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RIVER AS A FEEDING PLACE FOR CROWS (*CORVIDAE*)

(Ekol. Pol. 20: 609-635). The importance of river as a feeding place for *Corvus corone cornix* L., *Corvus frugilegus* L., and *Corvus monedula* L. was studied throughout a year. The relationship between diurnal activity and the importance of river as a food supplying medium during individual seasons of year as well as the influence of riverside landscape (towns, open areas, forests) upon the number of birds feeding in individual sections of river were indicated. The problem of food competition between *Corvus corone cornix* L. and *Larus ridibundus* L. was also discussed.

Contents

- I. Introduction
- II. Study area
- III. Study procedure
- IV. Feeding of crows on the Odra River
 1. Numbers and seasonal changes
 2. Effect of the nature of river on Crow numbers and on the way of their feeding
 3. Diurnal rhythm of feeding
 4. Food competition between Crow and Black-headed Gull
- V. Feeding of Rooks on the Odra River
 1. Numbers and seasonal changes
- VI. Feeding of Jackdaws on the Odra River
 1. Numbers and seasonal changes
- VII. Discussion of results and conclusions

I. INTRODUCTION

All the three Crows species discussed in the present paper belong to birds characteristic for open areas and at present on the area of Europe are a typical element of the avifauna of an agricultural landscape created by man.

Getting food by Crows near rivers and inland waters is known from very long ago, since already in the description of England by Harrison from 1577 there is a mention that Carrion Crows gather food from water of great English rivers (Fitter 1948). From among Polish authors Taczanowski (1882) mentioned the same. It was found also that feeding on the sea-shore and near human settlements enables Crows to winter beyond the polar circle (Bianki et al., 1967).

Inland waters and sea coasts provide favourable feeding places for numerous representatives of the genus *Corvus* L. Hulse and Atkeson (1953) reported food taking from water in the American species *Corvus brachyrhynchos* Brehm., while Nečajev (1969) – in *Corvus corone orientalis* Evers. and *Corvus macrorhynchos japonensis* Bon. on the Kurile Islands.

An American species *Corvus ossifragus* Wilson indicates the strongest relation with waters. Sea shore and river banks provided the main feeding place of this species (Imhof 1962, Bent 1964) what caused even that the bird was called a "Fish Crow". Data concerning *Corvus corone corone* L. and *Corvus corone cornix* L. feeding near water are quite numerous and will be cited further in the paper.

While studying contents of 2593 crops and stomachs of the Hooded Crow Hennicke found that fishes constituted 6.9% of animal diet. In other samples coming from Hooded Crows collected in aquatic or bog habitats there were found: on 30 occasions frogs, on 6 – Aquatic Beetles, 6 – Crustaceans, 125 – Snails, and 93 – Molluscs (after Mester 1959). On the other hand Hell and Sovis (1958) in 72 samples from Slovakia failed to find food gained near water.

While compiling the above information one can state that low fastidiousness in food selection and feeding in various biotopes is one of the symptoms of a great adaptive plasticity of the *Corvidae* family and provides undoubtedly a progressive factor of evolution which brought about a cosmopolitan distribution of the genus *Corvus* L.

Majority of data from literature cites single observations on European Crows feeding near waters (Anonymous 1947, Allen 1948, Tully 1951, Trelfa 1954, Moeller 1954, Roberts 1955, Richter 1955, Westerfrölke 1957, Levitsky 1958, and Mester 1959) and as a rule treat the phenomenon as exceptional. I did not find any quantitative data on this in literature and while taking observations on Odra River I found that inland waters probably provide this group of birds with a very important source of food during certain seasons of year.

It was then the purpose of the present paper to find what is the importance of inland waters as food resource for individual Crows species in an annual cycle and what are ways of food gaining near waters by this bird group.

II. STUDY AREA

Odra on its section from Wrocław to Szczecin is a trained river what decidedly affects its nature, changes in water level, bank erosion, formation of shallows, etc. It is a typical trained lowland river with slightly eroded banks and rather slow flow. On its full length stony groynes (heads) from banks enter river. Between them deep coves are situated.

Odra belongs to the most polluted rivers in this country. The assessment of the cleanness of its water reveals that no less than 83.2% constitute waters of the Vth class (not corresponding to any standards) and the remaining 16.8% are waters of the IIIrd class (Mańczak 1966, Florczyk 1969).

Meadows with varying degree of tree cover constitute the prevailing riverside landscape. Forest near Odra River are small and occur only in the upper section of the river (approximately to the estuary of Nysa Łużycka River). In the lower section of river small riparian willow bushes are to be met and along its entire course reed occurs sporadically between the groynes. On its section from Wrocław to Szczecin there are no big cities nor industrial centres, but smaller towns and settlements are situated. They are stretched along river at rather long distances. Human presence and penetration are regular there and rather intensive.

On the whole studied section of river forests situated directly on banks occupy together 94 km, the length of municipal sections amounts to 41 km, and the remaining 347 km fall to sections when river flows through open areas.

III. STUDY PROCEDURE

Data on the numbers of Crows feeding on Odra River I collected during 15 cruises by motor barges from Wrocław to Szczecin. In 1967 I took two cruises (second half of November and first half of December), while in 1968 – the remaining ones. I took two cruises a month beginning with the second half of February (when navigation was resumed after a winter pause) until the first half of May and afterwards I started again in the second half of August and completed in the second half of November.

I divided the whole route into three kinds of sections, considering the nature of riverside landscape. Identified were following kinds: "municipal" sections (8.5% of the route), open area sections (72.0% of the route), and forest sections (19.5% of the route).

