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Резюме на русском языке
Пища лисицы *(Vulpes vulpes L.)* в Дании

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Authors' addresses:

Mag. scient. Birger Jensen
Game Biology Station, Kalø
8410 Rønde, Denmark

Mr. Darrell M. Sequeira
Department of Agricultural and Forest Zoology
University of Helsinki
00710 Viikki Helsinki 71
Finland

Introduction

Studies of the diet of the Red Fox *(Vulpes vulpes)* based on analysis of contents of stomachs have been carried out in many countries. The value of these studies has been essentially qualitative, as good information has been obtained about the identity of food eaten, but information about absolute and relative quantities of different foods eaten has been less satisfactory and little has been learned about the relations between foxes and their prey. In spite of these limitations, the method still offers possibilities in cases where comparisons of the diet at different seasons of the year, different years and different geographical areas can be made, especially if these differences can be related to differences in availability of food.

As part of comprehensive studies on the biology of the Red Fox carried out at the Game Biology Station, Kalø, the contents of 285 stomachs were analysed. This work was done by one of the authors (DS) after work on the food ecology of the Red Fox in Holland. Notes have also been made of prey items found during the cubbing season, at 275 fox earths.

Apart from a short report on the contents of the stomachs and intestines of 40 foxes (Bistrup 1890), only scattered information about the food of the fox in Denmark is available in the literature. However, in many European countries, special studies on fox food have been published (Table 1). Nearly a hundred papers from different parts of the world are directly concerned with studies on the food of the Red Fox, plus numerous scattered notes about fox food and papers on the fox as a predator. In addition the more popular accounts like Burrows (1968) contain valuable information about the diet of the Red Fox.

Material and methods

The contents of 285 stomachs were analysed. They had been collected in three sample areas (Table 2, Fig. 1). 60 originated from foxes shot during 1965 – 1969 in the Løvenholm forest district (30 km^2 of woodland surrounded by farmland), 56 originated from foxes ear-tagged as cubs and recovered during 1966 – 1970 from many different localities in Denmark, and 169 originated from foxes killed and delivered for bounty during 1968 – 1970 in South Jutland, where a rabies control campaign was in operation. This latter area comprises about 3,000 km^2, of which about 75% is farmland and 8% forest.

The average annual temperature for Denmark is 8° C, while the February and July means are — 0.5° and 16.5° C, respectively.

Of the 285 foxes used for stomach analyses, 153 were males and 130 were females. In two the sex was unknown. The mean body weight of 143 males was 7.1 kg and of 126 females 6.0 kg, while the weight of 16 animals was not available. All the animals were more than six months old.

The maximum wet weight of the contents of stomachs was 435 g. Of the 285 stomachs with contents, 15 (5.3%) contained more than 200 g, 54 (18.9%) from 100 to 200 g, and 216 (75.8%) less than 100 g. Empty stomachs were neither collected nor recorded. Stomachs and their contents were kept in formalin, but were often obtained in a rather poorly preserved condition, those from South Jutland in particular having sometimes taken several days before being delivered at the incinerating plant where the foxes were deep frozen. This did not affect the hair, feather and bone material so much that it prevented identification of the prey.

The stomach contents were washed with warm running tap-water in a fine-mesh sieve and transferred into a white dish containing water, for removal of diagnostic pieces of food. Mammalian hair was determined microscopically with the aid of a reference collection of mounted hairs. A paper by DAY (1966) and various handbooks were also used in the identification of mammalian hair and bird feathers. A detailed determination of invertebrate and plant material was not made.

Notes on the prey remains found outside 75 fox earths during the cubbing season were collected during 1967 – 1969 when fox cubs were caught and ear-tagged (cf. JENSEN 1973). 22 earths were investigated in the Løvenholm forest district, 43 in the

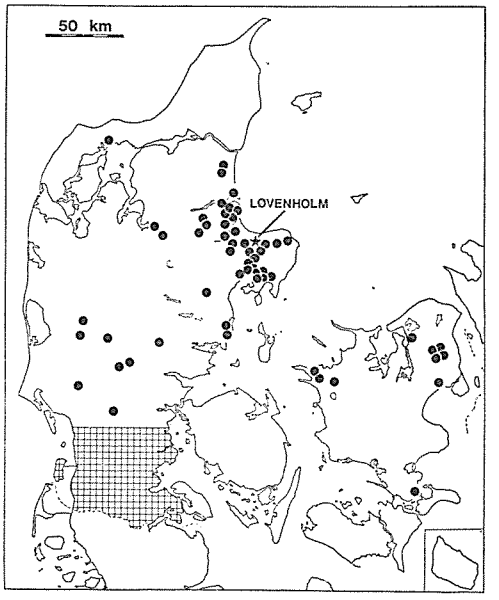

Fig. 1. Localities from which fox stomachs were obtained (cf. Table 2): Løvenholm forest district, South Jutland (cross hatched) and various other localities.

