

## BADGER *MELES MELES* AND FOX *WLPES WLPES* FOOD IN AGRICULTURAL LAND IN THE WESTERN PO PLAIN (ITALY)

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**ABSTRACT** – Fox and badger diets were studied by means of scat analysis in agricultural land in northern Italy. Earthworms and corn were the staple **food** for the badger, while **foxes** fed mainly on animal food (birds and mammals). Dietary overlap between the two species was low. Fox diets were substantially similar to those in north-central Europe and other areas of Italy. Badger diets differed from those in mediterranean areas of Italy and were similar to diets of north European populations.

**Key words:** badger, diet, fox, Northern Italy

**RIASSUNTO** – *Alimentazione di Tasso Meles meles e Volpe Vulpes vulpes in aree agricole della Pianura Padana occidentale* – La dieta di tasso e volpe in un'area agricola della Pianura Padana occidentale è stata studiata mediante analisi delle feci. Lombrichi e **mais** rappresentano la principale fonte alimentare per il tasso, mentre la dieta della volpe è basata prevalentemente **su uccelli e mammiferi**. La sovrapposizione alimentare fra **le** due specie è ridotta. La dieta della volpe è simile a quella delle **popolazioni** dell'Europa centrale e settentrionale; **la** dieta del **tasso** differisce nettamente da quella delle popolazioni italiane che vivono in ambiente mediterraneo.

**Parole chiave:** Dieta, Italia settentrionale, Tasso, Volpe

### INTRODUCTION

Badgers and foxes diets have been well-studied in northern and central Europe (see Kruuk, 1989 for further references), while less research has been conducted in the southern part of their range. Ciampalini and Lovari's (1985) study of the feeding habits of the two species was carried out in a mediterranean lowland habitat in which the pattern of seasonal food availability is presumably different from the Po plain, which is characterized by a temperate climate. Prigioni et al. (1988) studied the seasonal variability in diet of the two species and provided summary information.

Several studies on the dietary habits of allopatric populations living in Italian lowlands have been carried out in recent years on both foxes (Prigioni, 1991; Prigioni and Tacchi, 1991; Cantini, 1991; Pandolfi and Bonacoscia, 1991) and badgers (Rosa, 1986; Pigozzi, 1991).

The aim of our study was to describe the dietary habits and diet overlap in sympatric populations of badgers and foxes living in an agricultural region of northern Italy.

Tab. 1 – Frequency of food items in badgers and foxes diets in the study area, NW Italy, 1988-89.

FOOD SOURCE	BADGER	TOTAL FOR MAIN RESOURCE	Fox	TOTAL FOR MAIN RESOURCE
ANELLIDA		20		1
Earthworms	20		1	
INSECTA		14		8
Insecta unidentified	1			
Ortoptera	1			
Coleoptera	8		6	
Lepidoptera	4		2	
AMPHIDIA		5		
Frogs	5			
AVES		1		9
Mallard	1		2	
Moorhen			3	
Pheasant			3	
Cock			1	
MAMMALIA		10		21
Shrew unidentified			3	
Rabbit			9	
Rodentia unidentified	5		1	
Brown rat			2	
Wood mouse	4		4	
House mouse			2	
Savi pine vole	1			
VEGETALS		35		11
Rosaceae unidentified	6			
<i>Prunus</i> sp.	7			
<i>Rubus</i> sp.	2		2	
<i>Vitis vinifera</i>	1			
<i>Zea mays</i>	18		8	
<i>Triticum aestivum</i>	1		1	

#### STUDY AREA AND METHODS

The study was carried out from March 1988 to March 1989 in the "Garzaia di Valenza" Nature Reserve located along the Po river in Alessandria province. The study area was composed by agricultural land, extensively covered by cereal crops and rice fields, the most common cultivar, and by poplar (*Populus* sp.) plantations. Willow (*Salix* sp.) woodland and natural phytocenosis are rare in the study area, forming a small portion in the inner sector of the Reserve and bordering the river banks.

The study area (898.3 ha) was divided into four sectors ( $x=224.6$  ha,  $SD=97.7$ ) characterized by the presence of one or more badger sets; a

transect (1500x4 m) was selected in each sector and then checked every two months in order to collect carnivore scats.