Barge maintains an approximately constant speed amounting to 12–16 km/h. For observation I used field-glasses 15 × 50. Observations have been undertaken at dawn and ceased at dusk (barges do not go in night downward river). I counted exclusively birds which fed at the moment near water or were in its closest vicinity (up to several meters), as well as those watching water surface while sitting on branches emerging above water and on telegraph poles or flying over water surface. Thus counting included exclusively those birds which were within the open zone of riverside belt (Luniak 1968).

The technique of counting feeding Crows from a going barge appeared to be very effective, since as I could find it in the course of observations from bank, shyness of birds in the latter case is by far greater. E.g. Hooded Crows did not respond to the approaching barge even at the distance of 15–20 m, while at the sight of walking observer they flew away at the distance of 40–50 m.

Observations have been taken throughout a day and not only during hours when birds feed most intensively, therefore results cited are underestimated in relation to numbers of Crows actually feeding on Odra River at that time. This, however, does not affect the comparability of results.

Obtained results were converted into numbers of individuals per 1 km of river (both for the whole route and for individual kinds of sections). For each cruise, apart from the total number I calculated also the ecological number, while dividing the number of individuals by number of kilometers on which birds were feeding during definite cruise (Odum E. P. 1963, p. 152). In this way results given are although less comparable than the density given per area unit (e.g. 1 sq. km), but the determination of belt width for the entire length of river is practically unfeasible, because river width varies greatly in individual sections of its course.

Besides of the described observations from barge I carried out 11 counts on the section of Odra 10.5 km long flowing through Wrocław. Purpose of these observations was to determine which type of banks is most willingly frequented by feeding birds. I divided the count route into two sections. In the section "A" (5.5 km) banks are flat and regularly flooded several times a year. On its entire length there are installed groynes among which occur deep coves where water deposits silt and sand. The section "B" (5.0 km) presents an artificially digged navigable and flood canal. Here banks are steep, enforced with stones and deprived of groynes. During the winter time water level is here artificially lowered and then in certain portions long shoals of silt and sand outcrop. The entire route runs through areas adjoining the Szczytniki Park, Zoo, and other parks and the traffic of strollers and river ships is, in general, equally intensive in both sections.

IV. FEEDING OF HOODED CROWS ON THE ODRA RIVER

1. Numbers and seasonal changes

On the Odra River (both along the route Wrocław-Szczecin and on the counting route within Wrocław) Hooded Crows were feeding throughout the period of studies and one should assume that this species feeds near water during the year round. Numbers of birds feeding on river, however, are not equal during individual seasons of year. Most abundantly Hooded Crows were feeding on Odra River from October to March. Since the beginning of April the number of individuals feeding on river starts to decrease regularly and attains its minimum during summer months. Since the end of September one notes another increase in bird numbers and the highest number for this species I recorded in November (Fig. 1). During 15 cruises I recorded altogether 7 848 individuals and on average during 1 cruise 523 birds feeding on water. The total number fluctuates within limits from 0.4 individual per 1 km (August) to 1.8 individuals per 1 km (November) and thus during 3 months there occurs

