CORE
Metadata, citation and similar papers at core.ac.uk
Provided by I-Revues

FOOD HABITS AND TROPHIC NICHE VARIATION OF THE RED FOX *VULPES VULPES* (L., 1758) IN A MEDITERRANEAN COASTAL AREA

Marco CALISTI*, Barbara CIAMPALINI*, Sandro LOVARI** and Mauro LUCHERINI**

The flexible social organisation of the Red fox and its ability to adapt readily to environmental changes allow this Canid to survive, and often to establish flourishing populations, in a variety of environments. Therefore it is hard to draw general conclusions on many aspects of its biology, the parameters of which tend to vary locally. In particular, a thorough knowledge of its food habits and of their variation throughout the year is mandatory for any study on habitat use and pattern of distribution of this Canid (Macdonald, 1983).

There have been few studies of the food habits of the Red fox in southern Europe (e.g. Amores, 1975 ; Braña & Del Campo, 1980 ; Rau *et al.*, 1985, for Spain ; Reynolds, 1979, for S. France ; Leinati *et al.*, 1960 ; Macdonald *et al.*, 1980 ; Ciampalini & Lovari, 1985 ; Pandolfi & Marcon, 1985, for Italy). While most of the studies were conducted in mountain regions, only Reynolds (1979), Rau *et al.* (1985) and Ciampalini & Lovari (1985) studied the diet of the Fox in coastal areas. Two of these studies were undertaken to assess potential competition with the Spanish Lynx *Lynx pardina* in the Coto Doñana, S. Spain (Rau *et al.*, 1985), and with the Badger *Meles meles* in an area south of the mouth of the Ombrone river, Grosseto province, Italy (Ciampalini & Lovari, 1985). While the dietary niches of the Lynx and the Fox showed little overlap, if any, the Badger diet was found to be very similar to that of the Fox. The Spanish study was carried out in a dense Mediterranean scrub and a wetland area. The Italian study was done in a variety of habitats to give an overall picture of the food habits of the Fox.

As a preliminary study of the effect of environmental variables, notably food resources, on the use of habitat by the Red fox, we present in this paper a detailed picture of the Fox diet on a monthly basis, which allows us to estimate the breadth of its trophic niche and to correlate variations in diet composition with climatic seasonality.

MATERIAL AND METHODS

Fox scats (n = 325) were collected between April 1982 and March 1983 (sample size : A-M, n = 18 ; J, n = 11 ; J ; n = 17 ; A, n = 22 ; S, n = 19 ; O,

* Dipartimento di Biologia Ambientale, Università di Siena, I-53100 Siena.

** Zoologia e Anatomia Comparata, Dipartimento di Biologia Cellulare, Via F. Camerini 2, I-62032 Camerino (MC). Requests for reprints should be sent to this address (c/o S. Lovari).

n = 19 ; N, n = 25 ; D, n = 54 ; J, n = 51 ; F, n = 43 ; M, n = 46). The faeces were collected every fortnight along a *ca.* 6-km itinerary crossing the study area.

Each scat was subsequently analyzed as described by Kruuk & Parish (1981) and Ciampalini & Lovari (1985). All samples were soaked in a solution of water and formalin, and then rinsed under running water in a tea-sieve (1.3 mm mesh). The fine sediment was then examined under a binocular microscope (magnification × 40) to determine the presence of earthworm chaetae. The food remains were placed in a dish for identification and estimation, by eye, of the percentage volume of each category of food in the total ingested volume. For further details see Kruuk & Parish (1981) and Kruuk & De Kock (1981). The results were analyzed on :

(A) a monthly basis as : *i.* a percent frequency of occurrence in the total faeces ; *ii.* a volume percentage of the total estimated volume (Kruuk & Parish, 1981) ; as only a few scats were found in the first days of May, these were included in the April sample.

(B) on a seasonal basis, comparing the volume percentage with the percent frequency. The purpose of this method was to give as objective a picture as possible of the importance of the staple components of the Fox diet.

Following the suggestion of Ricklefs (1980 : 745) to estimate the trophic niche breadth, the Levins (1968) Index was applied to the frequency and volume of the various food categories. The Levins Index formula is :

$$B = 1 \Big/ \sum_{i=1}^{n} p_i^2$$

where *n* is the number of food categories and *p* is the proportion of records in each food category (*i*) set at 100 %. The trophic niche breadth value was calculated monthly to emphasize its seasonal variations.

Correlations were calculated using the Spearman rank correlation coefficient (Siegel, 1980).

