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TIBETAN WILD ASS (*Equus kiang)*-LIVESTOCK INTERACTIONS IN THE CHANGTHANG WILDLIFE SANCTUARY, LADAKH, INDIA

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Abstract

The study was conducted in the Changthang Wildlife sanctuary, the western most limit of kiang distribution (*Equus kiang kiang*). Wild equids in Asia share rangelands with pastoral communities. This study objectives were to determine resource selection by kiang and livestock in a seasonal Trans-Himalayan environment during winter. Using a temporal hierarchial design, we investigated whether Kiang habitat use in an area occupied by livestock resulted in Kiang using higher elevations and steeper slopes. Proportion of Kiangs involved in different behaviour patterns changed significantly due to livestock presence although diet preferences remained the same. An understanding of these processes in human-occupied landscapes in conjunction with locally appropriate conservation strategies is necessary for long-term conservation of kiang.

Key words: Tibetan Wild ass , Changthang, habitat shift, feeding preferences, trans-Himalayas.

Resumen

Interacciones entre el asno salvaje tibetano (Equus kiang) y el doméstico en el Santuario de Vida Salvaje de Changthang, Ladakh, India

El estudio se llevo a cabo en el Santuario de Vida Salvaje de Changthang, que es el límite mas occidental del asno salvaje tibetano (*Equus kiang kiang*), los kiang en las praderas de Changthang que compite con su ganado por los pastos. El objeto del estudio es determinar si las diferencias en la selección de hábitat entre el asno salvaje y ganado domestico son estacionales. Hemos utilizado un diseño de jerarquía temporal para determinar si la presencia o ausencia de ganado conlleva un cambio en el uso del hábitat, la dieta y el comportamiento del kiang. El uso del hábitat fue significativamente diferente antes y después de la presencia de ganado. Cuando el ganado tiene distintas prácticas de pastoreo, el kiang se ve obligado a desplazarse a pendientes pronunciadas de mayor elevación, con el mayor riesgo consiguiente de ser objeto de predación. El número de animales que presentaron un perfil etiológico diferente cambió de

forma significativa en presencia de ganado; el número de animales que se alimentaban también aumentó; el número de ejemplares que se desplazaban disminuyó de forma importante en presencia y ausencia de ganado; no hubo cambios significativos en las preferencias de dieta. Sería necesario comprender estos procesos en los paisajes ocupados por humanos, además de adoptar estrategias locales de conservación apropiadas para la conservación de la fauna transhimalaya.

Palabras clave: Asno salvaje tibetano, Changthang, selección hábitat, alimentación preferente, tras-Himalayas.

Introduction

Free ranging wild and domestic animals may exhibit non-randomness in resource use (Arnold & Dudzinski 1978). Habitat selection results from a complex interaction of both abiotic and biotic factors including human interventions. When environmental resources are heterogeneous and patchy, both spatially and temporally, animals are likely to become strongly selective or generalist. High animal density and heavy grazing pressures are commonly believed to reduce site selectivity. Competition between grazing animals occurs only when there is a limited supply of one or more critical resource. Competition can be for space, water, or cover but is most commonly forage. Under mixed grazing, competition can be negative, i.e. one species adversely affected, or synergistic in that grazing enhances the quality and quantity of forage for another species.

Interspecific competition plays a major role in determining animal distributions (Connel 1961, Case & Bolger 1991). Competitive asymmetry has been demonstrated between domestic and wild-ungulates in grazing systems of Africa and North America where livestock caused a shift in habitat use and foraging opportunities (Lima & Dill 1990). Namgail *et al.* (2007) found livestock caused a shift in habitat use and activity patterns of Argali *Ovis ammon hodgsoni* in rangelands shared with domestic sheep and goats (Harris & Bedunah 2001) We investigated the impact of livestock grazing and other related herding activities on habitat use, activity pattern and diets of Kiang *Equus kiang kiang*. We also investigated amount of forage removed by 3 species of livestock and dietary niche overlap between livestock and kiang.