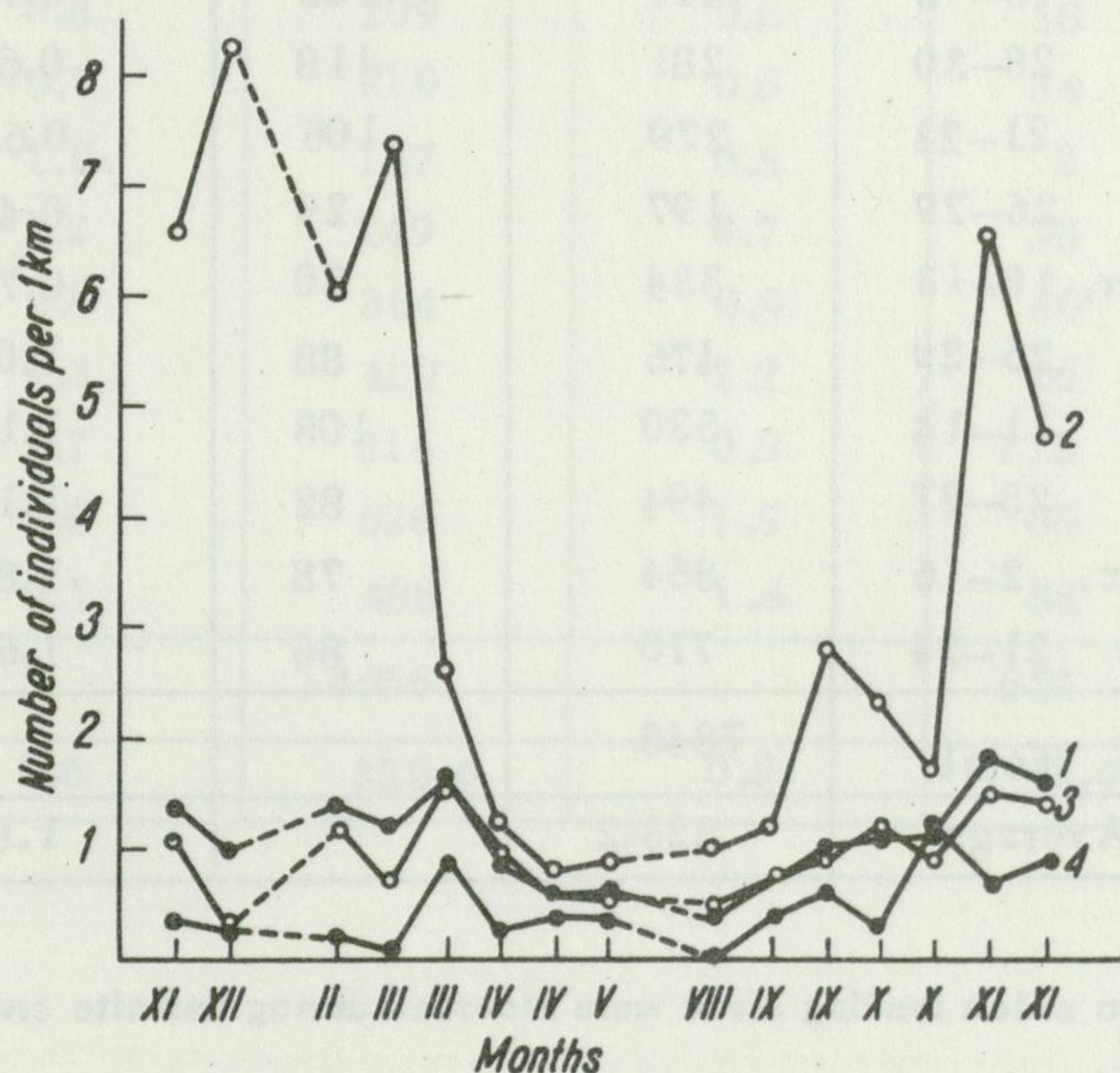


Fig. 1. Total numbers of Hooded Crows along the route from Wrocław to Szczecin and in identified sections of river

1 - total numbers on the whole route, 2 - municipal sections, 3 - sections of open areas, 4 - forest areas

a 4.5-times increase in the number of feeding birds (Tab. I). The mean number for the whole period amounts to 1.1 individuals per 1 km. These results are partially concordant with the data for Vistula River (Pinowski, Wasilewski 1962; Luniak 1971). The beginning of the autumnal increase in Hooded Crows numbers on Vistula River occurs already at the end of July and August,

Number of Hooded Crows feeding on the Odra River from Wrocław

No.	Date of cruise	Route Wrocław-Szczecin 482 km			
		number of individuals	km*	number of individuals per 1 km	
				numbers	
				total	ecological
1	November, 27-30	697	64	1.4	10.9
2	December, 15-19	498	50	1.0	10.0
3	February, 15-17	673	73	1.4	9.2
4	March, 9-12	567	79	1.2	7.2
5	" 23-25	769	171	1.6	4.5
6	April, 6-8	419	102	0.9	4.1
7	" 28-30	281	118	0.6	2.4
8	May, 21-23	279	106	0.6	2.6
9	August, 26-29	197	29	0.4	6.8
10	September, 10-13	334	80	0.7	4.2
11	" 26-29	476	88	1.0	5.4
12	October, 11-14	530	103	1.1	5.1
13	" 25-27	494	82	1.1	6.0
14	November, 2-6	864	78	1.8	11.1
15	" 21-24	770	86	1.6	9.0
Total		7848			
Average		523.2		1.1	

* Total kilometers on which feeding birds were recorded during definite cruise.

while on Odra River Hooded Crow numbers begin to increase only in September. This one month long delay in the increase in bird numbers on the Odra River when compared with Vistula is probably connected with the date of resuming wandering and the arrival of first wandering individuals from the east. Peak numbers of Hooded Crows on Odra and Vistula Rivers occur in November (Fig. 1).

Ecological numbers to a great extent depend upon the aggregation of crows in flocks and hence it attains greatest values during autumn and winter (9.0-11.1

to Szczecin and within individual sections of river

Tab. I

Municipal sections (41 km) 8.5%		Open area sections (347 km) 72%		Forest sections (94 km) 19.5%	
number of individuals	number of individuals per 1 km	number of individuals	number of individuals per 1 km	number of individuals	number of individuals per 1 km
	total number		total number		total number
272	6.6	383	1.1	42	0.4
341	8.3	127	0.3	30	0.3
245	6.0	412	1.2	16	0.2
304	7.9	253	0.7	10	0.1
108	2.6	572	1.6	89	0.9
47	1.2	342	1.0	30	0.3
34	0.8	209	0.6	38	0.4
35	0.9	210	0.6	34	0.4
38	1.0	157	0.5	2	0.02
47	1.2	249	0.7	38	0.4
112	2.8	304	0.9	60	0.6
94	2.3	410	1.2	26	0.3
67	1.7	314	0.9	113	1.2
273	6.6	526	1.5	65	0.7
194	4.7	488	1.4	88	0.9
2211		4956		681	
147.3	3.6	330.4	0.9	45.4	0.5

individuals/km), while during summer, when birds feed singly or in small groups these values are lower (2.4–6.8 individuals per 1 km) (Fig. 2).

From among the three identified types of river sections municipal sections were used by Hooded Crows to a greatest degree (in relation to the length of section) (Tab. I). Municipal sections comprised only 8.5% of the route length, but on average 28.2% of all observed individuals fed on them. Percentual proportion of birds feeding on municipal sections was highest during autumn and early spring (25.2–68.5%) and lowest during April and May (11.2–12.5%).

