Opportunistic animal’s diet depend on prey availability: Spring dietary composition of the red fox (Vulpes vulpes) in the Dhorpatan hunting reserve, Nepal

Achyut Aryal1,2, S. Sathyakumar3 and Brigitte Kreigenhofer1

1Ecology and Conservation Group, Institute of Natural Sciences, Massey University, New Zealand.
2The Biodiversity Research and Training Forum, Nepal.
3Wildlife Institute of India, India.

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The red fox (Vulpes vulpes) is a least concerned omnivore, distributed widely between 2,500 m and 4,500 m in different protected areas of Nepal. We investigated the spring feeding habits of the red fox in the Dhorpatan Hunting Reserve of Nepal. Livestock depredation by red fox, wolf and leopard, and the consequently retaliatory killings of these carnivores by local livestock herders, is becoming a serious issue for the conservation of these carnivores. At the same time, it leads to an increase in the number of prey animals by reducing the predators. Due to this situation, red fox change their dietary preference towards pika (Ochotona roylei), wild boar (Sus scrofa), and other ungulates. However, its main diet consists of insects (Coleoptera and Orthoptera) in other parts of its range. There is no significant difference ($\chi^2 = 0.86$, df = 12, $p > 0.05$) in the frequency of occurrence of different prey species in the scats of red foxes. The pika (Ochotona roylei) made up 30% of the scats of fox, making it the most abundant species in their diet.

Keys words: Omnivores, diet, Vulpes vulpes, prey, predators.

INTRODUCTION

The red fox (Vulpes vulpes) is a generalist and opportunistic omnivore (Delibes-Mateos et al., 2008; Macdonald et al., 2008), common and widely spread throughout most parts of Asia and in other parts of the world (Lloyd, 1980; Voigt, 1987). Red foxes have been recorded in habitats such as the tundra, desert, forest, and in city centres as well (Example, London, Paris, Stockholm, etc.), with their ideal natural habitat being a dry, mixed landscape with abundant "edges" of scrub and woodland. They are also abundant on moorlands, mountains (even above the tree line as they are known to cross alpine passes), sand dunes, and farmlands from sea level to 4,500 m (Macdonald et al., 2008).

The red fox has been introduced in Australia and has been implicated as one of the contributors to the decline of native species throughout the country, particularly the critical weight range (35 - 5,500 g) herbivores (Burbidge and McKenzie, 1989; Morton, 1990) and ground-dwelling birds (Catling and Burt, 1995). Food utilization is an important aspect in the study of carnivore ecology, being that trophic resources dominate several aspects of their biology (Macdonald, 1983; Bekoff et al., 1984). Therefore, a detailed understanding of the dietary composition of the red fox is fundamental for a better understanding of this species as a predator and also for the management of both prey and predator populations.

The red fox is largely distributed in the Dhorpatan hunting reserve of Western Nepal. Due to lack of research and management in the region, it is one of the species of least concern. Thus, this pioneering work on the dietary analysis of the red fox was conducted to identifying the dietary behavior in spring season in the Dhorpatan hunting reserve from March - June, 2008.
MATERIALS AND METHODS

Study area

This study was conducted in the Dhorpatan Hunting Reserve of Nepal. Located in the Baglung District in the Dhaulagiri Himalaya of Western Nepal (23°30’N - 28°50’N, 82°50’E - 83°15’E), this hunting reserve covers an area of 1325 km$^2$ with the altitude ranging from 2,850 - 5,500 m (Wegge, 1979). The reserve consists of seven different blocks, two of which that were similar in habitats were used in this study: the Phagune block and the Barse block. Collectively, these two blocks cover an area of 115 km$^2$ (Figure 1).

Phagune

In west along the trail up north from Uttar Ganga at Taka across the Phagune ridge at about 12,500 ft.; down to Pelma river, there...
turning east upstream along Pelma and Gustung river to an about 3.2 - 4 km east sheep ridge east of tributary, along east side of the ridge to the Dhorpatan trail intersection than following trail south to Dhorpatan and back down along Uttar Ganga.

**Barse**

Along the eastern part of Phagune block, up from gusting southwards along the Kharka trail to Dhorpatan, eastwards along Uttar Ganga to Barse Mount trail take-off, following trail along the ridge northwards across pass to eastern tributary of Gustung Khola, along the tributary and Gustung down back to Phagune block boundary.

Climate The reserve is located in front of an only moderately high saddle connecting the high Dhaulagiri and Hiuchuli. It is also shielded by several lekhs South of Uttar Ganga. The Sheep area therefore receives less precipitation than others areas of the Nepal Midlands (Stainton 1972), Wegge (1976) extrapolates the annual precipitation to somewhat less than 1000 m.

