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Dietary composition, breadth, and overlap between seasonally sympatric Himalayan musk deer and livestock: Conservation implications

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ABSTRACT

Livestock in high altitudes of Nepal and elsewhere, frequently and freely, use potential habitat of native wildlife for foraging. Such intrusion of ecologically similar domestic species is supposed to negatively impact the resident wildlife via 'perceived' and/or 'real' competitive interactions. Hence, assessment of dietary composition and overlap between herbivores is crucial to gain insight into the potential impacts via resource exploitation by foraging livestock. Also, evaluation of dietary composition of resident wildlife across seasons is important to decipher their seasonal resource needs. Within this context, microhistological technique, that makes use of fecal pellet for identification of plant species through comparison with reference slides of plant materials in the area, was used to assess dietary composition, breadth, and overlap between seasonally sympatric Himalayan musk deer and livestock in Nepal Himalaya. Musk deer and livestock were found to have significantly different dietary consumption and that partition was contributed by different species; meaning different plant species were associated to the diets of these two groups. Of notable, however, was a considerable 'number' of species (i.e., species richness) shared in diets by musk deer and livestock raising a concern of unchecked number of livestock with a potential to exploit and reduce the availability of shared plant species with musk deer. Also, seasonal dietary composition of musk deer significantly varied, with increased dietary breadth in winter, suggesting a potential for intraspecific competition for forage in winter because of limited availability of resources mediated by retarded growth and harsh conditions.

1. Introduction

Coexistence of sympatric species, despite extensive overlap in ecological requirements, is a function of resource partition (Hutchinson, 1959; MacArthur & Levins, 1967; MacArthur, 1972). Such differential use of resources such as food and space can potentially be attributed as a response to interspecific competition over evolutionary time, where selection would favor the separation of resources to increase fitness (Schoener, 1974; Ricklefs, 2008). Introduction of ecologically similar species into a system can disrupt the system, if resident and introduced species do not share a long evolutionary history for resource partitioning and coexistence (Voeten & Prins, 1999; Prins, 2000). The severity of such introduction amplifies when introduced species are domesticated livestock with artificial supplementation of diet and are thus potentially competitively superior (Mishra, van Wieren, Heitkonig, & Prins; Prins, 1992). The gravity of situation is serious when the residents are declining endangered species confined within boundary of Conservation areas (Mishra, van Wieren, Ketner, Heitkonig, & Prins). Thus, understanding the extent of resource use by native wildlife and resource overlap with introduced species is a crucial conservation concern for declining wildlife populations.

Wildlife and livestock share the rangelands worldwide (Prins, 2000). High altitudes in the Himalayas, in particular, experience heavy grazing by livestock because of substantial pastoralism practices in these areas. Livestock grazing in these areas can potentially result in competitive interactions between the herbivores, and such interactions are predicted to be severe when introduced species have similar feeding style with the native herbivore. Although demographic rates of the interacting species are desirable to con-

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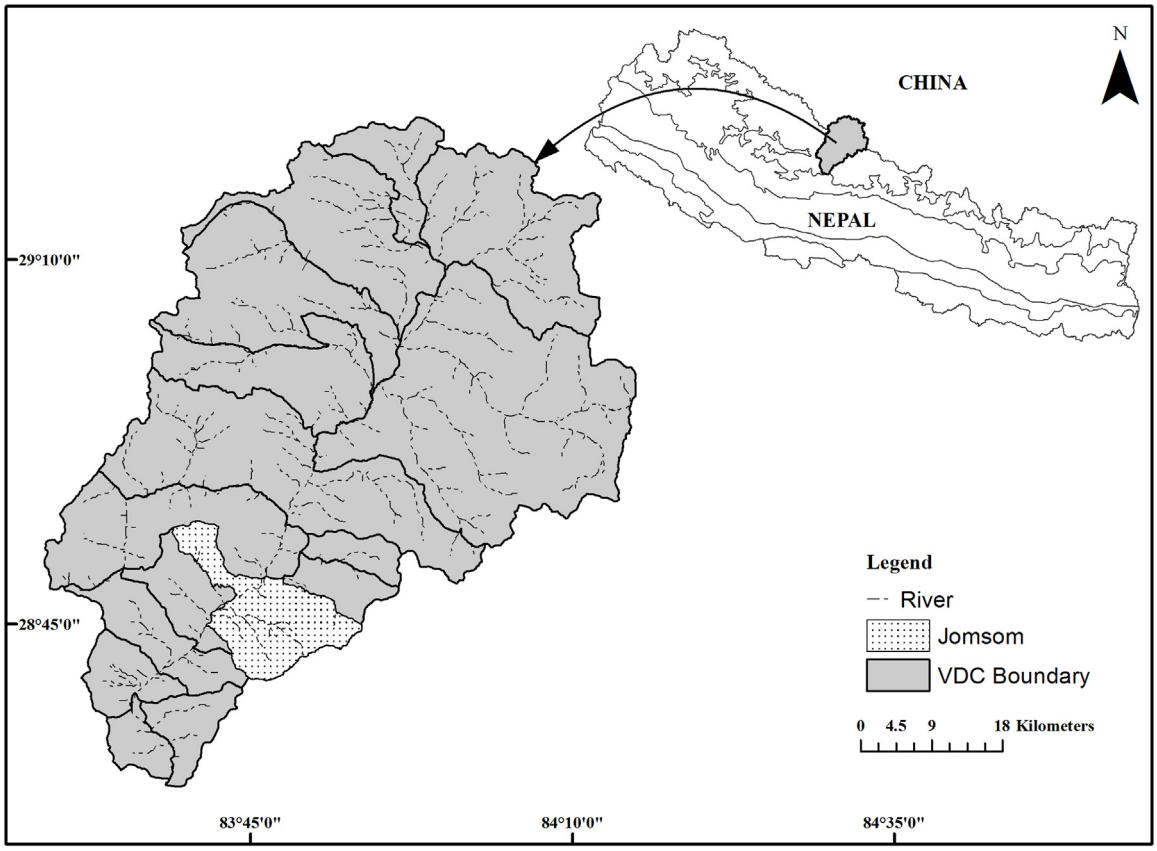