Study area

The study was conducted in Hanley Valley of Changthang Wildlife Sanctuary (32° 41' 27" N 79° 04' 3.5" E), which is also a wintering rangeland for domestic livestock The plateau is bounded by the Zanskar, Kailash and Great Himalayan ranges on the south, Karakoram range in the west, and Kunlun and Arjin Shan in the north. On the east the plateau extends to south-western Quinghai and Xinjiang provinces, People's Republic of China. The northwestern part of the plateau terminates in Aksai Chin, one of the most arid and desolate tracts. Hanley Valley is characterized by undulating terrain interspersed with outcrops. The altitude ranges from 4400 m to 5200 m. The study area can be divided into following broad habitat types: riverine, marsh meadows, scree slopes, rocky slopes, plateau, rolling hills, alluvium fan. The area lies in the Hanley River watershed which originates in the Zanskar Glacier in the Zanskar Range. The vegetation of the Chang Thang plateau can be broadly grouped as scrub formations, desert steppe and marsh meadows. Notable mammals in the area are Tibetan wild ass, Tibetan argali (*Ovis ammon hodgsoni*), wild yak (*Bos grunniens*), and Tibetan gazelle (*Procapra picticaudata*), Predators include snow leopard (*Uncia uncia*), Tibetan wolf (*Canis lupus chanko*), lynx (*Felis lynx*), red fox (Vulpes vulpes), and Tibetan brown bear (*Ursus arctos pruinosus*).

Methods

Habitat use

The field study was conducted from 12 December to 10 April. Kiangs were observed from four fixed trails. Two trails were monitored on vehicle and two were monitored on foot. The lengths of these trails ranged from 2-5 kms. Each trail was visited at least three times a month.

Data on Kiang habitat use were collected prior to 12 December 2008 - 13 January 2009 when livestock were absent and during the time livestock occupied the area (13 January 2009 - 5 April 2009). Group size and habitat variables were recorded for each herd at the initial sighting. Physical habitat variables recorded included slope, elevation, aspect, and vegetation community. Elevations were recorded with a handheld GPS unit and from a 1:50,000 contour map. Aspect

was recorded using a compass and slope, vegetation community, and landscape unit were visually estimated.

Activity budget

I used scan animal sampling to quantify time budgets of kiangs (Altman 1974). A group of kiang was selected randomly and was observed for 1-3 h and observations were made at 10 minute intervals. I used scan sampling because it was not possible to identify individual kiangs. To avoid pseudo-replication (Machlis *et al.* 1985), I observed different groups of Kiangs on different days. Activities of a group were observed through 10x50 binoculars and recorded by an assistant. An animal was deemed to be foraging when it fed on a plant species or lowered it head towards a food plant (Namgial *et al.* 2007). When its head was held above the shoulder, it was considered to be standing. When it moved with its head above its shoulders, it was deemed to be moving, and resting when it was lying down. We observed groups from an average distance of 150 m, and care was taken not to disturb the animals, prior to and during observations. Observations on the kiang were conducted during daylight hours to avoid over or underestimating behavioral activities associated with time of the day, as there are diurnal patterns in the time-budget of ungulates (Schaller 1977, Rukstuhl 1988, Namgial 2007).

Feeding preferences

Seven dung samples were collected every two weeks at random fixed trails. Dung samples were collected in paper bags and air dried. Diets were determined using microhistological fecal analysis. Direct observation was used to record diets of livestock. Five individual sheep, goats and horses were randomly selected. Each animal was followed for half day then the same animal was followed next day for another half hour. Focal animal sampling was used at 10- minute intervals and plant species being fed upon were recorded for a single bout. A bout was defined as the interval between the period when an animal lowers it head to feed until it raises it back. The number of bites varied from 3-47. Animal observations were spread across the study area to encompass all the habitats used. The number of bites per/min was also recorded after every 10 minutes for sheep, goats and horses

to estimate amount of biomass removed by livestock. Bite sizes of a livestock were estimated by a simulated hand plucking of plant species (Wallmo *et al.* 1973). The samples were oven-dried to obtain dry weight.

Ten composite kiang fecal samples were made from 28 independent samples collected over two months (December-January) when livestock were absent and 10 during February-March when livestock were present. Reference and dung samples were ground and passed through 1 mm mesh (Sparks & Malechek 1968). Unit slide prepared method was used for each composite sample and 100 identifiable Fragments were counted at 100 x magnification (Scott & Dahl 1980). Identification of plant species was compared with known reference samples and frequency of fragments of various species were estimated.

Analysis

Habitat use and activity pattern

Chi square test of association (contingency table) was used to determine the association of kiang to habitat variables during the presence and absence of livestock. Hypothesis tested was, H_0 : habitat use by kiang is independent of livestock presence: H_A: Habitat use by kiang is associated with livestock presence. I observed total of 14 groups of kiang for the time budget evaluation, 7 prior (640 min) and 7 (820 min) after livestock had occupied the area. Multi-response permutation procedure (MRPP) was used to statistically test the difference in time budgets with and without livestock (McCune & Grace 2002). Individual activity patterns were tested separately emulating a 2-sample t-test with MRPP to determine differences with and without livestock (Mielke 1982). Ten composit dung slide samples of kiang when livestock were present and 10 composit sample without livestock were analyzed. Diet and availibility profile matrix were developed and Ivelev's index was calculated for every slide (use). MRPP was used to test for significant differences for these two conditions (groups).