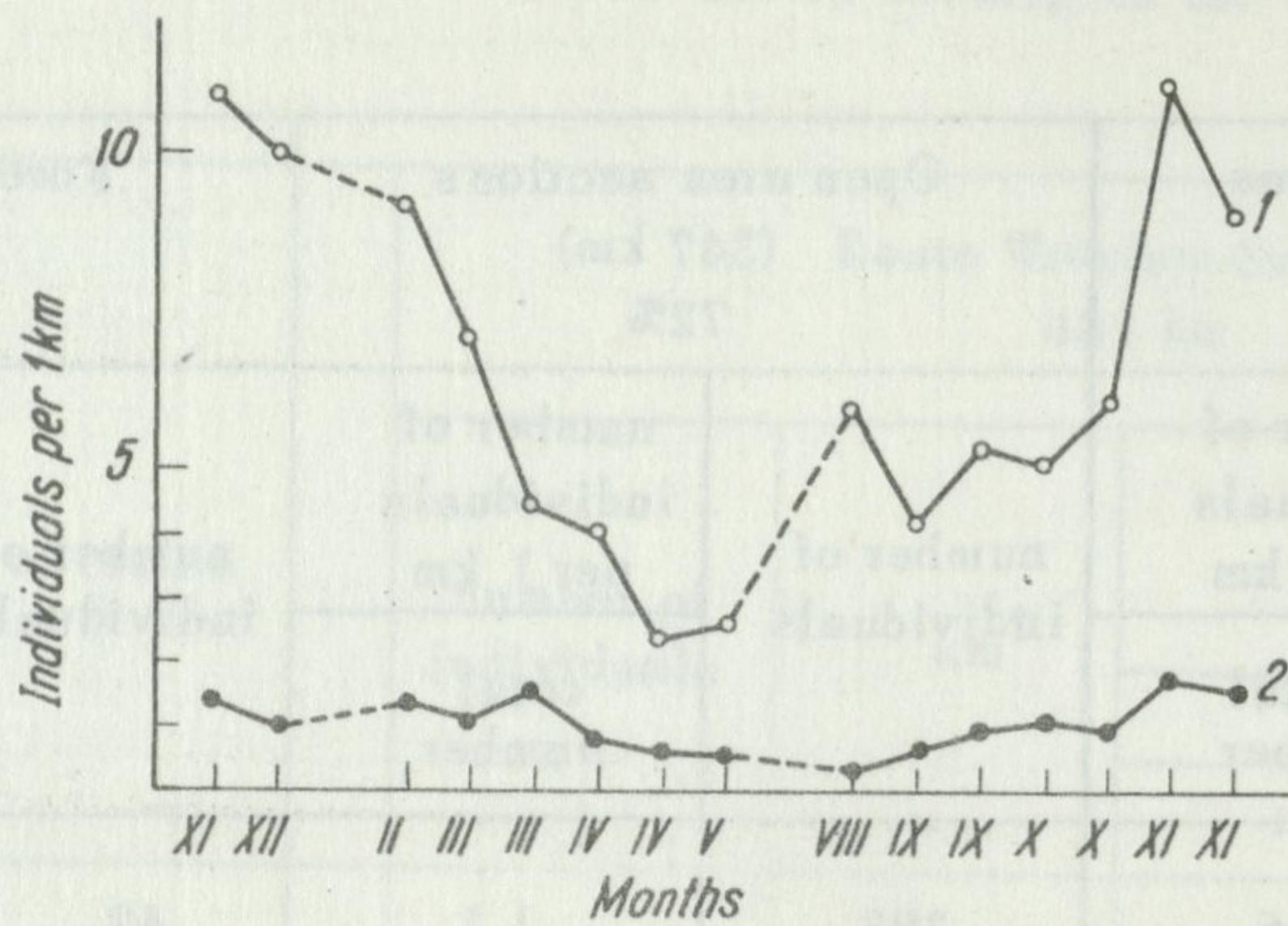


Fig. 2. Ecological and total numbers of Hooded Crows along the route from Wrocław to Szczecin

