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## Feeding habits of the Eurasian lynx in the Swiss Jura Mountains determined by faecal analysis

Jean-Marc WEBER\* and Michel WEISSBRODT

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The feeding habits of the Eurasian lynx were investigated in the Swiss Jura Mountains. Fifty one food items were identified in 38 scats of which most were collected on lynx tracks. Wild ungulates - roe deer and chamois - contributed 47.1% of the overall diet, while hare and rodents represented 19.6% and 17.6% of the prey items.

Sablons 30, 2000 Neuchâtel, Switzerland (J-MW); rue de Monchevaux 8, 2022 Bevaix, Switzerland (MW)

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### Introduction

Eradicated in the 19th century, the Eurasian lynx *Lynx lynx* (Linnaeus, 1758) was reintroduced into Switzerland more than two decades ago. From 1971 to 1976, 16 individuals in total were officially released in the northern Alps and in the Jura Mountains (Breitenmoser 1983). This reintroduction was considered successful as both populations expanded rapidly (Breitenmoser and Haller 1987a, Breitenmoser and Baettig 1992). Moreover, long-term monitoring of this newly-established top predator has provided some valuable information, particularly on its feeding ecology. In the Swiss Alps, as in most of its European range (ie Hell 1973, Birkeland and Myrberget 1980, Pulliainen 1981, Jędrzejewski *et al.* 1993), lynx feeds predominantly on wild ungulates. Smaller prey such as hares and rodents are also incorporated in the diet with the latter, however, being of negligible importance to the lynx in the Alpine area (Breitenmoser and Haller 1987b, 1993). In the Jura Mountains, the feeding habits of the lynx shows some similarity to those in the Alps, with wild ungulates representing nearly 90% of the prey. The red fox *Vulpes vulpes*, however, was the most frequent alternative prey taken by the lynx (U. Breitenmoser, pers. com.). As dietary analyses to date have been made from kills only, the occurrence of smaller prey items in lynx diet have been almost certainly neglected. Therefore, in order to fully determine the diet of the lynx in the Jura Mountains, we examine here its feeding habits through faecal analysis.

\*Present address: KORA, Thunstr. 31, 3074 Muri, Switzerland

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## Study area and methods

Lynx faeces were collected over an approximate 10 km<sup>2</sup> area, most of which is situated in the 'Creux du Van Nature Reserve', Swiss Jura Mountains (46°56'N, 6°44'E; altitude: 800–1400 m). Spruce (*Picea abies*)-dominated forest is the primary habitat in the area, predominantly covering the mountain slopes, whereas open pastures and wooded pastures are located mainly on the mountain tops. Broken up with rocky ledges and cliffs, the relief of the northern slopes is quite rugged. As the climate is wet and cold, a significant snow-cover is usually present from late autumn to early spring. Its presence constituted a great advantage, as it made faecal collection 'easier' and identification reliable. From 1979 to 1986, lynx tracks were followed by one of us (MW), and lynx droppings found on the tracks systematically picked up. Seven scats were also collected around a lynx lair in summer 1985. Sampling food habits based on faecal collection in an unbiased manner is difficult. Here, the sampling may suffer from some bias, since more than one scat was collected on the same lynx track on several occasions.

Scat analysis and identification of remains were made following Day (1966) and Debrot *et al.* (1982). Results are expressed as relative frequency of occurrence.

## Results and discussion

A total of 38 scats was collected, and 51 food items identified (Table 1). Wild ungulates, roe deer *Capreolus capreolus* and in a lesser extent chamois *Rupicapra rupicapra*, were the most frequent component of lynx diet, contributing 47.1%.

Table 1. Diet composition of lynx in the Swiss Jura Mountains. O – occurrence, RFO – relative frequency of occurrence (%) of the prey items in the scats ( $n = 38$ ).

