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# Habitat preferences of foraging Rooks *Corvus frugilegus* during the breeding period in the agricultural landscape of eastern Poland

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**Abstract.** The study was carried out in 2000–2002 around 6 rookeries. Rooks foraged in numbers from 1 to 132 birds ( $n = 417$ ); flocks of less than 10 individuals were dominant. The type of crop influenced the size of a foraging flock. Most of the rooks were recorded within 0.5–1 km of the rookery, while the greatest distance of a foraging ground from the rookery ( $\bar{x} = 2833.3$  m) depended on the size of that rookery. Spring corn, meadows and pastureland were of the greatest significance in the rooks' foraging area. Winter corn and root crops were avoided, while wasteland areas were visited intermittently.

**Key words:** Rook, *Corvus frugilegus*, foraging preferences, agricultural landscape

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## INTRODUCTION

We have quite a good idea of the composition of the Rook's diet (Holyoak 1967, Luniak 1977, Gromadzka 1980, Kalotas 1985) and of its foraging habits during winter (Hubalek 1983, Waite 1984, Winiecki 2000). However, only a few papers describe the Rook's foraging preferences during the breeding period (Feare 1974, Feare et al. 1974). It was the aim of this research to examine this question and to assess the significance of the various environmental components of a highly fragmented agricultural landscape. In central and eastern Poland rookeries are found in the vicinity of human habitations surrounded primarily by arable land. A census of the population of rooks discussed in this paper was carried out in 1998, at which time, its density over an area of 1400 km<sup>2</sup> was 3.17 pairs/km<sup>2</sup> (Kasprzykowski 2001).

## STUDY AREA AND METHODS

The study was carried out in the Siedlce region of east-central Poland. A feature of this region is

the very considerable fragmentation of the landscape. Arable land makes up 59% of this region (Agricultural Inventory 1997), meadows and pastureland 19%, woodland 17%, and orchards 1%. The other 4% of the region is built up. The data for this study were collected in April and May of the years 2000–2002 in areas of 30–40 km<sup>2</sup> around each of 6 rookeries. Detailed results of the complete breeding cycle in these colonies will be found in Kasprzykowski (2002). The Rooks from each colony were monitored 6–8 times (a total of 40 inspections) in order to locate foraging birds. Each time, foraging and flying rooks were observed through field glasses from 5–8 different points — eminences commanding a view of an extensive area around a single rookery. Movement between the observation points was on foot, or by car where longer distances were involved, an eye being kept on the Rooks' behaviour at the same time. Once a foraging flock was located, it was approached to a distance from which the number of individual birds, the type of crop the flock was foraging on, and the distance (accurate to within 125 m) from the rookery could be determined. Membership of a particular rookery was allocated

on the basis of birds carrying food back to the nest. It was found that all the birds in a particular foraging flock came from the same rookery, not from several.

In order to assess the proportions of the various crops in the study area, plots from 1.5 to 3 km in radius were delineated. Taken together, these plots accounted for 98% of the area used for foraging by Rooks from one colony. After discounting larger clumps of trees and densely built-up areas, the remaining open farmland was divided into 250 m squares — from 70 to 305 squares in each plot ( $n = 971$  squares). The area under crops was determined to an accuracy of 4 m<sup>2</sup> in 5% of randomly sampled squares (from 4 to 15,  $n = 50$ ), covering a total of 3.12 km<sup>2</sup>. The percentages of the various crops in the plots estimated in mid-June were as follows: meadows and pastures — 31%, spring corn — 33.9%, winter corn — 26.8%, root crops — 6.7%, waste land — 1.3%, other uses — 0.3%. In assessing the utilisation of these crops by Rooks, the May observations were also taken into consideration. This factor was expressed by means of the Jacobs preference index,  $D$  (Jacobs 1974):

$$D = (r - p)/(r + p - 2rp)$$

where  $r$  is the proportion of birds observed foraging in particular crop types, and  $p$  is the proportion of a given crop in the Rooks' foraging area. The index ranges from -1 (complete avoidance) to +1 (exclusive use). Temporal changes were analysed with respect to periods of ten days. In the presentation of results, medians were used as mean values, and the median test and Spearman's correlation were applied using the Statistica for Windows program.

