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# Seasonal food habits of corsac and red foxes in Mongolia and the potential for competition

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## Abstract

Competition often occurs between sympatric species that exploit similar ecological niches. Among canids, competition may be reduced by partitioning resources such as food, time, and habitat, but the mechanisms of coexistence remain poorly understood, particularly among fox species. We described the food habits of two foxes that live sympatrically across northern and central Asia, the corsac fox (*Vulpes corsac*) and red fox (*V. vulpes*), by analyzing scats collected during a field study in Mongolia. We analyzed 829 corsac and 995 red fox scats collected from April 2005 to August 2007 and tested the extent to which food partitioning occurred. The diets of both species consisted mainly of insects followed by rodents, but also included birds, reptiles, large mammal remains (carrion), plant material (including fruits and seeds), and garbage. Despite high overlap in the proportion of food items consumed, differences existed between species in overall diet with corsacs more frequently consuming beetles, but proportionally fewer crickets and large mammal remains than red foxes. We detected interspecific differences during the pup rearing and dispersal seasons, when prey was abundant, but not during the breeding season, when prey was scarce and diet overlap highest. Each species' diet also differed seasonally and exhibited moderate overall breadth. Corsacs consumed proportionally more beetles and rodents during pup rearing and crickets during dispersal relative to other seasons, whereas red foxes consumed proportionally more crickets during pup rearing and dispersal and more rodents and large mammals during pup rearing and breeding relative to other seasons. Our results suggest that partitioning of food resources during most of the year facilitates coexistence, and that the potential for competition is highest during winter months.


***Keywords:*** *Vulpes*; Competition; Diet; Niche partitioning; Mongolia

## Introduction

Sympatric canids often share limited resources such as food, time, and habitat, which frequently results in exploitation and interference competition (Macdonald

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and Sillero-Zubiri 2004). Several studies have shown that competition between species can be reduced through niche partitioning (Tilman 1982; Arthur 1987; Sommer and Worm 2002). Food-niche partitioning, in particular, often allows sympatric canids to coexist by reducing overlap of shared prey and minimizing the likelihood of potentially dangerous encounters. Swift foxes (*Vulpes velox*) in Colorado, USA (Kitchen et al. 1999) and kit foxes (*V. macrotis*) in California, USA (Cypher and Spencer 1998), for example, avoid direct competition with coyotes (*Canis latrans*) by eating a more specialized diet. Studies of the competitive relationships between sympatric canids, however, are relatively few and most have focused on species in North America and sub-Saharan Africa (Johnson et al. 1996).

We examined the food habits of corsac (*V. corsac*) and red foxes (*V. vulpes*), two species that range widely throughout central and northern Asia. The corsac is a small (ca. 2.5 kg) arid-adapted fox that lives mainly in grassland steppe areas and has a highly variable diet throughout its range (Allen 1938; Ognev 1962; Heptner and Naumov 1992). Details of the fundamental biology of corsacs, however, remain poorly known and several aspects of its behavior and ecology are unstudied (Poyarkov and Ovsyanikov 2004). The biology of the red fox, by comparison, is well known from studies in Europe and North America (Larivière and Pasitschniak-Arts 1996; Macdonald and Reynolds 2004). In northern Asia, red foxes occupy nearly every habitat, exhibit a high degree of dietary flexibility, and live throughout the entire range of the corsac fox (Heptner and Naumov 1992; Macdonald and Reynolds 2004; Poyarkov and Ovsyanikov 2004).

Corsac and red foxes share similar food items throughout their range (Heptner and Naumov 1992), suggesting that exploitation competition occurs between them. Historical accounts also note that red foxes, which are nearly twice as large as corsacs, will kill them during encounters, suggesting that interference competition also occurs (Heptner and Naumov 1992). In Kazakhstan, a previous account related a decrease in corsac fox numbers to a rapid growth of the red fox population (Heptner and Naumov 1992), further indicating that competition probably occurs in some areas and may be intense. The mechanisms that allow corsac and red foxes to coexist, however, remain largely unknown.

We describe the food habits of corsac and red foxes in central Mongolia to gain greater insight into the ecological relationships between these species. Although the diets of red foxes and, to a lesser extent, corsacs, have been documented in other parts of Asia (Ognev 1962; Heptner and Naumov 1992), few published details on their food habits in Mongolia exist. In this study, our objectives were to (1) quantify corsac and red fox diet composition, breadth, and overlap, and (2) test whether diets between species differ by season and overall (across all season), to evaluate the degree to which both species share or partition food resources throughout the year and the potential for food-niche competition between them. Based on previous accounts of exploitation and interference competition, we expected a high degree of dietary partitioning to exist. We expected the greatest differences (and least dietary overlap) to occur during the summer months when more prey is available as there are more opportunities to partition food resources. We predicted higher overlap in the diet of the two foxes in winter when resources are scarce (e.g., reptiles, insects, and some small mammals hibernate, and birds migrate south). We also estimated the abundance of major prey items to assess the extent to which foxes consumed prey relative to abundance.

## Material and methods

### Study area

We conducted the study in the Ikh Nart Nature Reserve (hereafter Ikh Nart; area = 666 $km^2$), Dalanjargal Soum, Dornogobi Aimag of Mongolia (N45.72°, E108.65°) (Reading et al. 2006). The reserve is situated at the confluence of 'steppe' and 'semi-desert' ecosystems (Murzaev 1948) and consists of grasslands, shrublands, and semi-shrublands in open plains, and rugged, rocky terrain interspersed with dry creek beds and valleys (Jackson et al. 2006). Climate in the reserve is arid and highly variable throughout the year, with temperatures ranging from −40 °C in winter to +43 °C in summer. Precipitation occurs rarely (<200 mm/year), and falls mostly as rainfall in summer. Corsac and red foxes live sympatrically in the reserve and have been documented in all major habitats in the region (Murdoch et al., in press-b).

### Scat collection and analysis

We evaluated food habits based on an analysis of scats that were collected from 15 April 2005 to 14 August 2007. We identified scats as fox based on shape, size, odor and color and to species-level based on reference samples collected from foxes live-trapped as part of a parallel radio-telemetry study and foxes killed by hunters. Reference samples indicated that red fox scats were longer, and typically wider and more segmented than corsac scats. As such, we relied on length to distinguish species: scats >8 cm were considered red fox and those <4 cm were considered corsac fox. To minimize the potential for misidentification, we collected scats at dens used by radio-collared animals and opportunistically at locations where tracks were present. We also did not collect scats that were of