STUDY AREA

The research was carried out inside the Maremma Natural Park (*ca.* 10 000 ha), Grosseto province, along the Tyrrhenian coast of central Italy (42° 39′ N, 11° 05′ E).

The transect along which the scats were collected mostly crossed meadows (representing about 70 % of total itinerary), where the vast majority of scats were found : it also included some scrub woodland (*macchia*), pinewoods (*Pinus pinaster, P. pinea*) and wetlands. For a detailed description of the vegetation of this area, see Arrigoni *et al.* (1976).

Inside the park the use of pesticides is not allowed and there is therefore no artificial control of the number of invertebrates.

RESULTS

Description of the diet

By and large, plants made up the bulk of the diet, representing more than 65 % of the autumn and winter total volumes, but dropping to *ca.* 50 % and 40 % in summer and spring respectively (Fig. 1).

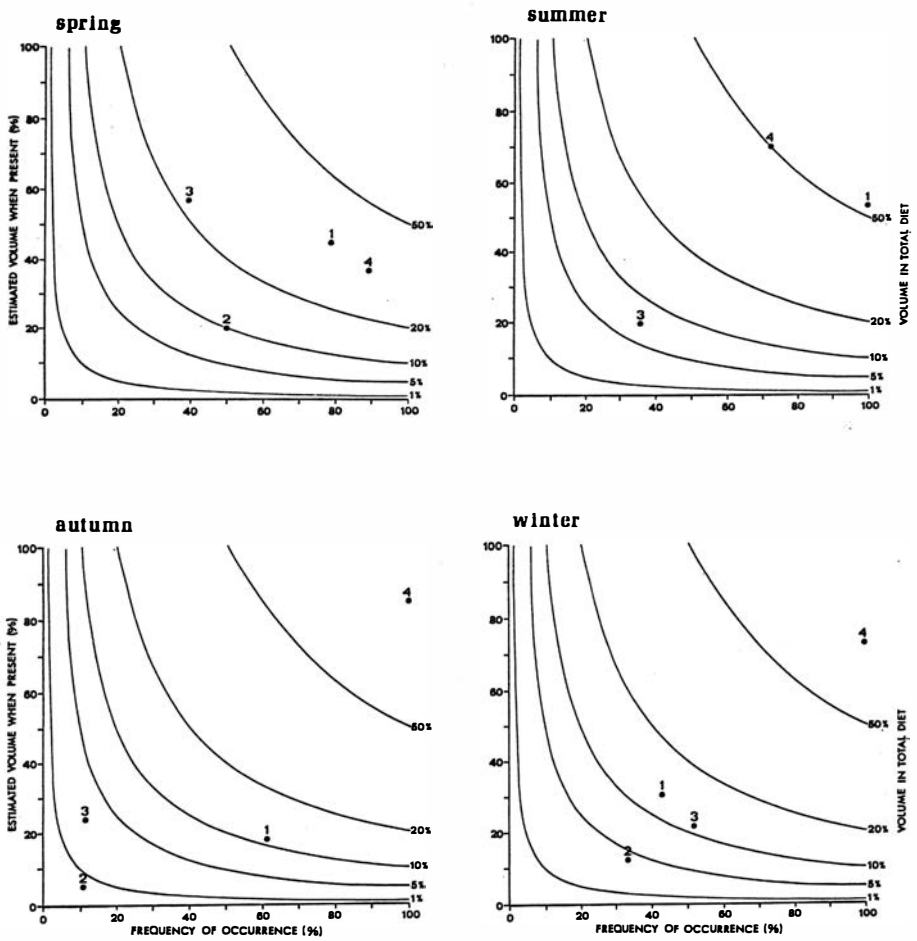

Figure 1. — Estimated volume of the main food categories, versus their frequency of occurrence. Isopleths connect points of equal relative volume in the overall diet. Seasonal data. 1 : Insects ; 2 : Other Invertebrates ; 3 : Vertebrates ; 4 : Fruit.