1 - ecological numbers, 2 - total numbers

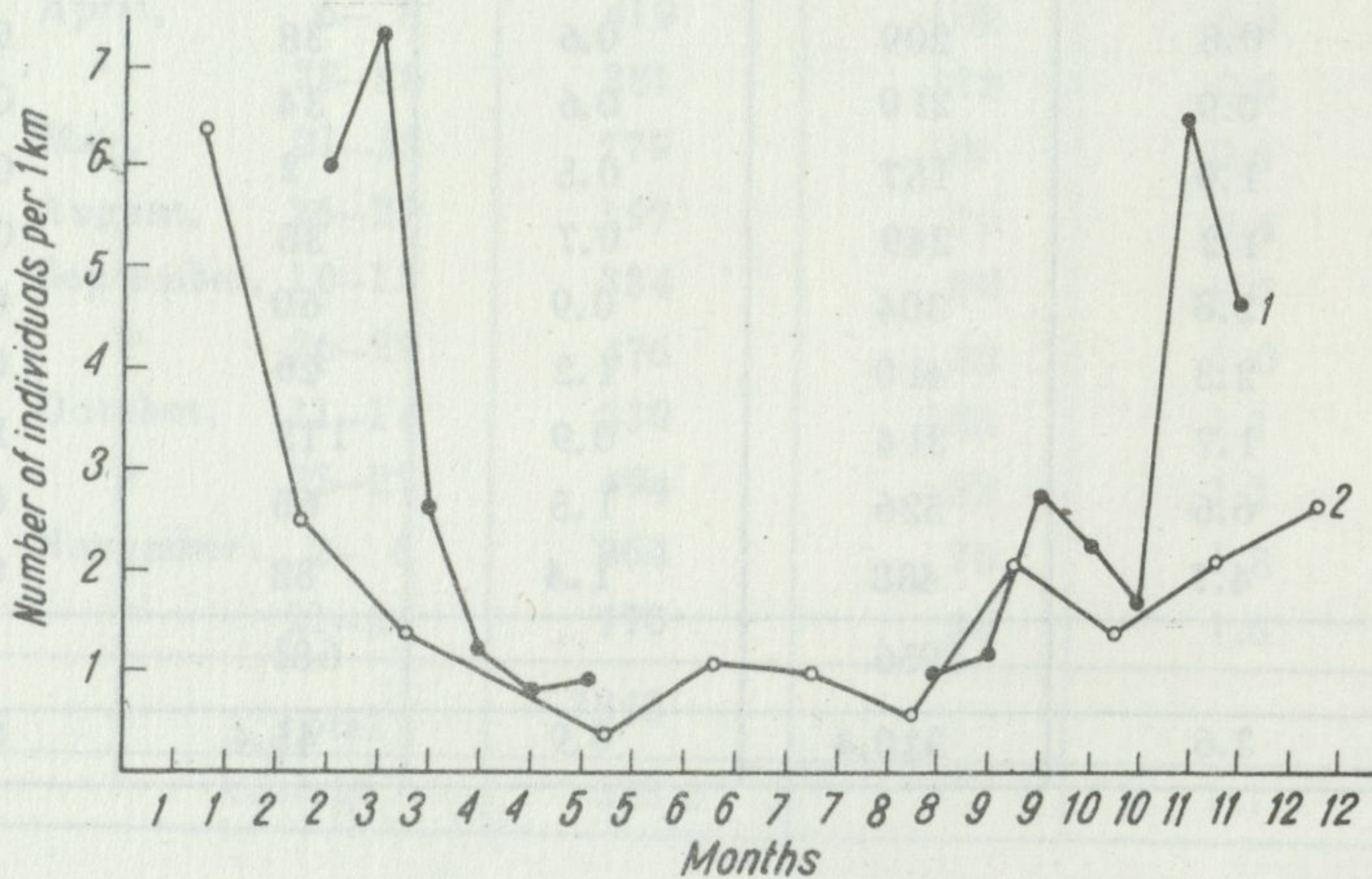


Fig. 3. Numbers of Hooded Crows on the Odra River on the area of Wrocław and in municipal sections on the route from Wrocław to Szczecin

1 - numbers in Wrocław, 2 - numbers along municipal sections

It is understandable, because at this time crows build nests and avoid the close presence of humans. The value of numbers, which during the highest intensity of Hooded Crow feeding on these sections amounts to 4.7–8.3 individuals per 1 km, i.e. by 6 times more than on the whole route, provides a measure of the attraction of municipal sections. During the spring and summer period numbers of Hooded Crows on municipal sections decline to 0.8 individual per 1 km, i.e. 10 times lower numbers. During 11 counts on the area of Wro-

cław I got similar results (Fig. 3). The mean number on municipal sections amounts to 3.6 individuals per 1 km and is by thrice higher when compared with numbers on the whole route. While analyzing numbers of Hooded Crows on municipal sections one can state a phenomenon of seasonal synantropisation, since birds use municipal sections of river throughout a year, but during the autumn and winter season rivers flowing through towns are particularly intensively used as feeding places (Fig. 1).

Results obtained enabled also the determination of the zone of town effect along river. With this in mind I analyzed numbers of observed birds within towns as well as on 5 km long section of river above town and on 6 km long section of river down the town. I considered only towns which do not border directly forests, namely: Głogów, Krosno Odrzańskie, Fürstenberg, and Gryfino. Figure 4 presents the total numbers of observed birds in the 4 selected towns and within their suburban zones for the whole study period.

The number of Hooded Crows observed on river sections above town does not reveal any trend of increase along with approaching town, but after passing it one can distinctly see a slow decrease in the number of observed birds. This regularity occurs on the area of the all four towns. Based on the figure 4 one can assume that the zone of town influence includes a 4 km long section of river down a town.