## RESULTS AND DISCUSSION

### Flock size

In the vicinity of the rookeries flocks from 1 to 132 birds were found foraging on one type of crop (Fig. 1). Although the numbers of foraging rooks did not vary significantly during the season, they were dependent on the crop type (median test:  $\chi^2 = 40.87$ ,  $df = 6$ ,  $p < 0.001$ ). The crops could be divided into two distinct groups in which the mean foraging flock size differed significantly (median test:  $\chi^2 = 34.03$ ,  $df = 1$ ,  $p < 0.001$ , Fig. 2). On meadows and pastures, spring corn and arable fields, the mean flock size was > 5 birds ( $Me = 7$ ,  $n = 352$ ), in the other group of

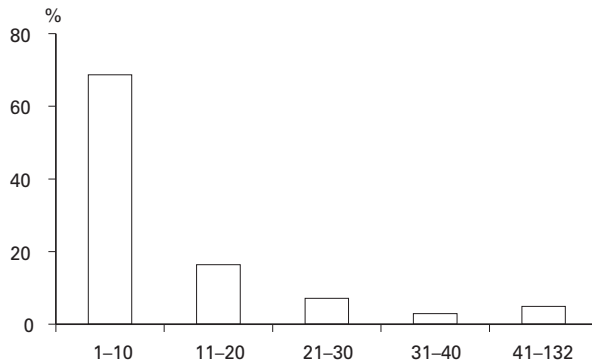


Fig. 1. Size of foraging flocks (Median = 6,  $N = 417$  flocks).

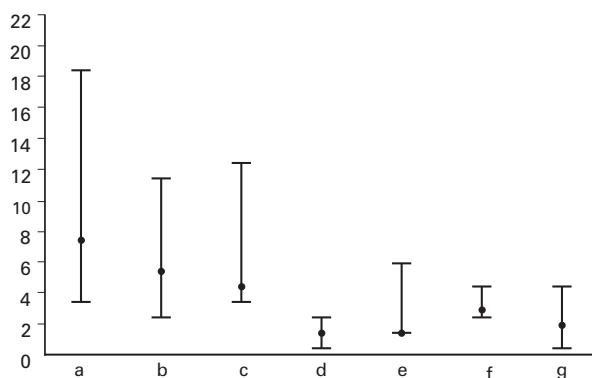


Fig. 2. Mean size of flocks foraging on particular crops — median and quartiles (25%–75%).  $N$  — number of flocks observed, a — meadows and pastures ( $N = 147$ ), b — spring corn ( $N = 157$ ), c — cultivated fields ( $N = 49$ ), d — winter corn ( $N = 14$ ), e — root crops ( $N = 8$ ), f — set aside ( $N = 14$ ), g — other uses ( $N = 26$ ).

crops it was < 4 birds ( $Me = 3$ ,  $n = 65$ ). According to Höglund (1985), Rooks achieve a lower mean foraging success in small flocks (< 10 individuals). It is also known that communal foraging improves hunting success with regard to food items concealed just beneath the surface, e.g. earthworms (Chantrey 1982). An increase in flock size, besides conferring anti-predator benefits, could also be a way of reducing food kleptoparasitism on the part of Jackdaws *Corvus monedula* (Höglund 1985). In the study area, however, Rooks were not often seen foraging in mixed flocks with Jackdaws; when this did occur, it was usually within half a kilometre of the rookery and towards the end of the breeding season.

Distance from rookery

As a source of food, the area within a radius of 1 km from the rookery was the most significant, and it was here that more than half the foraging Rooks were sighted (Fig. 3). The largest flocks were counted between 0.5 and 1 km from the rookery; numbers and frequency of occurrence fell distinctly with increasing distance from the rookery. No significant differences were found with respect either to distance of the foraging area from the rookery during the season (ten-day periods) or to crop types. The farthest distances of foraging birds lay between 1250 and 3940 m from the rookery ( $\bar{x}$  = 2833.3, SD = 1024.6, n = 6). These values were related to the number of nests in the rookery ( $r_s$  = 0.83,  $p$  < 0.05, n = 6). The size of the foraging area depends on the resources available in the environment: depending on the part of Europe in question, breeding Rooks fly a maximum distance of 1.5–3 km to their foraging grounds (Cramp & Perrins 1994). The size of the rookery also affected the mean distance of the foraging area from the rookery (median test:  $\chi^2$  = 51.63, df = 5,  $p$  < 0.001), but not the mean size of a foraging flock.