Country and references	No. of stomachs or intestines with contents analysed	No. of scats analysed	Other information
Norway, LUND 1962	484	984	Snowtracking
Sweden, ENGLUND 1965a	1166	–	–
ENGLUND 1965b	120	–	–
ENGLUND 1969	243	–	–
Finland, LAMPIO 1953	325	–	–
Estonian SSR, NAABER 1967	–	229	42 remains
Poland, RZEBIK-KOWALSKA 1972	496	–	–
RYSZKOWSKI et al. 1971	–	523	–
GOSZCZYNSKI 1974	–	ca. 1000	–
Denmark, BISTRUP 1890	40	–	–
Present study	285	–	Remains at 275 earths
Germany, BEHRENDT 1955	128	–	Remains at 4 earths
LESSMANN 1971	235	–	–
WITT 1976	131	–	–
France, BROSSET 1975	–	450	–
Switzerland, WANDELER & HÖRNING 1972	623	–	–
FUCHS 1973	–	–	3021 bones
Czechoslowakia, SOVIS 1967	86	–	Remains at 11 earths
Rumania, HELLWING 1960	8	–	–
Bulgaria, ATANASSOV 1958	192	142	–
PESHEV 1965	262	–	–
Italy, LEINATI et al. 1960	–	5280	–
Spain, AMORES 1975	121	–	–
Portugal, MAGALHAES 1974	–	157	–
United Kingdom, SOUTHERN & WATSON 1941	40	18	–
LEVER 1959	ca. 300	123	–
Scotland, LOCKIE 1956	14	98	–
LOCKIE 1964	–	178	–
DOUGLAS 1965	14	–	–
HEWSON et al. 1975	–	523	–
WATSON 1976	–	219	–
RICHARDS 1977	–	186	64 feeding remains
Ireland, FAIRLEY 1970	503	–	Remains at 23 earths
FORBES & LANCE 1976	–	53	–

Table 1. List of studies (from literature) of the food of the Red Fox in Europe (with the exception of Estonia excl. USSR).

Sample area and duration	Jan.–Feb.	May–July	Aug.–Sept.	Oct.–Dec.	Total
Løvenholm forest district, 1965–69	–	–	–	60	60
Various localities in Denmark, 1966–70	20	–	–	36	56
South Jutland, 1968–70	45	30	29	65	169
Total	65	30	29	161	285

Table 2. Number of fox stomachs with contents analysed.

rest of Jutland and 10 on Sealand. In addition, in South Jutland Mr. HOLGER HOLM kept a record from 1966 to 1970 of more than 1000 fox earths during gassing operations in a rabies control programme. This file contained notes on most prey remains found outside 200 fox earths during the months of April – June, all of them still with cubs or recently having been inhabited by cubs. Normally, no thorough search for remains was carried out round the earths, and small prey items and those represented by only a few feathers or hair might not have been recorded. Nevertheless, these observations on remains of altogether 700 food items gave useful information about prey remains normally found in Denmark around fox earths with cubs, and they supplement the information obtained from stomach analyses.

Results

The presence of each food item was expressed as a percentage frequency of all stomachs with contents examined. The percentage frequencies of the main categories of food found in the stomachs are given in Table 3. Further details are given below for each category of food and here most of the observations of food remains found outside fox earths have been incorporated.

Mammals

Insectivora

Nine shrews, probably all Common Shrew *(Sorex araneus)* were identified in 4 stomachs (1.4%). Moles *(Talpa europaea)* were not found in stomachs, but as many as 22 were found around fox earths, where a single shrew was also noted. In addition a single Hedgehog *(Erinaceus europaeus)* was found at a fox earth.

Lagomorpha

There are no recognizable structural differences in the hairs of Rabbit *(Oryctolagus cuniculus)* and Brown Hare *(Lepus capensis)* and thus the lagomorph material could not be separated with any certainty. However, the Rabbit occurs in scattered populations and only in parts of South Jutland, but not in the rest of the country, whereas the Hare is a widespread and often numerous species in all parts of Denmark. It is therefore very probable that even in the material of South Jutland, the Hare forms the greatest proportion of the lagomorphs taken. 42 of the stomachs (15%) contained lagomorphs. In South Jutland remains of Hare (but no Rabbits) were found at 71 earths (36%), and in the rest of Denmark Hare remains were found at 14 earths (19%).

Rodentia

192 (67%) of the stomachs examined contained rodents. Among these the *Microtidae* were most frequent as they occurred in 185 stomachs (65%). *Muridae* occurred in only 23 (8%) of the sto-

			Percentage frequency						
		Number of stomachs	Rodents	Lagomorphs	Domestic pig	Poultry	Wild birds	Insects	Fruit
Løvenholm	Oct.–Dec.	60	67	17	38	35	22	33	17
Various localities	Oct.–Dec.	36	44	11	30	33	39	8	22
	Jan.–Feb.	20	60	10	25	20	65	0	5
South Jutland	Oct.–Dec.	65	80	15	23	23	35	32	17
	Jan.–Feb.	45	71	11	36	24	44	0	2
	May–July	30	70	20	20	30	37	20	3
	Aug.–Sept.	29	66	17	0	28	38	48	17