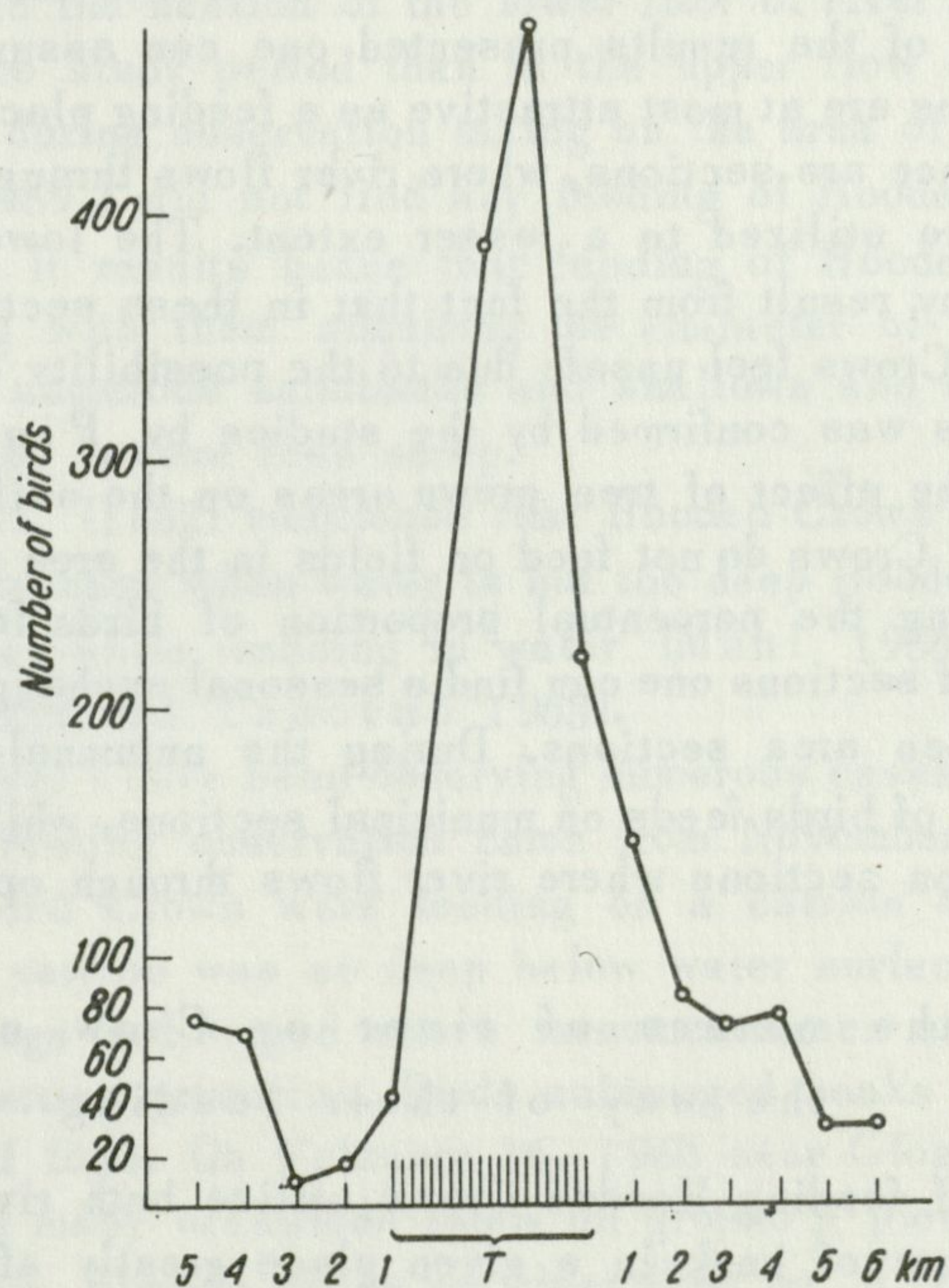


Fig. 4. Total number of Hooded Crows feeding on river within boundaries of towns and on river sections above and below towns

T - town

River sections crossing open areas comprised in total 72.0% of the whole route. On these sections Hooded Crows were also feeding throughout a year, but in by far lower numbers, than in municipal sections. Number of Hooded Crows feeding in sections where river flows through open areas is proportional to the total number of Hooded Crows feeding on river during a given period (Fig. 1). Percentual proportion of Hooded Crows feeding on river in these sections is different during individual seasons of year (Tab. I). The highest percentage of birds feeds on open area sections during summer months (end of March – beginning of September) and amounts to 74.3–81.6% of individuals feeding on river. During autumnal and winter period the percentage of birds feeding in sections of this type decreases considerably and amounts to 25.5–63.3%. On the average throughout the year 63.1% of all observed Hooded Crows fed in sections where river flows through open areas. The highest number of Hooded Crows in these sections I found during the autumnal–winter period and the lowest during the summer period, but fluctuations in numbers are not so pronounced here and extremal values differ only 3 fold (Tab. I).

The mean total number during a year amounted: for municipal sections to 3–6 individuals/1 km, for open area sections – to 0.95 individuals/1 km, for forest sections 0.5 individual/1 km. Differences between those results are statistically significant $3.6 > 0.95 - P = 0.05$ and $0.95 > 0.5 - P = 0.05$.

On the basis of the results presented one can assume that sections of river crossing towns are at most attractive as a feeding place for Hooded Crows. Second in importance are sections, where river flows through open areas, while forest sections are utilized to a lesser extent. The lower attractiveness of forest sections may result from the fact that in these sections with restricted visibility Hooded Crows feel unsafe due to the possibility of a surprise attack by predators. This was confirmed by the studies by Pinowski (1954) who while observing the effect of tree grown areas on the avifauna of open areas found that Hooded Crows do not feed on fields in the area adjacent to forests.

While comparing the percentual proportion of birds feeding on the three mentioned types of sections one can find a seasonal exchange of birds between municipal and open area sections. During the autumnal-winter period the highest proportion of birds feeds on municipal sections, while during the spring-summer period – on sections where river flows through open areas.

2. Effect of the nature of river on Crow numbers and on the way of their feeding

As a place of feeding Hooded Crows utilize both river banks and water surface. The nature of bank in a given place greatly affects the number of Hooded Crows feeding on definite river section. Most willingly Hooded Crows feed on flat banks with a broad strip of area without vegetation (muddy, stony,

and snady banks). A similar relationship was found by Tenovuo (1963) under conditions of skerries of the seacoast of Finland and Rettig (1965) mentions this as well.

Steep banks with little varying line are by Hooded Crows used to a considerably lesser degree.

To this end I carried out observations in two sections of the Odra River flowing through Wrocław. From the comparison of data it results that on the "A" section with flat banks, groynes, and coves, as well as with numerous muddy shoals almost 5 times more Crows fed throughout a year than on the section "B" with steep and even banks (Tab. II). On average during 11 counts on the section "A" I met 76.6% of all feeding Hooded Crows. Numbers also were in the section "A" thrice greater than in the section "B". Results obtained indicate that the regulated river with groynes entering its stream provide by far more favourable conditions than a canal and that the number of Hooded Crows feeding on river depends directly upon the availability of food on bank. On flat and vegetation deprived banks the food is by many times easier to find than on steep and grown with vegetation ones. It was confirmed also by the analysis of Crow occurrence along the Odra River. While comparing two 100 km long sections of open areas in the upper and lower flow of the river I found that in the section of the lower flow of river there fed 20% more birds throughout the study period than in the upper flow of the Odra River. On the other hand during observation taking on the area of the Kłodzko Basin during 1968 and 1969 I did not find any feeding of Hooded Crows on rivers with rapid stream. It results hence that feeding of Hooded Crows on rivers is increased along with them acquiring the character of lowland river with broad water body, numerous sandbanks and shallows and as the rate of flow decreases and banks become less steep.

Taczanowski (1882) mentioned that Hooded Crows gather food thrown out on banks. In the case when water is not too deep Hooded Crows look after food, mostly snails, while wadding in water (Mühl 1954, Moeller 1954, Dobrowolski 1959, and Tenovuo 1963).