Diet preferences

A matrix of diet profiles and availability matrix of kiang, sheep, goat and horse were developed. Usage and availability for evaluating Resource preference (Ivelev's index) was done to determine the preference or avoidance for a particular

food plant. Diet overlap was calculated using Schoener's index (Schoener 1968): Ivelev's index for diet preference was calculated for kiang during the preence and absence of livestock. Multi-response permutation procedure (MRPP) was used to test if the indices for kiang and other livestocks (sheep, goat and horse) differed. MRPP was also used to test statistically if the preference indices are significantly different.

Results

Habitat use

There were 105 and 181 kiang observations before and during livestock presence, respectively. Habitat use variables (Table 1) were subjected to NMDS (ordination) which identified two axes (individual distances in ordination space). MRPP was found to be significantly different (δ= 0.013, $p < 0.05$) for these two axes. Chi-square test of association for elevation categories was significantly different (χ^2= 27.90, $p < 0.05$) , thus indicating shift in use of elevation in response to disturbance (livestock and herders figure 1). Chi-square test of association for slope categories was significantly different (χ^2= 16.49, $p< 0.05$), thus indicating shift in use of slope in response to disturbance (livestock and herders figure 2). While as use of aspect and vegetation community were also significantly different, the shift was not profound.

Table 1
Percent overlap (Schoener's niche overlap index) between kiang and other ungulates.

Species	Kiang	Sheep	Goat	Horse
Kiang		58%	57%	82%
Sheep			91%	69%
Goat				68%

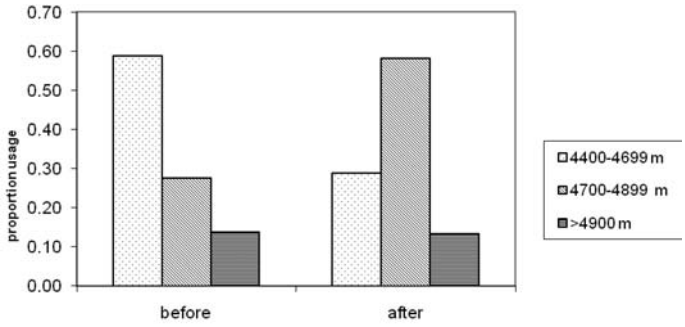

Figure 1. Proportion of kiang using different elevation categories before and after livestock use in the study area.

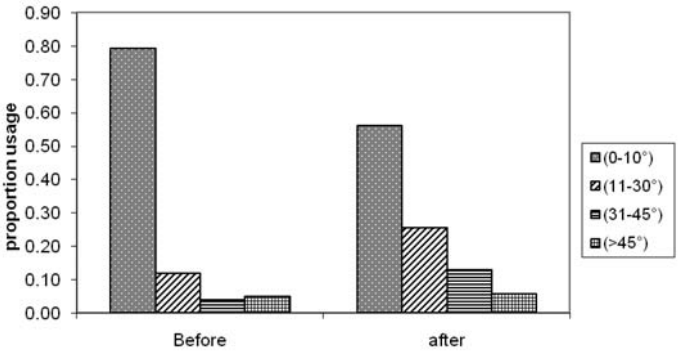

Figure 2. Proportion of kiang using different slope categories before and after livestock coming into the study area.

Activity pattern

The proportion of animals engaged in various behavioral patterns (feeding, standing, moving and resting) was found to be significant (χ= 0.03, p< 0.05). Emulative 2-sample MRPP t-test was used to test for differences in individual behaviour patterns taking into account before and after livestock presence (Mielke 1986). Individual activity patterns, standing (before and after) and resting (before and after) were not significantly different (δ= 0.163, p> 0.05) and (δ= 0.925, p > 0.05) respectively. Feeding and movement (before and after livestock presence) was found to be significantly different (δ= 0.20, p<0.05) and (δ= 0.4, p< 0.05) respectively (Figures 3 & 4).