Table 3. Percentage frequency of main food categories in contents of stomachs of the Red Fox.

machs. Field Voles *(Microtus arvalis* and *M. agrestis)* occurred in 179 stomachs (63%), the Water Vole *(Arvicola terrestris)* in 5 (2%) and the Bank Vole *(Clethrionomys glareolus)* in 6 (2%) of the stomachs. About 500 Field Voles were identified, and in most cases a stomach contained only a single or a few individuals. In 8 cases, however, the remains of more than 10 adults were found and the maximum number in one stomach was 13 adults and about 60 juveniles. Not all rodents were identified to species, as cross-sectional outline of hair was not used as a criterion for identification. However, in these cases, identification to family level was always possible. Among the *Muridae*, the Yellow-necked and/or Wood Mouse *(Apodemus flavicollis/sylvaticus)* were found in 19 stomachs (7%), and the Brown Rat *(Rattus norvegicus)* in 4 (1%). With the exception of five Rats (or remains hereof, such as skin or tail) no rodents were found outside fox earths.

Carnivora

One stomach contained hair and flesh of a Badger *(Meles meles)*, another remains of a Fox, including a foot. A few other cases, where the stomachs contained fox hair in small quantities only, have not been considered the result of cannibalism, but licking of the fur. In South Jutland there have been several incidents of foxes eating carcasses of Badgers and Foxes, dug out when for occupation they re-opened earths previously gassed and closed during the rabies control campaign. In two cases a half-eaten fox cub was found outside a fox earth and in two instances a Stoat *(Mustela erminea)*.

Ungulata

Remains of Roe Deer *(Capreolus capreolus)* were found in a total of 7 stomachs (2.5%), 5 from South Jutland and 2 from Løvenholm. All of them occurred during the period Oct.–Feb. In four cases in the south of Jutland and in two cases in the rest of Denmark, remains of fawns were found at fox earths.

Domestic mammals

Remains of piglets and offal from slaughtered pigs (e.g. a piece of skin, a lump of fat) were found in a total of 76 stomachs (27%). Remains of domestic pig were found at 18 fox earths (9%) in South Jutland, 12 (55%) at Løvenholm and 23 (43%) in the rest of Denmark. Two stomachs contained remains of domestic cats and altogether cats or their remains were found at 8 fox earths (3%). In one case three cats were found at the same earth. The remains of sheep were found in two stomachs (0.7%). A domestic rabbit was found at one fox earth, and a piece of calf skin at another.

Birds

Wild birds occurred in 105 stomachs (37%). Most of the remains could be grouped as *Galliformes*, »Other bigger birds« and passerines (incl. corvids). Remains of *Galliformes* occurred in 18 stomachs (6%) and were found in 7 cases to belong to Pheasants *(Phasianus colchicus)* and in 4 to Partridge *(Perdix perdix)*. »Other bigger birds« were found in 29 stomachs (10%) and included 8 ducks, a bird of prey, a small wader, Coot *(Fulica atra)*, Moorhen *(Gallinulla chloropus)* and pigeon *(Columba* sp.). Passerines were

found in 48 stomachs (17%) and included several corvids, some thrushes, a starling and a number of small passerine species.

Remains of Pheasants were found outside 46 fox earths in South Jutland (23%). Altogether 53 specimens were found and of these 40 were females and 9 were males, the sexes of 4 remaining undetermined. Outside 75 fox earths investigated in the rest of Denmark, pheasant remains were found in 20 cases (27%). Partridge were found in 8 cases (4%), all in South Jutland, and Black Grouse *(Lyrurus tetrix)*, a species occurring very locally and in small numbers, in 3 cases. Of these 2 were in South Jutland and 1 in West Jutland.

Of other bigger birds found outside fox earths 12 were Mallards *(Anas platyrhynchos)*, some of them possibly domestic birds, 2 Shelducks *(Tadorna tadorna)*, 1 bird of prey, 3 Moorhens *(Gallinulla chloropus)*, 2 gulls *(Larus* sp.) and 12 Wood Pigeons *(Columba palumbus)*. Of 31 passerines found 9 were Hooded Crow *(Corvus cornix)*, 5 Rooks *(Corvus frugilegus)*, 3 Magpies *(Pica pica)* and 1 Jackdaw *(Corvus monedula)*. The remaining 13 were smaller species, mostly thrushes *(Turdus* sp.).

Poultry

Remains of poultry were found in 80 stomachs (28%). Except for a few cases of domestic ducks they were all domestic hens. Remains of domestic hens were found at 191 earths (96%) in South Jutland, 17 earths (77%) in Løvenholm and 43 earths (81%) in the rest of the country. Remains were also found of 2 geese, 1 guinea fowl and 1 domestic pigeon.

Eggs

Three out of 30 stomachs collected during May–July contained pieces of eggshell and -membranes (2 from pheasant, 1 from domestic hen). Of the 255 stomachs collected during August–February, 3 contained remains of eggs, probably all from domestic hen.

Reptiles and amphibians

None were found in stomachs but a Grass Snake *(Natrix natrix)* was found at an earth.