On the Odra River I have been observing numerous cases of similar feeding and the most interesting observation came from November 15, 1967. In this case several Hooded Crows were feeding on a carrion drowned few meters from a bank. The carrion was so deep below water surface that birds sitting on it had their legs submerged above tarsometatarsus and kept their wings raised to avoid wetting primaries. Birds submerged beaks and heads in water and tore pieces of food. On February 16, 1968 near Głogów I observed how a Hooded Crow on many occasions threw on ground a piece of something and then lifted it in air. Similar cases are described by Kirchner (1957) and Mühl (1954) who observed Hooded Crows which in winter broke molluscs in this way and Pinowski (1968) described a similar procedure with walnut fruits.

Number of Hooded Crows feeding on the Odra River within boundaries of Wrocław

Tab. II

No.	Month	Observation route 10.5 km		Section "A" 5.5 km		Section "B" 5 km	
		number of individuals	numbers per 1 km	number of individuals	numbers per 1 km	number of individuals	numbers per 1 km
1	January	80	7.6	66	12.0	14	2.8
2	February	31	3.0	23	4.2	8	1.6
3	March	18	1.7	12	2.2	6	1.2
4	April	—	—	—	—	—	—
5	May	5	0.5	2	0.4	3	0.6
6	June	14	1.3	5	0.9	9	1.8
7	July	13	1.2	13	2.4	—	—
8	August	7	0.7	5	0.9	2	0.4
9	September	26	2.5	24	4.4	2	0.4
10	October	18	1.7	13	2.4	5	1.0
11	November	26	2.5	15	2.7	11	2.2
12	December	34	3.2	32	5.8	2	0.4
	Total	272		210		62	
	Average	24.7	2.4	19.1	3.5	5.6	1.1

Food from the water surface is collected by Hooded Crows with the aid of both beak and legs. Richter 1955, Wolter 1957, Vietinghoff-Riesch 1954, Spenner 1956, Wendland 1957, and Moeller 1954 from the area of Germany wrote about cases of lifting food from water surface with beak. Similar cases from the area of England are reported by: Bromley 1947, Anonymous 1947, Allen 1948, and Jones 1955. On Dniepr River Levitsky (1958) observed similar cases and found that Hooded Crows in this way capture mostly bleaks (*Alburnus alburnus* L.). Besides, the capturing of fish by Crows was described by: Allen (1948), Holmberg (1957), Betmann (1954), Tully (1951), Kuročkin and Gerasimova (1960), and many others.

Cases of raising bits of food with the aid of legs are mentioned by: Anonymous 1947, Mester 1959, Westerfrölke 1957, Bösenberg 1957, Kirchner 1957, and Zedler 1958. On the other hand Hulse and Atkeson (1953) observed a similar case in an American species *Corvus brachyrhynchos* Brehm.

On the Odra River I observed the both ways of raising food bits from water surface. It seems that the way of lifting food depends on the size of definite bit. In case of small bits Hooded Crows raise them with beak, when a bit is greater they use legs. In one case I watched a Hooded Crow which grasped in her legs so big piece that it could not lift it into air and the bird was dragging it to bank while grasping in legs.

The passing barge causes the water outflow from banks (particularly in places with narrow river bed) and then for a short time great areas of bottom unavailable otherwise become exposed, while after barge passes a wave is formed which carries on bank numerous things, including food of various kind. Hooded Crows in masses utilized both phenomena and during the passage of barge were catching food from exposed bottom portions and also penetrating bank beaten by waves brought about by barge.

All the observations cited indicate that Hooded Crow, as an omnivorous species, utilize many kinds of food available on river (wastes, carrion, fish, snails, etc.) and diverse ways of gaining food evidence that Hooded Crow as a species learns easily, particularly activities leading to gaining food.

3. Daily rhythm of feeding

The results presented concern only the daily rhythm of Hooded Crow feeding on sections of open areas, since only for those sections I gathered a sufficient number of samples. As a sample I accepted half hour duration of observation taking, what while considering various speed of barge on individual sections of river and with various water levels gives sections from 5.5 to 8.4 km long. However, samples taken in the upper and lower river stream entered the same

time intervals (classes) so that the above differences are levelled off to a serious extent and may be neglected in final considerations.

In a case when certain portion of the sample collected fell to the passage through forest or municipal sections the duration of passing those sections was deducted from the time of the sample and I determined the percentual portion of the complete sample. Final results constitute weighted arithmetic mean (bird number divided by the number of samples in given class).

The material obtained made it possible to follow the daily rhythm of feeding for the following four phenological periods:

1. Winter period – data collected during cruises in November and December from 7.00 a.m. until 4.30 p.m. I collected 175.8 samples and the daily rhythm of feeding was established on the basis of 1462 individuals observed.

2. Period of spring migration – data collected during February and March from 5.30 a.m. until 6.30 p.m. I collected 134.4 samples and the daily rhythm of feeding was established on the basis of 1232 individuals observed.

3. Breeding period – data collected during April and May from 4.00 a.m. until 8.30 p.m. I collected 149.8 samples and the daily rhythm of feeding was established on the basis of 761 individuals.

4. Period of autumnal migration – data collected during August, September, and October from 5.00 a.m. until 7.30 p.m. I collected 238.7 samples and the daily rhythm of feeding was established on the basis of 1395 individuals observed.

Distinct diurnal changes of the daily rhythm of feeding occur during individual phenological seasons (Fig. 5) and the results obtained confirm a known fact of the correlation of diurnal activity of birds with the duration of day (Allee et al., 1958). During the winter season the highest intensity of feeding occurs during morning and noon hours (Fig. 5a). During the spring migration the peak of feeding activity occurs during noon hours (Fig. 5b). During the breeding period the feeding intensity is uniform throughout a day and no distinct peak was recorded (Fig. 5c). Feeding intensity during the autumnal migration is intermediate between that of breeding and winter seasons (Fig. 5d).