Badger and fox scats were collected along the four transects, stored in plastic bags and deep-frozen, as suggested by Kruuk and Parish (1981). Badger scats (n=53) were collected only from known latrines and their exact number could not always be assessed since sometimes scats were agglutinate due to rain action; fox scats (n=33) were collected in the neighbourhood of the transects; no vagrant dogs were observed during the study periods and since hunting is not allowed in the Nature Reserve we consider the possibility of bias in scat collection to be very low.

After defrosting, scats content was washed in three sieves with decreasing meshes. The contents were then analyzed following the routine methods proposed by Kruuk and Parish (1981). The data are presented as the frequency of occurrence of each food category and its estimated volume when present in scats.

Diet overlap was assessed by the index  $2 \sum x_i y_i / \sum x_i + \sum y_i$  (Goszczyński, 1986), where  $x_i$  and  $y_i$  are the use proportion of the same food resource by the species  $x$  and  $y$ ; its value range from 0 (no diet overlap) to 1 (complete diet overlap).

## RESULTS

Frequency of occurrence and percentage frequency of each food source for both species are reported in Tab. 1 and Fig. 1, respectively; both data sets roughly estimate the importance of each food category in diet.

As confirmed by the low value of the overlap index (0.12), badger and fox diets differs; badgers mainly feed on corn and earthworms that made

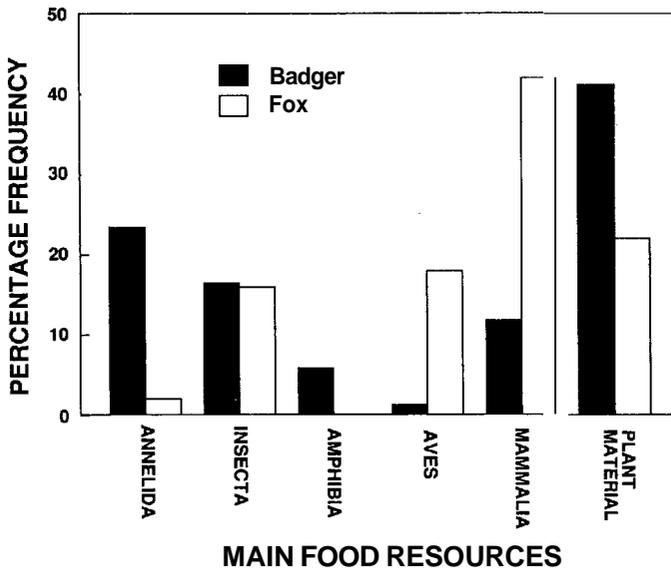


Fig. 1 - Percentage frequencies of the main food resources.

up more than **64%** of whole diet, while the diet of the fox was animal-formed, with birds and mammals accounting for more than 60%.

Secondary dietary components for both species were insects, plant material for foxes and frogs and mammals for badgers.

Corn was the main vegetal resource component for badgers, accounting for more than **51%**; small mammals prevailed among mammals. Foxes preyed on both small and medium sized mammals such as wood mice (*Apodemus sylvaticus*) and rabbit (*Oryctolagus cuniculus*); Tab. 1 shows that foxes also preyed on game birds such as mallards (*Anas platyrhynchos*), pheasants (*Phasianus colchicus*) and domestic birds.

Dietary data are further elucidated in Fig. 2 where the percentage of occurrence of certain food resources and their estimated volume are plotted. Badger diets may be summarized as follows: earthworms and corn were present in a high number of scats in high volume; fruit and coleopterans occurred with an intermediate frequency and with the lowest (fruit) and highest (coleopterans) estimated volumes. A third conspicuous group of food resources rarely occurred in scats but had high volume.

Fox annual diet was composed of a first animal food group (birds, small mammals and rabbits) that appeared in about one third of the scats in high quantity, a second group of prey that appeared rarely in scats and with intermediate volume (mainly insects and corn) and earthworms, occasionally present in scats and in low volume.

## DISCUSSION

As an obvious premise it should be remembered that because of the low sample of scats any results must be considered cautiously. On the other hand the badger and fox populations in the study area seem to be small and strongly localized; the number of scats should therefore be related to the low abundance of carnivore populations.