In particular, the berries of *Juniperus oxycedrus* proved to be the main dietary item of Foxes in our study area. In fact, these berries were found in the scats with a frequency of more than 50 % every month except July and August (Fig. 2). A comparison of the percentages of occurrence with the volumetric data (Fig. 3) shows that the maximum consumption of juniper berries took place between October and February (> 65 % in volume). Conversely, during the spring and summer months these berries were far less frequent in the faecal samples. It is worth noticing here that the berries of another juniper (*J. phoenicea*), also present in the study area, were far less often consumed, and only from August to November. Other food of vegetable origin was also present in the diet at a relatively high frequency. The seeds of the Italian Stone Pine (*Pinus pinea*) were

eaten in all months except June, but more often between January and May (Fig. 2). Their volume percentage (Fig. 3) confirms that these seeds are a far from negligible food source for the Fox in our study area. Blackberries (*Rubus* sp.) and fruits of the Strawberry Tree (*Arbutus unedo*) were also identified in the scats. The consumption of these foods was highly seasonal. In fact, blackberries were eaten during the three summer months, while the fruits of the Strawberry Tree were consumed during autumn and winter (Fig. 2 and 3).

Insects represented the second most important group of dietary items in autumn and winter, but they were of primary importance in spring and summer (Fig. 1). Orthoptera and Coleoptera were the most frequently consumed insect prey. They were present in the diet all year round, but particularly so in hot weather (Fig. 2). The percent frequency of Orthoptera increased sharply in April, and decreased equally sharply in November (Fig. 2). Their volume percentage was high only from June to September (Fig. 3). The beetles consumed were mostly Lamellicornia. The peak percent frequency of all Coleoptera was lower than that of Orthoptera in June and July ; the volume values were high between June and August (Fig. 2 and 3). The underground larvae of Lamellicornia were consumed throughout the year, except in July when the consumption of adult individuals reached its peak (Fig. 3). Cicada (*Cicada orni*) larvae were eaten in late spring and mostly in summer, whereas caterpillars were very seldom eaten in summer (Fig. 2 and 3). Myriapoda and Oligochaeta were found with a relatively high frequency in Fox scats, but never during the hottest months (Fig. 2). However, their volume percentages were almost always low (Fig. 3).

Vertebrates amounted to more than 20 % of the total dietary volume in spring (Fig. 1), but their remains were present in scats in every month, except October (Fig. 2 and 3). The most numerous component, the mammals, were present in the diet most frequently from March to June (Fig. 2 and 3). Most of them (*ca.* 75 %) were micromammals, but parts of carcasses of Wild boar were also eaten, although to a lesser extent. The mammalian volume percentages (Fig. 3) were rather high, compared with frequency of occurrence percentages, emphasizing the importance of mammals in the diet of the Fox. Birds were also regularly present in the diet, but they reached lower percentage values, both in frequency and in volume (Fig. 2 and 3). A few reptiles (lizards) and amphibians (anurans) were also present in the diet (Fig. 2 and 3).

To summarize, the main food categories of the Red fox in our study area were juniper berries, Orthoptera, Coleoptera and, to a lesser extent, mammals.

Correlations with seasonality parameters

Temperature and photoperiod are important parameters of climatic seasonality, which in turn is the major determinant of the availability of fruit and invertebrates at different times of the year. In fact the presence in the diet of some seasonal dietary items, such as certain invertebrates and fruit, was correlated with the mean monthly atmospheric temperature of the study area (Table I). The strongest positive correlations were obtained for Orthoptera ($p < 0.001$), *Cicada* larvae and blackberries ($p < 0.01$). The strongest negative correlations were found for juniper berries ($p < 0.001$) and pine seeds ($p < 0.01$). The level of significance for the negative correlations with earthworms was lower ($p < 0.05$).