During winter or dry season, which lasts from mid-September to early June, there is very little human activity in the hills above the timberline. The weather is dry and cold, with light snow during midwinter, and unpredictable heavier snowstorms into late spring (Wegge 1976).

Vegetation The area is characterized by many plant species of the drier climatic belt to the north, but remnants of the more humid zone are also present, giving the area a mixed vegetation cover.

Data collection

Sign (scats, pugmarks, scrapings, and scent spray) surveys were also carried out in study area to distinguish different predator’s scats and to estimate scat density. Different predators’ signs were identified based on their size, colour, pugmarks and other features (wherever available). Confusion with dog and lynx scats were avoided because herders and livestock were in downhill and there was no record of lynx or wild dogs in Barse or Phagune blocks. An existing human and livestock trail was used as a transect line for collecting different predators’ scats. Considering that the maximum altitude of red fox distribution is 4500 m, research was only carried out up to this elevation. The red fox scat survey was carried out in the Barse and Phagune blocks of the Dhorpatan Hunting research (115 sq. km collectively). Scats of red foxes were indentified on basis of certain characters such as a relatively smaller size, long and final pointed tips, scats covered with grasses and fruit material, etc. A total of 85 red fox scats were collected from the field for dietary analyses. The field data were collected from March - June, 2008, from different altitude 2000 - 4000 m. Scats were prepared according to Mukherjee et al. (1994) for identification of prey. A standard micro-histological method was then used to identify which prey species were present in the scat samples by comparing the hairs from the collected faeces with reference hair samples. Specifically, the hair surface scale patterns of the guard hairs were compared with those from a reference hair collection comprising all the potential prey species from the area.

The hair samples from the scats were first washed in hot water. Subsequently, they were thoroughly air dried and then cleared in ether for one hour to remove any wax depositions and traces of the moisture. Finally, the hairs were passed through Xyloc for 24 h and mounted with DPX into permanent slides to see the medulla structure of the hairs. A gelatin solution was used to prepare the slides for cuticular structure visualization and cuticular scales were observed using impression techniques. The slides were observed under a light microscope (400x) and digital photos were taken to visualize the cuticular and medulla pattern of the hair samples. At least twenty hair samples were taken from each fecal sample for analysis. The prey residue composition of the predator scats was extrapolated in terms of the frequency of occurrence of the prey species in the scat samples (Fi), calculated by equation I (Karanth and Sunquist, 1995; Mizutani, 1999; Pikunov and Korkishko, 1992; Ramakrishan et al., 1999; Aryal and Kreigenhofer, 2009).

\[ Fi = \frac{ni \times 100}{N} \]

Where \( ni \) is the number of scats where a given i-th prey species residue occurs and \( N \) is the total number of all scats samples.

**RESULTS**

**Diet composition of the red fox (**Vulpes vulpes**)**

The frequency of occurrence of different prey species in the scats of the red foxes of this study are found in Table 1. Excluding zero values, there are no significant differences between the frequencies of different prey species in the red fox diet (\( \chi^2 = 0.86, df = 12, p > 0.05 \)). The pika (Ochotona roylei), which was found in 30% of the samples, was the most frequently found prey species in the red fox diet. Wild boar (Sus scrofa) was the second most frequently occurring prey animal (11%). The remaining high frequency items found in these fecal samples were vegetation (25%) and non-food items (13%). Other prey items found include insects, serow, and musk deer, amongst others (Table 1).

**DISCUSSION**

There is a significant increase in the abundance of scats...
Table 1. Occurrence of prey frequency in red fox scats (n=85).

<table>
<thead>
<tr>
<th>Prey species</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pika</td>
<td>508</td>
<td>29.88</td>
</tr>
<tr>
<td>Vegetation</td>
<td>421</td>
<td>24.76</td>
</tr>
<tr>
<td>Non food item</td>
<td>221</td>
<td>13.00</td>
</tr>
<tr>
<td>Wild boar</td>
<td>192</td>
<td>11.29</td>
</tr>
<tr>
<td>Insect</td>
<td>176</td>
<td>5.41</td>
</tr>
<tr>
<td>Himalayan Serow</td>
<td>62</td>
<td>3.65</td>
</tr>
<tr>
<td>Monkey</td>
<td>45</td>
<td>2.65</td>
</tr>
<tr>
<td>Himalayan Musk deer</td>
<td>41</td>
<td>2.41</td>
</tr>
<tr>
<td>Birds</td>
<td>44</td>
<td>2.59</td>
</tr>
<tr>
<td>Goral</td>
<td>26</td>
<td>1.53</td>
</tr>
<tr>
<td>Goat</td>
<td>23</td>
<td>1.35</td>
</tr>
<tr>
<td>Blue sheep</td>
<td>25</td>
<td>1.47</td>
</tr>
</tbody>
</table>

The study strongly recommends that concerned governments initiate conservation programmes for carnivores in this area, including the red fox.

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