Fox diet appeared to be similar to those described for north-central Europe and for all the Italian range falling in the temperate climate zone. The pattern described here, with foxes mainly eating mammals and birds is indeed consistent with Goszczyński (1974, 1986), Frank (1979), Lloyd (1980) and others. The same pattern is reported in studies analysing a larger sample of scats and carried out in temperate areas of the Italian range (Prigioni and Tacchi, 1991; Pandolfi and Bonacoscia, 1991; Cantini, 1991). The comparison with Prigioni and Tacchi (1991) appears to be the most interesting, since their study was carried out in an area of plain near our study area and a larger sample; the only obvious differences between our data and theirs is that our foxes overexploit corn and prey on rabbits, while in their study area rats were preyed on in the medium sized mammal category. The substantial agreement of the results suggests that our small sample gives effective information on

foxes' dietary habits; small differences in the type of diet, such as the prevalence of rats, are probably due to a higher density of human settlement, which favours a high availability of commensal rodents such as rats, in area studied by Prigioni and Tacchi (1991).

Badger diet substantially differed from previous research carried out in the Italian range. Ciampalini and Lovari (1985) and Pigozzi (1991) found a strong prevalence of fruit and arthropods in badger diet; moreover earthworms occurred rarely and in small quantities and corn was absent in the data of these authors. Their results are similar to those reported by Rodriguez and Delibes (1992) in dry areas of Spain.

Conversely, our data appear to be more similar to that from north-central Europe (Kruuk and Parish, 1981; Kruuk, 1989), where earthworms, as in our study area, were a staple food; the importance of cereal food is also similar to data reported by these authors, even though in our case corn was consumed instead of oats and barley and in slightly higher quantities.

Even the other food categories such as small mammals and plant materials fall within the 1% and 5% isophlets (Fig. 2), as reported in a general review by Kruuk (1989); fruit occurred rarely but in high volume, probably reflecting a irregularly distributed food source in our study area.

The role of a worm-based diet in shaping the social system of the badger in northern Europe, and, conversely, the different social behaviour of this species in arid areas where worms are scarce, has been discussed by Kruuk (1989) for the former areas and by Ciampalini and Lovari (1985) and Pigozzi (1987a and 1987b, cited in Kruuk 1989) for the latter.

Far from confirming anything about the badger social system, our data on its dietary habits seems to attest that the populations living in the

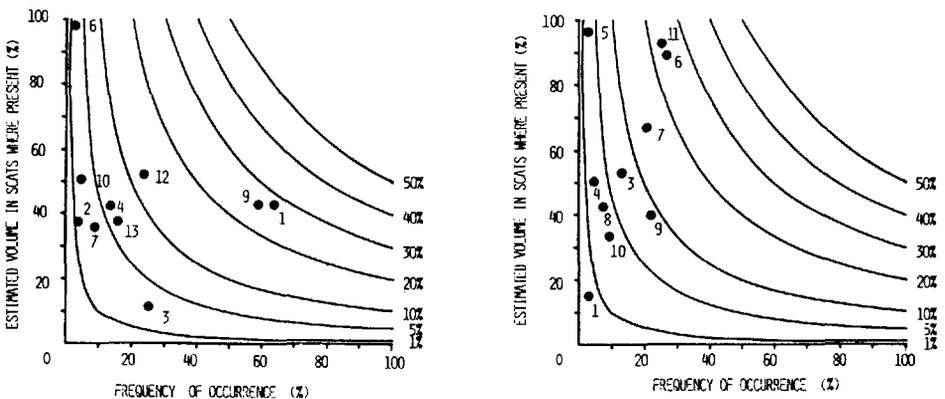


Fig. 2 – The annual diet of badger (left) and fox (right). The isophlets connect points of equal importance in the total diet. (Food categories: 1=Annelida, 2=Orthoptera, 3=Carabidae, 4=Lepidoptera, 5=Erystalidae, 6=Aves, 7=Rodentia, 9=corn, 8=Insectivora, 10=other plant materials, 11=Leporidae, 12=fruit, 13=Amphibia).

northern Italian plain behave like the northern European ones and confirm that feeding habits differ between populations living in temperate and mediterranean areas.

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