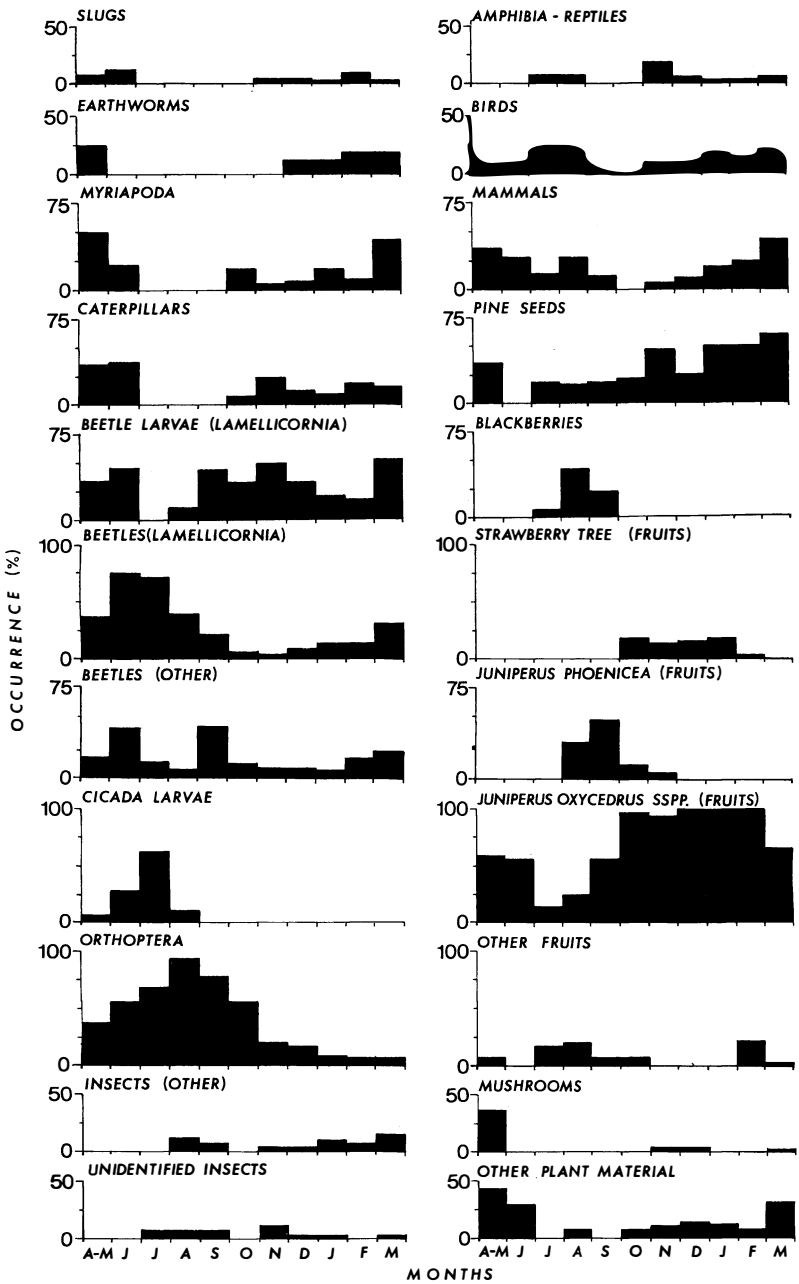

Figure 2. — Percentage of occurrence of the various food categories in the Red fox diet over a year.