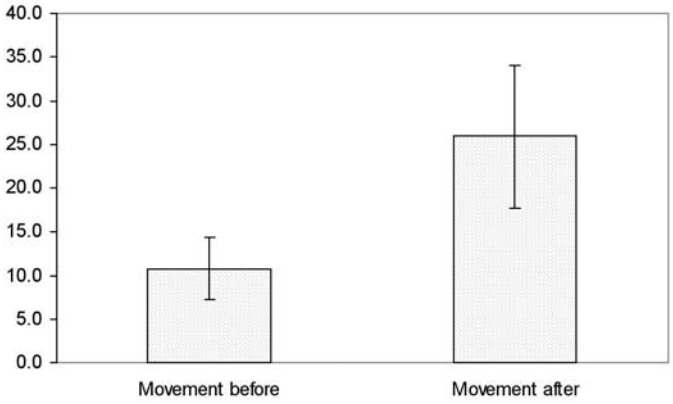

Figure 3. Percent animals moving before and after livestock use in the area.

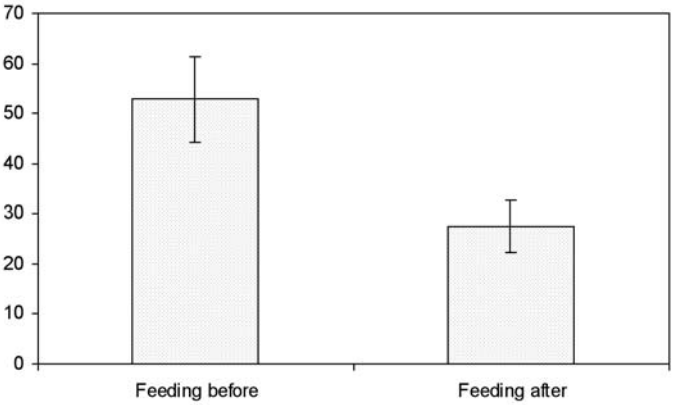

Figure 4. Percent animals feeding before and after livestock coming into the area.

Diet preferences

Preference (Ivelev's Index) for different plant species was not significantly different ($\delta = 0.96$, $P > 0.05$) for kiang during the presence and absence of livestock. Schoener's diet overlap between kiang and sheep was 58%, kiang and goat was 57% and between kiang and horse was 82% (table 1).

Discussion

A study addressing the issue of resource partioning on a spatial scale is not sufficient to reach definite conclusions; hence these issues also should be addressed on temporal scale. Kiangs continued using the same catchment but started to move out of the study area during late winter which may have been be due to the fact that there was a decline in the forage availability and increase in direct disturbance due to human presence. Kiang showed a marked change in their habitat use in response to livestock presence in the area. Similar results were obtained by other researches on white-tailed deer (Cohen *et al.* 1989, Beier & Mccullough 1990) where white tailed deer shifted habitat use in response to the presence of cattle. Namgail *et al.* (2006) also found out that Argali shifted to areas with less vegetation cover and to steeper habitats in response to livestock presence. During the present investigation we also found kiang shifted to higher elevations, Aspects with low vegetation cover and steep slopes probably were avoided because of higher predation risk.

Diet preferences of kiang did not change or were similar even if their habitat use shifted. Kiangs activity budget also changed due to livestock presence, as foraging time decreased and movement increased significantly. Such an change can be attributed to livestock grazing and collateral herding activities. These conditions can be more aggravated as forage availability decreaes in winter. Such conditions may led to lower the fitness level of the animal which ultimately can have an effect on reproductive performance due to energy constraints associated with decreasing foraging opportunities in marginal sites, thereby reducing fecundity (Clutton-Brock *et al.* 1982).

There was moderate niche overlap between kiang and sheep (58%), kiang and goat (57%) and very high overlap between kiang and horse (82%). Although difference in feeding type tended to predict degree of diet overlap, where body mass did not, the weak predictive power of both these niche axes may imply that several niche axes need to be taken into account to successfully predict ungulate diet (Hanley and brady 1982). Resource use overlap between the domestic ungulates was generally high (>60%).

Conclusions

Though livestock grazing and associated herding activities affects kiang's habitat use and activity patterns, feeding preferences did not change. All the previous population estimates on kiang have shown that kiang populations have not declined but have increased?. There is enormous pressure on these winter pastures because sheep goats are consuming are large proportion of the biomass, which may be critical during winter. So it becomes critical from the academic and conservation point of view to explore if kiangs reoccupy areas when the disturbing factors are removed (that is when these pastoralists move out of the area to new pastures) and to find out the threshhold of livestock which these pastures can sustain with out compromising livestock production.

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