. 2002. Status and action plan for the Kiang (*Equus kiang kiang*). Pages 72–81 in P. D. Moehlman (ed.), Equids: Zebras, asses, and horses status survey and conservation action plan. IUCN, Gland, Switzerland
- Stockley G. 1936. Stalking in the Himalayas and Northern India. Herbert Jenkins, London