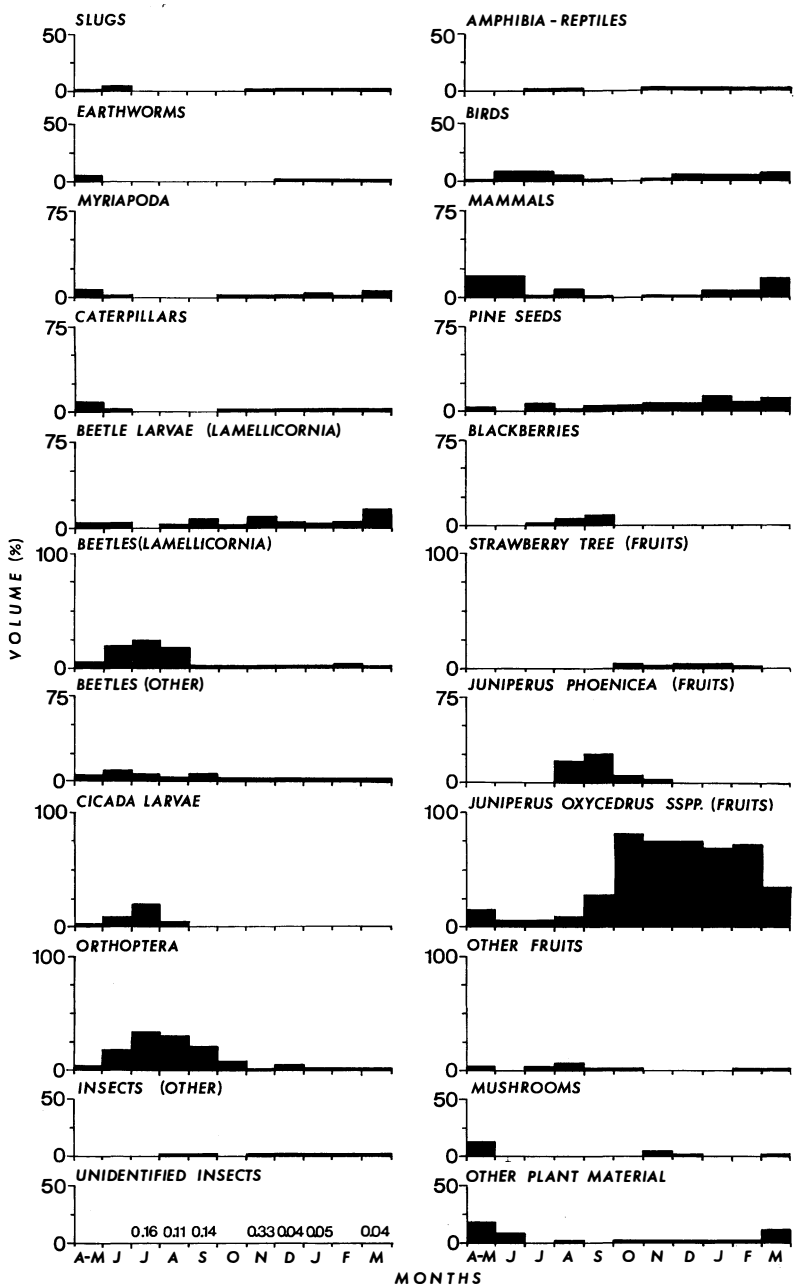

Figure 3. — Percentage of estimated volume of the various food categories in the Red fox diet over a year.

The positive correlation with Coleoptera Lamellicornia almost reached the significance level. The influence of photopheriod on diet was always similar to that of temperature (Table I).

TABLE I

Correlations, on a monthly basis, of food categories with temperature and photoperiod.

	Temperature		Photoperiod	
	t	Signific.	t	Signific.
Earthworms	− 2.92	*		
Beetles (Lamellicornia)	+ 2.15	AS	+ 5.42	***
Cicada larvae	+ 2.98	**	+ 5.13	***
Orthoptera	+ 7.98	***	+ 2.58	*
Pine seeds	− 4.13	**	− 2.16	AS
Blackberries	+ 3.42	**	+ 1.97	AS
Juniperus oxycedrus (fruits)	− 5.86	***	− 5.37	***

N = 11, d.f. = 10.
AS = Almost Significant ; * = $p < .05$; ** = $p < .01$; *** = $p < .001$.

On the basis of the bimodal frequency pattern in this diet and its correlation with temperature, a generalized picture can be drawn of the dietary variations over time. The positive correlations between environmental temperature and consumption of Coleoptera (Table I) indicate that these dietary items are predominantly consumed during the hotter months. By contrast, the negative correlation between temperature and frequency in diet of juniper berries indicates that their consumption takes place mostly during the colder months. In winter, invertebrates are scarce, and the consumption of juniper berries was inversely correlated both with that of Orthoptera ($t = -3.54$, $p < 0.01$ for frequencies ; $t = -2.12$, almost significant for volumes), and with Coleoptera ($t = -3.62$, $p < 0.01$ for frequencies ; $t = -4.04$, $p < 0.01$ for volumes). The juniper berries/mammal correlations were also negative ($t = -0.93$, not significant for frequencies ; $t = -2.84$, $p < 0.05$ for volumes).

We conclude that Orthoptera and Coleoptera, and to a lesser extent mammals, alternate as staple food in spring and summer when the consumption of juniper berries is reduced, probably because of changes in their availability.

Variation in trophic niche breadth

The two indices, Bv (calculated on the basis of volume percentages) and Bf (calculated on that of frequencies) provide information which, although not identical, is complementary (Table III). In fact, Bf, being based on objective data, is more reliable. On the other hand, while being based on a subjective estimate, Bv allows more realistic evaluations of the diet to be made on the basis of the quantity of food ingested.

TABLE II

Variation of the trophic niche breadth throughout the year.

The Levins index ranges between 1 and the number of all food categories in that month (maximum breadth).

	Bf	Bv	N° food categories
April-May	12.34	8.69	16
June	9.43	7.46	12
July	6.53	4.92	12
August	8.19	6.21	16
September	7.87	5.15	13
October	5.52	1.60	12
November	6.94	1.85	18
December	5.64	1.83	18
January	6.80	2.16	17
February	6.49	2.02	17
March	10.10	5.78	18

B = Levins index ; f = occurrence ; v = volume.