Item	O	RFO
Lagomorphs	10	19.6
Brown hare <i>Lepus europaeus</i>	10	19.6
Rodents	9	17.6
Red squirrel <i>Sciurus vulgaris</i>	2	3.9
Water vole <i>Arvicola terrestris</i>	2	3.9
Common/field vole <i>Microtus</i> sp.	2	3.9
Bank vole <i>Clethrionomys glareolus</i>	1	2.0
Garden dormouse <i>Eliomys quercinus</i>	2	3.9
Ungulates	24	47.1
Roe deer <i>Capreolus capreolus</i>	15	29.4
Chamois <i>Rupicapra rupicapra</i>	7	13.7
Domestic goat <i>Capra hircus</i>	2	3.9
Birds	4	7.8
Passeriformes	4	7.8
Insects	2	3.9
Coleoptera	2	3.9
Fruits	2	3.9
<i>Prunus</i> sp.	2	3.9

Smaller mammalian prey, such as the brown hare *Lepus europaeus* and rodents, also occurred in significant proportions in the diet, representing 19.6% and 17.6% of the food items, respectively. Birds, exclusively passeriformes (7.8%), were taken occasionally by the lynx, as were insects and fruits, both found twice (3.9%) in the scats.

Although our approach gives only a qualitative impression of lynx diet and does not take into account the bulk of each prey category, our findings suggest that the lynx in the Jura Mountains might incorporate smaller prey in the diet more frequently than expected from previous work (Liberek 1992). Even if ungulates ranked first in importance in the diet, more than 50 % of the food items identified in the scats were prey of a much smaller size than ungulates, mainly lagomorphs and rodents. Unlike Liberek (1992), we did not record the red fox amongst the prey. According to this author, predation on the red fox by the lynx is uncommon, and where it occurs it may result from individual specialization to this prey. Predation on small-sized prey is not infrequent, and has been reported for the lynx all over its range (ie Breitenmoser and Haller 1987b, Pulliainen *et al.* 1995, Okarma *et al.* 1997). Nevertheless, its importance varies greatly according to region. For instance, in the Alps, lagomorphs and rodents represent less than 10% and 4% (by frequency) of the prey items, respectively (Breitenmoser and Haller 1987b). In contrast, hares contribute up to 42% of lynx prey in SW Finland, whilst rodents contribute 12% (Pulliainen *et al.* 1995).

Unlike its North American and Spanish counterparts, the Eurasian lynx is a predator built to feed primarily on medium-sized ungulates such as roe deer (Pulliainen 1981). Should those prey be scarce or absent, the lynx adapts its feeding strategy accordingly, and lagomorphs usually become its main prey (Jedrzejewski *et al.* 1993, Pulliainen *et al.* 1995). In these circumstances, could low ungulate availability in the Jura Mountains be responsible for the high relative contribution of small-sized food items in the diet of local lynx? Probably not. Although chamois are less abundant than roe deer in these mountains, ungulate numbers are still high enough, apparently, to fulfil the trophic requirements of the lynx (Breitenmoser and Baettig 1992).

Like many solitary carnivores, the Eurasian lynx exhibits sex-related differences in prey selection, males hunting usually larger prey than females (Pulliainen *et al.* 1995, Okarma *et al.* 1997). Moreover, the Polish study also suggests that prey choice could be influenced by age since subadult lynx, beside single adult females, fed more frequently on brown hares than other individuals. Probably not efficient enough in catching large ungulates, younger individuals, thus, would find in lagomorphs a more adequate prey to hunt. In this respect, Okarma *et al.* (1997) consider the brown hare a crucial alternative prey for the survival of subadult lynx during their first year of independence.

In the Jura Mountains, subadult lynx are often much smaller than adults when they disperse (Breitenmoser *et al.* 1993). Considering that most scats were collected at the very beginning of the dispersal period (late winter), the frequent occurrence

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of hare and rodents in the remains could partly reflect the feeding habits of younger individuals and, if so, would confirm the essential role of alternative prey such as the brown hare at this stage of their life. In addition, this raises the question of to what extent severe changes in the availability of alternative prey such as the permanent brown hare population decline recorded in Switzerland could put the lynx population at risk in areas like the Jura Mountains.

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