Fishes

Only 2 stomachs (1%) contained remains of fish, a Lavaret *(Coregonus lavaretus)* and a Perch *(Perca fluviatilis)*. At one fox earth a Lumpsucker *(Cyclopterus lumpus)* was found and at another earth both Pike *(Esox lucius)*, Bream *(Abramis brama)*, and Silver Bream *(Blicca bjoerkna)* were found.

Insects

Insects occurred relatively often in stomachs collected in the autumn. But only dung beetles *(Geotrupes)* and agriotid moth larvae (cutworms) sometimes occurred in great numbers. Dung beetles were much fragmented and their number difficult to estimate but in a dozen cases from August–October they were found in tens sometimes mixed with dung. Cutworms were found in 25 cases from August–November, mostly a few or some tens but in three cases about one hundred and in a single case even about two hundred. Further a few Carabid, Silphid and Staphylinid beetles were found and maggots in some cases. Single records were made of a moth, two ants and a piece of a hymnopterous nest, perhaps a bumblebee.

Plant material

Plant material was found in many stomachs. Much of it appeared to have been swallowed incidentally along with prey, or to have been contained in the prey, like corn, husks and hay. Green grass leaves present in a number of cases may have been eaten deliberately, as must have been the case for fruit.

Only the latter will be treated. Stones and/or skin and flesh of cherries, cherry plums and plums were found in a total of 26 stomachs from August–November. Cherry plums strongly dominated and in most cases the stomach contained up to 10 stones but as many as 48, 31 and 27 were recorded. Seeds, skin and stalk from apple and especially pear were the only other remains of fruit found regularly in autumn and winter altogether in 11 cases.

Various and unidentified contents

In several cases it was difficult or impossible to place food remains under any of the chosen headings, especially lumps of flesh and fat and pieces of bigger bones where no hairs or feathers were found in the same stomach. Most of these cases should probably be added to the number of domestic pigs and/or poultry. In addition Mallards and Pheasants were classified as wild birds, though some of them might have been domestic or reared birds.

In a few instances stomach contents included a piece of string, a rubber-band and pieces of plastic, paper and newspaper, probably originating from packets with food or rubbish. Such items are also found at fox earths; at 3 earths white loaves were found.

Discussion

The results have been presented here as a percentage frequency of occurrence of the different food items. In fact this is not very satisfactory for evaluation of the relative importance of different food items as this method does not consider the quantity (i. e. size of individuals) of the different items. It is even difficult to quantify from stomach contents as the material is mixed, and different food items are not equally well represented in the contents of the stomach, some items being more quickly digested than others. Also the presence of a food item does not always indicate that a whole prey specimen has been devoured and especially in the present material it was difficult to calculate actual amounts of different foods eaten by foxes. While the number and weight of small rodents can be fairly well estimated from the remains found in stomachs, the same cannot be done from a portion of the skin of a slaughtered pig or some poultry feathers. No doubt foxes often obtain this food in fragment form e.g. the leg of a slaughtered hen. Consequently, estimates of the quantities of such important foods are extremely unreliable.

These problems have been discussed by various authors. The present authors agree with ENGLUND (1965a) who after a detailed analysis of data from 1,338 stomachs concluded (op. cit. p. 432) »it is therefore impossible to estimate by analysis of stomach contents the number of prey specimens eaten by a fox per annum«. As, furthermore, it is difficult to relate a number of food items to quantity the percentage frequency of occurrence of food items is not a measure of the quantities consumed by foxes.

SEASONAL AND GEOGRAPHICAL DIFFERENCES IN THE DANISH MATERIAL

In spite of the above limitations comparisons can be made of the percentage frequency of different foods at different seasons, in different years and in different geographical areas.

Comparisons of stomach contents from different areas may contain inherent errors as the foxes may have been killed under different circumstances (cf. ENGLUND 1965 a). The 60 foxes from Løvenholm were all shot during drives in the forest whereas the 169 foxes from South Jutland were killed by various methods but excluding bolting, which was illegal there because of the rabies situation of the region. In the rest of Denmark bolting is common practice and has been the fate of several of the remaining 56 foxes. In addition, the stomachs examined were collected irregularly over a 6-year period during which the availability of prey, particularly rodents, may have differed. It is therefore advisable only to consider similarities and more striking differences and to ignore small differences in the samples irrespective of possible statistical significance.

It is doubtful whether any of the seasonal differences in percentage frequency of single vertebrate foods (Table 3) indicate a consistent difference in the composition of the diet during the year. This does not, however, imply that such differences do not exist. Rodents occurred in relatively few stomachs in South Jutland in August–September but when pre-

sent, were in relatively high numbers per stomach (2.5 adults) and especially high if three cases with a total of about 80 juveniles are included. The complete absence of pig remains in August–September is especially curious, as poultry occurred at its normal high frequency, and no obvious explanation can be offered. The quantities of different vertebrate foods consumed may vary considerably during the year, but probably more as a result of local conditions prevailing at any given time than of a common seasonal change in availability. Insects, however, are frequent during summer but decrease in percentage frequency during the autumn (October 51% of 65 stomachs, November 22% of 49 stomachs and December 2% of 47 stomachs) and similarly there is a decline in the frequency of occurrence of fruit (October 25%, November 16%, December 11%).