The trends of the two indices are almost parallel, but the Bf values are constantly higher than the Bv values. Consequently, although a number of food categories are frequently consumed, only some of them are quantitatively important. The maximum possible value of the Levins index for our study would be 22, but the value of 10 was rarely exceeded. As regards the monthly variations of the index, the pattern is clear : the trophic niche is narrowed in late autumn and winter, and is broader in spring and summer. For instance, even though 18 trophic categories are present in the December diet, the latter is essentially made up of a small number of food categories, whereas in June (only 12 categories present) the resources are exploited in a more balanced way.

The niche breadth variation is not correlated with the mean monthly temperature, although the Bv values are significantly associated with the photoperiod ($t = -2.96$, $p < 0.05$) implying that seasonal factors other than temperature may be involved.

DISCUSSION

The Fox is generally considered to be a « generalist », particularly as regards its food habits (Englund, 1965 ; Amores, 1975 ; Sequeira, 1980 ; Hockman & Chapman, 1983), on the basis of what is known in central and northern Europe, and in mountain environments. Can a similar picture now be drawn for the Mediterranean area ?

To do so, we compared our results with those of Reynolds (1979) for the Camargue, Rau *et al.* (1985) for the Coto Doñana, Bruni (1980, in Boitani & Vinditti, 1988) and Ciampalini & Lovari (1985) for the Grosseto Maremma (1),

(1) Ciampalini and Lovari's data refer to the Maremma Natural Park, whereas those of Bruni concern the Burano Sanctuary.

and with the still unpublished data of Fais *et al.* for Sicily. Making allowance for the different ways of assorting food remains and of analysing data, it is now clear that some general conclusions can be drawn (Table III).

TABLE III

Relative rank of abundance in diet of the major food categories of the Red fox in Mediterranean coastal areas.

	Fruits	Invertebrates	Vertebrates	Study area	N° of scats
Bruni (1980)*	1	2	2	Maremma	1 342
Ciampalini & Lovari (1985)	1	2	3	Maremma	208
Present study	1	2	3	Maremma	325
Fais *et al.* (in press)	2	1	3	Sicily	539
Reynolds (1979)**	3	2	1	Camargue	107
Rau *et al.* (1985)	3	1	2	Coto Doñana	487

* in : Boitani & Vinditti (1988).
** 99 scats and 8 stomachs.

Several common characteristics are obvious. First, vegetable food is everywhere important in the diet of the Mediterranean Red fox. It is mainly made up of fruits of *Juniperus* sp., seeds of *Pinus pinea* (in the Maremma and at Doñana), fruits of *Arbutus unedo* (Maremma) — all typical Mediterranean plants — berries of *Rubus* sp. (everywhere), and fruits of *Prunus* sp. (Camargue and Sicily) and *Pyrus* sp. (Sicily). At all study sites (even though the Camargue data only embrace six months and can hardly be used for such comparisons) there is a distinct increase in the use of these plant resources in the second half of the summer. Consumption remains high during the autumn, and then drops in winter, or at the beginning of spring. Thus, fruit consumption is relatively steady throughout the year, though their availability varies seasonally. Invertebrates are mainly consumed in spring and summer, insects being most commonly eaten around the Mediterranean, in contrast to Great Britain where earthworms are the favourite invertebrate prey of the Fox (cf. Macdonald, 1980). Among insects, the preferred groups are Coleoptera and Orthoptera (in all areas studied), as well as Odonata (Camargue) and *Cicada* larvae (Maremma). Finally, vertebrates seem to be preyed upon mainly in winter and spring, although they are also consumed in summer at the Coto Doñana and in the Camargue. Apart from micromammals and lagomorphs, reptiles, birds and carcasses of macromammals are also consumed in all the areas studied.

In order to understand why different proportions of fruits, invertebrates and vertebrates are found in Fox's diets in different areas, the first factor to be taken into consideration is the availability of these resources. In the Maremma Natural Park, where fruit was the Red fox's staple food, hares and rabbits were rare, and micromammals relatively so (L. Santini, *pers. comm.*). Phasianidae and Anatidae were also almost completely lacking. By contrast, in the area studied by Reynolds,

all the potential prey categories were abundant. In fact, in the Camargue, vertebrates were the staple food of Red foxes, although both insects and fruit were also frequent in their diet. Bruni's results are more surprising, since in the Burano Sanctuary both rabbits and numerous species of birds are available, and yet the main food were *Juniperus oxycedrus* berries. This suggests that the abundance of this fruit perhaps compensates for its low digestibility. In Sicily and Doñana, too, Red foxes could feed extensively on vertebrates, but invertebrates made up the bulk of their diet in both areas.