Habitat preferences

Rooks usually foraged on meadows and pasture-land and in spring corn (Table 1); these observations

are confirmed by the values of Jacobs' coefficient, which determines preferences with regard to the choice of foraging area (Fig. 4). More than 70% of the birds counted were seen foraging on permanent grass or in spring corn. In early April around 20% of birds were foraging on meadows and pastures; this figure later rose to and then remained at 40–50% (Table 1). At the same time, the highest mean number of foraging birds (8) was also recorded in these habitats (Fig. 2). Meadows and pastures are the richest in animal food (Waite 1984). Luniak (1972), too, stressed the importance of the size of such localities on the occurrence of Rooks in the study area. During the present study, Rooks were observed to congregate on permanent grassland also during the fledging period. Moreover, during haymaking in late May – early June, large flocks, sometimes more than 100 birds, were attracted by the abundance and availability of prey items, principally insects. To a large extent, the Rooks also fed on the seeds and seedlings of spring wheat, oats and barley, or mixtures of these cereals. Maize was a only very minor item in their diet; in this part of Poland it is grown on less than 1% of the arable land. This is in contrast to some other parts of Europe, where rooks graze maize seedlings in considerable quantities, the farmers sustaining substantial losses as a result (Pinowski 1956, Kalotas

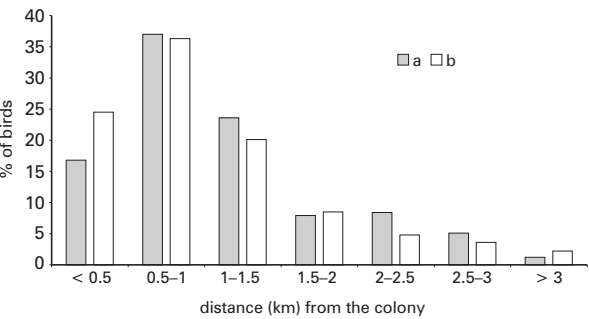


Fig. 3. Percentage of foraging individuals (a) and flocks (b) in relation to the distance from breeding colony.

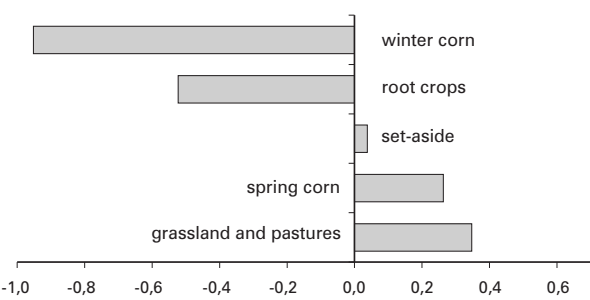


Fig. 4. Foraging preferences of the Rook expressed by Jacobs Index (D).

Table 1. Numbers (n) and percentage (%) of Rooks foraging on particular crops. a–g see Fig. 2 for categories of crops.

Months	decades	a		b		c		d		e		f		g	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
April	I	131	22.3	287	48.8	8	1.4	-	-	115	19.6	9	1.5	38	6.5
	II	437	44.5	231	23.5	25	2.5	-	-	271	27.6	8	0.8	10	1.0
	III	640	55.8	379	33.1	10	0.9	-	-	56	4.9	9	0.8	52	4.5
May	I	344	50.0	297	43.2	-	-	-	-	37	5.4	4	0.6	6	0.9
	II	537	51.1	471	44.9	-	-	16	1.5	13	1.2	10	1.0	3	0.3
	III	117	37.9	165	53.4	-	-	14	4.5	4	1.3	9	2.9	-	-
Total		2206	46.3	1830	38.4	43	0.9	30	0.6	496	10.4	49	1.0	109	2.3