When results from different years were compared, no significant differences were observed in the contents of stomachs from the same area. No doubt changes in availability of different food items from one year to another are generally moderate in Denmark compared for example with those caused by rodent cycles in more northern latitudes.

For comparison of stomachs from different areas (Table 3), material is only available from late autumn (October-December) covering three areas and from winter (January-February) covering two areas. Stomachs from the mid-eastern part of Jutland predominate in the sample from ear-tagged foxes (Fig. 1), and no clear differences in areas are evident even when the 10 stomachs from Sealand and those from West Jutland are excluded from this sample. Looking at the three samples from October-December the impression is gained that rodents and other live wild animals are a more important source of food in South Jutland than in the two other samples in which livestock forms a relatively higher percentage. However if comparison is made using the two samples from January-February a similar difference is less obvious. There are probably minor differences in the composition of the diet from one part of the country to another, but the present material does not enable any definite conclusions on this point.

It is noteworthy that the percentage frequency of domestic pig and poultry is even higher in fox stomachs from the Løvenholm forest district than in stomachs from the rest of the country. This illustrates the high degree to which foxes find their food outside a wood, even in a forest that is big (30 km^2) according to Danish conditions.

During 1882–1888, chief forester Bistrup examined the stomach contents of foxes shot in autumn at Torbenfeldt forest district, Sealand. He found that the occurrence of rodents in stomachs was directly correlated with the abundance of rodents as observed by him in the forest. In a note from 1890, he listed the contents of stomachs and intestines of 40 foxes shot in October 1886, a year with very few rodents in the forest. Out of 25 stomachs with contents, 11 (44%) contained rodents, and out of 37 intestines with contents 11 (30%) contained rodents. Of the rodents found 2 were Wood Mice and the rest Field Voles. Roe Deer, Hare and Hedgehog were identified in one case each. A few birds were found, and 4 stomachs and 5 intestines contained poultry. Pig was not mentioned but some of the 9 cases listed with meat, fat and tendons may belong in that category. Insects occurred in 56% of the stomachs and 78% of the intestines, and fruit in 48% and 70% of these respectively.

COMPARISON WITH OTHER COUNTRIES

A direct and detailed comparison of Danish studies on fox diet with several of those published from other countries in Western Europe is somewhat difficult, as the data were collected by different methods (cf. Table 1) and the results presented in different ways. The most comparable results are those of stomach analyses, given as percentage frequency. Although different biotopes are represented in all these investigations which cover nearly six thousand stomachs and ten thousand scats, general features in the diet of the Red Fox can be recognized.

If the results of the present analysis are summarized and compared with the results obtained in other countries in Europe, certain general conclusions emerge.

Only a small percentage of the stomachs examined contained insectivorous mammals. Their occurrence was similarly infrequent in all other studies on fox food, in spite of the common occurrence of species of this order in most biotopes of Europe.

Rodents, especially voles, were most frequent and occurred in 44–80% of the stomachs. Similarly high percentages were found in other countries, e.g. Poland, Czechoslovakia, and Germany. In Ireland where there are no voles, rodents (mostly rats) occurred in only about 20% of the stomachs. In Sweden the percentage, in the same region, varied from about 30% to more than 90%, according to the local abundance of rodents. A wide range of percentage frequency is found in other countries too, but often about half of the stomachs contain rodents. A general great excess of voles over mice in the diet of foxes may partly be because voles are more easily obtained, but they also show a clear preference for voles (MACDONALD 1977).

Lagomorphs, probably all Brown Hare were found in 10–20% of the Danish samples. In countries where there are no Rabbits such as Norway, most of Sweden, and Finland, and where the Hare population is relatively sparce, lagomorphs occur in less than 10% of the stomachs. Further south in Europe where hare densities increase the percentage frequency of lagomorphs also increases and especially in areas containing Rabbits. In Ireland and Poland 45% and 25% of the stomachs respectively contained lagomorphs, in Sierra Morena in Spain 70%, and in Rabbit areas in Sweden (Scania, Gotland), about 50%. From the island of Gotland, ENGLUND (1965b) mentions a halving of the percentage frequency of Rabbits in fox stomachs after myxomatosis had reduced the Rabbit populations to approximately $^1/_{20}$ and a similar but less marked drop was found in Britain after myxomatosis (LOCKIE 1956, LEVER 1959). Taking into account the size of the individual prey, lagomorphs can be considered a main food of the fox, even when they occur in a relatively moderate number of stomachs compared with rodents, and in cases where they occur in high frequencies, they must be the most important food.

Other wild living mammals e.g. deer and carnivores were found in a few cases. In most other studies too they occur incidentally, in small numbers probably often obtained as carrion.