Therefore, bearing in mind the intrinsic differences between study areas, one may conclude that in the European Mediterranean region : (1) invertebrates, particularly insects, seem to play an important role in the Fox diet throughout the year, except in winter ; (2) in certain seasons (particularly in autumn) fruits may be extensively consumed, probably in proportion to their availability ; (3) vertebrates often do not represent the most important animal prey ; (4) around the Mediterranean, as elsewhere, the trophic behaviour of the Red fox is apparently opportunistic.

Climatic factors play a major role in determining the diet of the Red fox, as monthly variations of temperature and photoperiod have proved to be significantly correlated with the frequency of consumption of fruits and insects (Table I). Furthermore, the trophic niche breadth values calculated from the volume percentages are also correlated with the photoperiod (see above). Analysis of the trophic niche breadth of the Fox at Maremma (Table II) shows that the period during which its diet is limited to a small number of food categories corresponds to autumn and winter, i.e. when Foxes consume the largest amount of juniper berries. One can therefore hypothesize that in our study area the availability of trophic resources during the autumn and winter months is low, and that Foxes are consequently forced to content themselves with juniper berries and the few other food items still available. The Fox has a short and simple digestive tract, typical of Carnivores, which is little adapted to the assimilation of vegetable food. Indeed, many juniper berries eaten by our animals were often found almost intact in their faeces. For this reason it is to be expected that, concomitantly with a diet essentially based on this fruit, the transit time would decrease, due both to the poor digestibility of this food item and to the need to ingest it in large amounts in order to cover the Foxes' energy requirements. This hypothesis is indirectly supported by the significant correlation found between the number of scats collected along our transect and the amount of *Juniperus oxycedrus* berries in the diet ($t = 3.42$, $p < 0.01$ for frequency ; $t = 2.62$, $p < 0.05$ for volume).

However our conclusions regarding the trophic niche of the Red fox in the Mediterranean area need to be supported by further research aimed at examining the relationships between food availability and food choice, and between food choice and Fox ranging behaviour (Cavallini & Lovari, *in prep.*). It will also be necessary to determine the nutritional value of the fruits and insects consumed.

Finally, we would like to emphasize the usefulness of the Levins Index for such studies. This index is a simple tool for studying the trophic niche breadth and its variation in time. However, great care should be taken when using it to compare different areas and, above all, different studies. The range of values that B can assume is directly dependent on the number of food categories into which the diet is subdivided. Moreover, it is obvious that this number varies as a function of the availability of food sources in the study areas.

SUMMARY

The diet of the Red fox *Vulpes vulpes* was studied by faecal analysis in a coastal area of central Italy (Maremma). Orthoptera and Coleoptera predominated in the diet in spring and summer, whereas juniper berries were the staple food during the rest of the year, when the trophic niche of the Fox was narrowest. Vertebrates were taken mainly in spring, but their importance in the overall diet remained small (10 %). Seasonal variations in diet and trophic niche breadth were significantly correlated with variations of temperature and photoperiod. The comparison with other studies carried out in Mediterranean habitats emphasizes the importance of invertebrate food and fruit (seasonally) in this area. The opportunistic foraging strategy of this Canid is confirmed.

RÉSUMÉ

Le régime alimentaire du Renard roux *Vulpes vulpes* a été étudié par analyse des faeces dans la zone côtière italienne de la Maremma. Les Orthoptères et les Coléoptères constituent les éléments dominants du régime au printemps et en été, tandis que les baies de genêvriers (*Juniperus oxycedrus*) le deviennent durant le reste de l'année. Pendant cette dernière période on a constaté une réduction sensible de la niche trophique. C'est au printemps que la consommation de Vertébrés atteint son maximum, bien que leur importance dans le régime total reste toujours faible (10 %). Les variations mensuelles du régime et de l'amplitude de la niche trophique sont significativement corrélées avec les variations de la température et de la photopériode. Une comparaison avec les autres études du régime du Renard en région méditerranéenne révèle l'importance, dans cette zone, des Invertébrés et, saisonnièrement, des fruits. La stratégie alimentaire opportuniste du Renard roux est, une fois de plus, confirmée.

ACKNOWLEDGEMENTS

We wish to thank I. Boschi, Director of the Maremma Natural Park, for supporting our work from the very start, and H. Kruuk, who encouraged us to undertake this study. Thanks are also due to J. Burge and J.B. Hutchison for having helped in the translation of the manuscript. Two anonymous referees made valuable suggestions and one of them also greatly improved the structure of our paper. Financial support was provided by the Maremma Natural Park Agency.