Fig. 1. Mustang district of Nepal with river network and VDC boundary. Village Development Committee (VDC) is the lower administrative part in Nepal. Study site is labeled as Jomsom.

firm the existence of competition (Prins, 1996), incidences of significant spatial segregation between native wildlife and livestock have been reported in the literatures (Acevedo, Cassinello, & Gortazar; Loft, Menke, & Kie; Stewart, Bowyer, Kie, Cimon, & Johnson) as evidences for competition between them. However, spatial segregation alone cannot be a consistent response to interactions between the herbivores. Understanding dietary breadth and overlap appears to be an additional important yardstick for understanding interactions (MacArthur & Levins, 1967; Gauze, 1971), and gauge the potential impacts of livestock-grazing on native wildlife species.

Himalayan musk deer (*Moschus leucogaster)* and alpine musk deer (*Moschus chrysogaster)*, in particular, are confined to high-altitude forests of Bhutan, northern India, Pakistan, Nepal, and China (Green, 1986; Grubb, 2005; Yang et al., 2003). The species are listed on Appendix I of CITES and as endangered on International Union for Conservation of Nature (IUCN) red list. Taking expert-based range map of IUCN red list as a reference, the species of concern in this study is treated as *Moschus leucogaster*, although both the species are interchangeably treated as Himalayan musk deer and/or alpine musk deer. It is probably due to their overlapping habitat, difficulties in species identification from their morphology because of their elusive nature, and lack of genetic studies for species identification. In Nepal, musk deer are found in birch, pine, and fir forests at an altitude of 2400–4300 m (Khadka & James, 2016) and considerably share their potential habitat with seasonally-sympatric livestock that are the means of sustenance for people (Fox, Yonzon, & Podger; Metz, 1990). Yet the likely impacts of livestock grazing in the potential musk deer habitats appear to be overlooked and still remain largely unexplored. An earlier study (Khadka & James, 2016) found a spatial segregation between musk deer populations and livestock in study area considered here. However, that separation could not be attributed as a response to competition, due in part to independent selection of habitat conditions by two groups. Moreover, the species do not share a co-existing evolutionary history for such niche segregation. So, it was hypothesized that the spatial separation between livestock and musk deer is due to significant overlap in dietary composition between them. Hence, the present study is directed towards an assessment of seasonal diet composition, diet breadth, and diet overlap between livestock and musk deer. It is expected that findings of the study shed light on the likely impacts of livestock on musk deer populations in the area, and potentially aid in management and conservation of the species. Besides, it is also anticipated that the study helps to address interests of both wildlife managers and people, and reduce the probable conflicts between the two via well-informed decisions.

2. Methods

2.1. Study area

We conducted this study in Jomsom, Mustang area of Nepal (Fig. 1); it lies in the central North region of the country in the rain-shadow part of Annapurna and Dhaulagiri Himalaya ranges. The altitude ranges from 2750 m above sea level to 6700 m and average annual precipitation is 250–400 mm. The study site is located in the Annapurna Conservation Area Project (ACAP), the largest protected area, covering 7629 sq. km in Nepal. Vegetation of the area is characterized by temperate coniferous forests and alpine meadows, while the northern boundary of the area consists of arid landscape and long steep bare slopes cut by deep river gorges (Ives,