Wild birds, possibly including some hand reared Pheasants and Mallards were found in 22–65% of the Danish samples (cf. Table 3) and studies in other countries also show a considerable variation in percentage occurrence. In Norway not less

than 70% of the stomachs contained wild birds, while in Sweden the proportion was between one fourth and two thirds of most of the samples and in Poland it was about one fifth. Though many of the birds are of moderate size, in some situations this type of food appears to be rather important.

Poultry, mostly domestic hens with some domestic ducks, includes what has been taken as carrion and offal, and was found in 20–35% of the Danish fox stomachs. Compared with other European countries this is a high percentage as normally only 10–20% of stomachs containing poultry are recorded. However, from Scania in South Sweden which is in many respects comparable with Denmark, 15–31% are recorded.

Domestic pig (obtained as carrion and offal) occurred in 26% of the stomachs. This is a very high percentage compared with those found in other countries. Although in several cases pig is not treated specifically, in Ireland, Poland and Norway percentage occurrences of 1, 3, and 11 respectively were recorded. In Schleswig-Holstein just south of the Danish-German border only 1 fox stomach out of 131 contained domestic pig (Witt 1976). Again Scania in South Sweden is most comparable with Denmark, as Englund (1965a) mentions that out of 169 stomachs, carrion and offal occurred in 43, and that »the most commonly found carcass consisted of remnants of pig«. No other domestic mammal is an important food source for the fox in Denmark but for example in hill-country in Britain, sheep – mostly obtained as carrion – may play a similar or even greater role in the diet than pig does in Denmark.

Reptiles and amphibians were not found at all in the Danish material, and in other countries they occurred in small percentages.

Insects occurred in between half of the Danish fox stomachs in summer, and none in winter. Similar results have been found in other countries and although in some cases high numbers of an insect species have been found in one stomach, quantitatively this food item is not as important as its percentage frequency might suggest.

In the Danish material fruit occurred in roughly one fifth of the fox stomachs obtained in late summer and autumn but in insignificant quantities in stomachs obtained at other seasons. Also in other countries fruit is found regularly in late summer and autumn and especially in cultivated areas it appears, in short periods, to be a food item of some importance.

As a whole the diet of the fox in Denmark compared with other countries reflects the high degree of agriculture in the country. Besides rodents, lagomorphs and wild birds, both poultry and domestic pigs are regularly eaten. The quantitative importance of the latter two is however difficult to evaluate, as they are mostly obtained incomplete, as offal on dung hills, or in manure brought out to the field, or dug up around farms. This close contact with human habitation is further shown by the occurrence of different other types of offal and of fruit grown in orchards. Altogether this probably gives the fox in Denmark a relatively varied and stable food supply during the year and from one year to another compared for example to the fox living under more natural conditions in Scandinavian forests and mountains.

COMPARISON OF FOOD ITEMS FOUND IN STOMACHS AND AT FOX EARTHS

Analysis of stomach contents is the most common method used in the study of fox food, but analysis of scats has also been applied and can be useful (Lockie 1959) especially as scats can be collected over a period without killing the foxes (Burrows 1968). In addition snow tracking and collection of food remains at the earths have been used. In the survey p. 5, information on 700 food remains found at 275 earths during the cubbing season has been included. The data may help towards an understanding of the feeding ecology of foxes, but the remains found are far from representative of food taken by them.

It is most striking that although rodents occur in more than half of the stomachs examined apart from a few rats or parts hereof, not a single rodent was found at fox earths. They are probably always swallowed whole, and never left on the ground. To some extent the same applies to small passerines. Conversely, no moles were found in 285 stomachs, although 22 specimens were found lying outside fox earths. They are probably distasteful to foxes, although moles are occasionally known to occur in fox stomachs. Considering another example, poultry was found in about one quarter of the stomachs, but at more than three quarters of the fox earths. In some cases study of food remains at fox earths may contribute details not so easily obtained by examination of contents of stomachs. For example it is worth noticing the high percentage (82%) of females among 49 Pheasants found at fox earths in South Jutland (p. 7), and that most of the remains of Hare (p. 5) appeared to belong to adult and sub-adult specimens. Probably, however, leverets are easier to devour completely, so that normally no traces of them are left outside earths.

THE RED FOX AS A PREDATOR

While so many studies on the contents of fox stomachs and scats have given a reasonably good picture of the food of the Red Fox, they have not been able to provide satisfactory evidence of the effect of the fox as a predator. Speculations based on stomach contents (Lampio 1953, Behrendt 1955) attempt to answer this question and experiments with scat analysis (Lockie 1959, Goszczynski 1974) have contributed towards it. Basically the amount of predation and the size of the prey population must be known. This information is difficult to obtain, and the relationship between them may be further complicated when predation by the fox influences turnover in the prey population. When game species are considered, it is of special interest to know not only whether foxes can influence the size of breeding populations in spring, but also whether they can affect the game bag of sportsmen in autumn; in other words whether there is competition between foxes and sportsmen for the surplus production of game. This is an even more complicated question than the predator-prey relationship, because it also involves the portion of the game population taken by shooting. Also, for several of the prey species, the proportion taken as live prey and as carrion is unknown. The effect of

foxes as predators is related to the effect of active predation on mortality and production in populations of their prey. This effect will be diminished if carrion arising from other causes of mortality becomes available.