REFERENCES

AMORES, F. (1975). — Diet of the Red fox (*Vulpes vulpes*) in the Western Sierra Morena (South Spain). *Doñana Acta Vertebrata,* 2 : 221-239.

ARRIGONI, P.V., GELLINI, R., INNAMORATI, M., LENZI-GRILLINI, C., LOVARI, S., RENZONI, A., SANESI, G. & SARTONI, G. (1976). — Relazione al Consorzio per l'istituzione del Parco della Maremma. *Inf. Bot. Ital.,* 8 : 283-324.

BOITANI, L. & VINDITTI, R.M. (1988). — *La volpe rossa,* Edagricole, Bologna.

BRAÑA, F. & DEL CAMPO, J.C. (1980). — Estudio de la dieta del zorro (*Vulpes vulpes* L.) en la mitad occidental de la Cordillera Cantabrica. *Boletin de Ciencias de las Naturaleza, I.D.E.A.,* 26 : 20-30.

CIAMPALINI, B. & LOVARI, S. (1985). — Food habits and trophic niche overlap of the Badger (*Meles meles* L.) and the Red fox (*Vulpes vulpes* L.) in a Mediterranean coastal area. *Z. Säugetierk.*, 50 : 226-234.

ENGLUND, J. (1965). — Study on the food ecology of the Red fox (*Vulpes vulpes*) in Sweden. *Viltrevy*, 3 : 375-485.

FAIS, I., COSTANZO, N. & MASSA, B. (in press). — Posizione trofica della volpe (*Vulpes vulpes* L.) in Sicilia. Analisi preliminare. In : *Atti I Simposio Italiano sui Carnivori*, Pavia.

HOCKMAN, J.G. & CHAPMAN, J.A. (1983). — Comparative feeding habits of the Red foxes (*Vulpes vulpes*) and Grey foxes (*Urocyon cinereoargenteus*) in Maryland. *Amer. Midl. Natur.*, 110 : 278-285.

KRUUK, H. & DE KOCH, L. (1981). — Food and habitat of Badger (*Meles meles* L.) on Monte Baldo, Northern Italy. *Z. Säugetierk.*, 46 : 295-301.

KRUUK, H. & PARISH, T. (1981). — Feeding specialisation of the European badger (*Meles meles* L.) in Scotland. *J. Anim. Ecol.*, 50 : 773-788.

LEINATI, L., MANDELLI, G., VIDESOTT, R. & GRIMALDI, E. (1960). — Indagini sulle abitudini alimentari della volpe (*Vulpes vulpes* L.) nel Parco Nazionale del Gran Paradiso. *Clinica Veterinaria*, 83 : 1-24.

LEVINS, R. (1968). — *Evolution in Changing Environments*. Princeton N.J. : Princeton University Press.

MACDONALD, D.W. (1980). — The Red fox, *Vulpes vulpes*, as a predator upon earthworms, *Lumbricus terrestris*. *Z. Tierpsychol.*, 52 : 171-200.

MACDONALD, D.W. (1983). — The ecology of carnivore social behaviour. *Nature*, 301 : 379-384.

MACDONALD, D.W., BOITANI, L. & BARRASSO, P. (1980). — Foxes, wolves and conservation in the Abruzzo mountains. *Biogeographica*, 18 : 223-235.

PANDOLFI, M. & MARCON, E. (1985). — Comportamento alimentare di *Vulpes vulpes* L. in un area appenninica del querceto misto caducifoglio. *S.I.T.E. Atti*, 5 : 723.

RAU, J.R., DELIBES, M., RUIZ, J. & SERVIN, J.I. (1985). — Can the increase of fox density explain the decrease in lynx numbers at Doñana ? *Rev. Ecol. (Terre Vie)*, 40 : 1-16.

REYNOLDS, P. (1979). — Preliminary observations on the food of the Fox (*Vulpes vulpes* L.) in Camargue, with special reference to Rabbit (*Oryctolagus cuniculus* L.) predation. *Mammalia*, 43 : 295-307.

RICKLEFS, R.E. (1980). — *Ecology*. Nelson & Sons, Sunbury-on-Thames

SEQUEIRA, D.M. (1980). — Comparison of the diet of the Red fox in Gelderland (Holland), Denmark and Finnish Lapland. *Biogeographica*, 18 : 35-51.

SIEGEL, S. (1980). — *Statistica non parametrica per le scienze del comportamento*. Firenze : Organizzazioni speciali.