1985). Spring corn was the favoured foraging area for the rooks in the study area. Depending on the length of the growing season, these areas provided a wide diversity of food items. At the start of the breeding season (early April) the birds foraged on arable land on which crops such as spring corn were to be grown, usually while the soil was being ploughed and harrowed (Table 1). Later, they ate grains of corn and grazed the high-energy shoots. In March and April over 30% of a Rook's food may be of vegetable origin (Gromadzka 1980) and these birds may spend over 60% of their foraging time on freshly-planted cropland (Feare et al. 1974). Their preference for oats and wheat rather than rye (Luniak 1977), which in the study area is the main type of winter corn planted, again underlines the importance of spring corn for foraging Rooks. In May Rooks foraging in spring corn take mainly animal food. At this time of year this makes up around 70% of the total diet, the highest proportion in the annual cycle (Gromadzka 1980). In Scotland Rooks forage very much more frequently on oats (Feare 1974); there, wheat is a marginal crop planted as a winter corn (Feare et al. 1974). Fields of winter corn — almost exclusively rye — were here rarely visited for foraging, and then only in April. This was also where the smallest foraging flocks of Rooks gathered (Fig. 2). Rooks almost completely avoided these crops (Fig. 4), especially in May, by which time the plants had in any case grown too tall to allow foraging. Areas of waste land were visited throughout the study period, though only to a minimal extent. The utilisation of this particular habitat was roughly the same as its proportion in the environment (Fig. 4). Rooks foraged on root crops only between the 10 May and the end of the month, and the number of birds doing so was never more than 5%; this type of crop was generally avoided (Fig. 4). The birds also made use of other types of foraging ground: orchards, small rubbish dumps, roadsides, the areas around farm buildings, etc. As on the waste land, only single birds or small flocks were sighted there: such observations were far more frequent than the actual numbers of birds counted in such places. However, large rubbish dumps may be attractive to flocks of foraging Rooks, especially if they are situated at distances less than 10 km from the rookery (Author's own data).

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## STRESZCZENIE

### [Preferencje żerowiskowe gawrona w okresie lęgowym w krajobrazie rolniczym wschodniej Polski]

Badania przeprowadzono w regionie Siedlce, w środkowo-wschodniej Polsce. Cechą tego terenu była znaczna fragmentacja krajobrazu rolniczego, w którym największy udział miały pola uprawne. Materiał zbierano w kwietniu i maju w latach



2000–2002. Wokół 6 kolonii lęgowych wykonano od 6 do 8 kontroli (łącznie 40), penetrując obszar od 30 do 40 km<sup>2</sup> przy każdej kolonii. Po zlokalizowaniu żerujących osobników dokumentowano liczbę osobników, rodzaj upraw oraz odległość od kolonii lęgowej. Oszacowany udział poszczególnych upraw w areale żerowiskowym wynosił: łąki i pastwiska — 31.0%, zboża jare — 33.9%, zboża ozime — 26.8%, okopowe — 6.7%, nieużytki — 1.3% oraz pozostałe uprawy — 0.3%. Określono to na podstawie 5% wyznaczonych losowo kwadratów o boku 250 m, obejmujących łącznie 3.12 km<sup>2</sup>. Preferencje żerowiskowe określono na podstawie wskaźnika Jakobsa.

Wokół badanych kolonii lęgowych na jednym rodzaju uprawy stwierdzono żerowanie grup od 1 do 132 osobników (Fig. 1). Liczebność żerującego stada nie zmieniała się w czasie sezonu, a związana była z rodzajem upraw (Fig. 2). Większość gawronów odnotowana była w odległości od 0.5 do 1 km od kolonii (Fig. 3). Maksymalna odległość żerowiska wynosiła od 1 250 do 3 940 m (średnio 2833.3 m) — zwiększała się w zależności od wielkości kolonii. Wielkość kolonii zwiększała ponad-

to średnią odległość żerowiska, lecz nie miała wpływu na średnią wielkość żerującego stada. Najczęściej gawrony żerowały na zbożach jarych: pszenicy, owsie i jęczmieniu albo na mieszance tych zbóż. Biorąc pod uwagę preferencje (Fig. 4) odnoszące się przede wszystkim do 2 i 3 dekady maja oraz żerowanie na kiełkujących nasionach, ten rodzaj upraw miał największe znaczenie w areale żerowiskowym gawronów we wschodniej Polsce. Wyraźnie preferowane były także łąki i pastwiska, skupiające ponad 40% żerujących osobników (Tab. 1). Na początku okresu wegetacyjnego gawrony często wykorzystywały na żerowiska pola orne. Zboża ozime (prawie wyłącznie żyto) były omijanym miejscem żerowania (Fig. 4), wykorzystywanym przez stada średnio poniżej 3 osobników. Gawrony unikały także pól z roślinami okopowymi, zaś nieużytki odwiedzane były w ciągu całego okresu badań i nie odznaczały się preferencjami. Jako miejsca zdobywania pokarmu sporadycznie wykorzystywane były także m.in. sady, niewielkie wysypiskach odpadów, poboczach dróg i otoczenia zagród.



*T. Cofta*