Scarcely any conclusion can be reached about the relationship between fox predation and game bag by sportsmen from the present food study. The results however do fall in line with those obtained from a study of bag-records in an area of fox-control (JENSEN 1970 and unpublished). In connection with two outbreaks of rabies in the south of Jutland, foxes were controlled by gassing of earths and shooting in the years 1964 – 1973. During the campaign the annual bag of foxes dropped from about 4,500 to 600 in an area of about 4,000 km^2. At the same time the bag of Hares increased although there was a general decrease in the bag north of the fox control zone and in the rest of the country. In the case of the Pheasant there was an acceleration of an increasing bag in the control zone, but a levelling of the bag north of the control zone and in the rest of the country. For the Partridge changes in the bag were more difficult to evaluate and fox control did not appear to influence the bag of other game species.

Since January 1975 there has been no fox control in the above-mentioned area following the disappearence of rabies and bag records for the seasons 1974/75 – 1976/77 show an increase in the bag of foxes and a tendency towards a decrease in the bag of Hare, Pheasant and Partridge.

In Nordrhein-Westfalen in Germany, SPITTLER (1972) found an increase in the bag of Hare and Partridge as a result of a reduction in the fox population caused by rabies. No doubt the situations described give a very good opportunity to study the relationship between fox density and the bag by sportsmen of some other game species.

Dansk resumé

Rævens *(Vulpes vulpes* L.) føde i Danmark

Til belysning af rævens føde i Danmark er indholdet af 285 rævemaver blevet bestemt (fig. 1, tabel 2). Desuden er der gjort notater om bytterester fundet ved 275 rævegrave i hvalpetiden. 200 af disse i Sønderjylland, de øvrige spredt rundt i landet, men fortrinsvis i Østjylland.

Side 5–7 er der givet en oversigt over, hvilke fødeemner der er konstateret i maverne og ved gravene, og i tabel 3 er forekomsten af de vigtigste fødeemner i maverne angivet i procent af det samlede antal maver med indhold.

Nedenfor er der givet et kort sammendrag af, hvad der er fundet.

Ialt fandtes 9 spidsmus i 4 maver. Der konstateredes ingen muldvarpe i maverne, men 22 blev fundet ved rævegravene. Her fandtes også rester af et pindsvin. 42 maver (15 %) indeholdt rester af hare, og ved 85 grave (31 %) fandtes rester af hare. Bortset fra nogle mindre øer forekommer vildkanin kun i spredte bestande og kun i dele af Sønderjylland, og denne art fandtes ikke med sikkerhed i det undersøgte materiale. 192 maver (67 %) indeholdt gnavere. I 65 % var det studsmus og kun i 8 % ægte mus. Af gnavere fandtes der ved gravene kun rester af 5 rotter. Rester af grævling og ræv fandtes hver i 1 tilfælde i maverne og af rådyr i 7 tilfælde (2,5 %). I 6 tilfælde fandtes rester af rålam ved gravene. Rester af pattegrise og slagteaffald fra gris fandtes i 76 maver (27 %) og ved 53 grave (19 %). Rester af kat og får fandtes i 2 maver, og ved gravene fandtes 10 katte, 1 tamkanin og et stykke kalveskind. Vildtlevende fugle fandtes i ialt 105 ma-

ver (37 %). I 18 tilfælde (6 %) drejede det sig om hønsefugle, hvoraf 7 kunne bestemmes til fasan og 4 til agerhøne. Andre større fugle bl. a. and, måge, due fandtes i 29 maver (10 %) og spurvefugle inkl. kragefugle i 48 (17 %). Ved 66 grave (24 %) fandtes rester af fasan. Af 49 kønsbestemte var 40 høner og 9 haner. Agerhøne fandtes ved 8 grave (4 %). Af større fugle fandtes ved gravene yderligere rester af 35, især gråænder og duer, og af spurvefugle 31, især kragefugle. Rester af fjerkræ, næsten alle tamhøns, fandtes i 80 maver (28 %) og ved 251 grave (91 %). 2 maver indeholdt rester af fisk, og ved en enkelt grav fandtes tre. Insekter fandtes ofte i maver indsamlet om efteråret, men kun skarnbasser og knoporme optrådte til tider i større mængde. Planterester forekom hyppigt, men meget var sikkert tilfældigt fulgt med anden føde. Sten og skind af kirsebær, blomme og især mirabelle forekom i 26 maver fra august–november og rester af æble og pære i 11 tilfælde fra efterår og vinter.

Maveindholdet giver et godt billede af, hvilke fødeemner ræven fortærer, men det er vanskeligt at beregne deres mængdemæssige betydning. Det gælder specielt, hvor rester af husdyr og fjerkræ og andre store fødeemner optræder. Her kan det ofte være små dele af det oprindelige fødeemne, der er fortæret. Smågnavere er det hyppigst forekommende fødeemne i maverne, og af vildtlevende pattedyr er det yderligere kun haren, der spiller en rolle. Vildtlevende fugle udgør en fast del af føden, og det samme gælder selvdøde pattegrise og fjerkræ samt slagteaffald fra gris og fjerkræ. Insekter og frugt optræder til tider hyppigt i maverne, men spiller mængdemæssigt næppe nogen større rolle.

Blandt de fødeemner, der blev fundet i de danske rævemaver, udviste kun insekter og frugt en klar sæsonmæssig variation i forekomstprocent (tabel 3). Der konstateredes ikke i det foreliggende materiale forskelle i fødens sammensætning fra år til år og ingen klare forskelle fra egn til egn. Sammenlignes de danske resultater med udenlandske undersøgelser (tabel 1), giver de i hovedtrækkene samme billede af rævens føde. Dog spillede selvdøde pattegrise og fjerkræ samt slagteaffald fra gris og fjerkræ en større rolle end i andre lande. Disse fødeemner henter ræven på møddingen eller nedgravet ved landbrugsejendomme, og i det hele taget er sammensætningen af rævens føde præget af, at den hentes i et kulturlandskab domineret af landbrugsdrift.

De bytterester, der kan indsamles ved rævegrave specielt i hvalpetiden, afspejler kun dårligt, hvad ræven æder. Rester af små fødeemner som mus og småfugle fandtes næsten ikke ved gravene, men ofte i maverne, og fjer fra tamhøns fandtes ved næsten alle grave, men kun i en fjerdedel af maverne. Nogle byttedyr kan ræven undlade at æde og lade ligge ved graven. F. eks. kan nævnes, at der ikke fandtes rester af muldvarp i maverne, men at der ialt noteredes 22 muldvarpe liggende ved gravene.

Maveundersøgelser giver et billede af rævens føde, men de belyser kun i ringe grad rævens betydning for byttedyrbestandene. Hertil kræves undersøgelser, der bedre viser, hvilke mængder af de enkelte byttedyr ræven selv fanger og fortærer, og hvor stor en del disse udgør af den samlede byttedyrbestand.

Резюме на русском языке

Пища лисицы *(Vulpes vulpes L.)* в Дании

Для выяснения пищи лисицы в Дании было определено содержание желудков 285 лисиц (Фиг. 1, Табл. 2). Кроме того проводились записи об остатках добычи, найденных у 275 лисьих нор в периоде вскармливания лисят, 200 из них в Южной Ютландии, остальных по всей стране, но преимущественно в Восточной Ютландии.

На стр. 5-7 дан обзор предметов пищи, обнаруженных в желудках и около нор, а в Табл. 3 находки наиболее значительных предметов пищи указаны в процентах общего количества желудков с содержанием.

Содержание желудков дает хорошие указания о том, какие предметы пищи пожираются лисицами, но трудно вычислить их количественное значение. Это в особенности так обстоит в тех случаях, когда были обнаружены остатки домашних животных, домашней птицы и других крупных предметов пищи. В таких случаях часто бывают съедены небольшие части первоначального предмета пищи. Чаще всего встречающимся предметом пищи в желудках являются мелкие грызуны, а из дикоживущих млекопитающих кроме них играет роль только заяц. Дикие птицы составляют постоянную часть пищи, и то же относится к подохшим поросятам и домашним птицам, а также к отбросам от убоя свиней и домашней птицы. По временам в желудках часто встречаются насекомые и плоды, но количественно они едва ли играют значительной роли.

Из предметов пищи, обнаруженных в желудках датских лисиц, ясные сезонные колебания процентов их нахождения выказывали только насекомые и плоды (Табл. 3). В имевшемся в распоряжении материале не было обнаружено разниц между составами пищи из году в год или четких разниц между составами пищи в разных местностях страны. Сравняя результаты датских и иностранных исследований (Табл. 1) получается в общих чертах одна и та же картина пищи лисиц. Однако, подохшие поросята и домашние птицы, а также отбросы от убоя свиней и домашней птицы, играют более важную роль, чем в других странах. Эти предметы пищи добываются лисицами из свалок или из земли, в которую их зарывают около крестьянских хуторов, и вообще состав пищи лисиц свидетельствует о том, что она добывается в культурной среде, где преобладает земледелие.

Остатки добычи, которые можно собирать у лисьих нор, в особенности во время вскармливания лисят, только неясно отражают, чем кормятся лисицы. Остатки мелких предметов пищи, например мышей и небольших птиц, почти не встречались у нор, но часто в желудках, а перья домашних кур были найдены почти у всех нор, но только в четвертой части желудков. Бывает, что некоторых добытых животных лисица не съедает, а оставляет около норы. Например следует заметить, что в желудках не было найдено остатков кротов, но было записано 22 крота, брошенных у нор.

Исследования желудков дают понятие о пище лисицы, но только в незначительной степени выясняют значение лисицы для популяций добываемых ею животных. Для этого необходимы исследования, более четко выясняющие, какие количества отдельных добываемых животных ловятся и пожираются самой лисицей, и какую часть общей популяции добываемых животных они составляют.

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