A great increase in numbers of feeding birds directly before the dusk is very distinctly marked on all diagrams illustrating the daily rhythm of feeding. This is most probably connected with the need of refilling moisture supply in organism before night and gaining adequate food supply for night. Dobrowolski (1959) recorded also an aggregation of Crows flocks on Vistula shallows at night before roosting for night.

The results presented would indicate that the river as a feeding place of Crows plays a main part during periods when birds encounter problems with food collection. The highest activity of feeding during morning hours in winter season indicates that it is one of the first places of Hooded Crow feeding at this time. Also during the season of spring migration, when birds

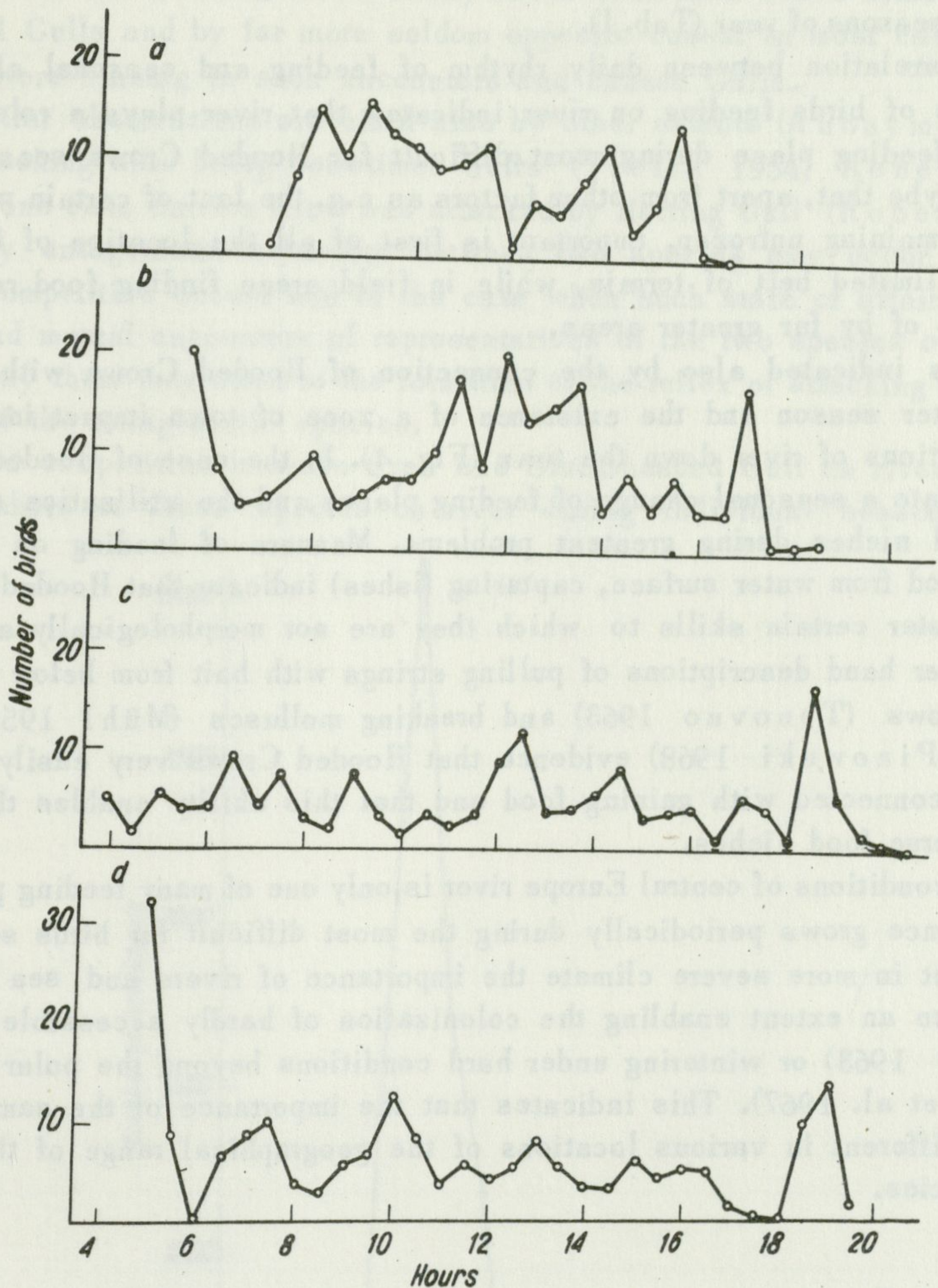


Fig. 5. Daily rhythm of Hooded Crow feeding during four phenological seasons
a - winter period (November, December), *b* - spring migration (February, March), *c* - breeding period (April, May), *d* - autumnal migration (August-October)

cover great distances during rather short time, river as a feeding place is utilized mainly during noon hours, when as it is commonly recognized birds rest and feed. On the other hand during hours when birds migrate there is marked an obvious decrease in numbers of feeding Hooded Crows. During breeding and autumnal migration seasons, the latter being considerably extended in time, when quantities of available food are greater in all biotopes, the importance of river as a food resource decreases. These results are fully con-

firmed by data on numbers of Hooded Crows feeding on Odra River during individual seasons of year (Tab. I).

The correlation between daily rhythm of feeding and seasonal changes of numbers of birds feeding on river indicates that river plays a role of an important feeding place during most difficult for Hooded Crows seasons of year. It maybe that, apart from other factors as e.g. the fact of certain portions of river remaining unfrozen, important is first of all the location of food in a strictly limited belt of terrain, while in field areas finding food requires penetration of by far greater areas.

This is indicated also by the connection of Hooded Crows with towns during winter season and the existence of a zone of town impact including certain portions of river down the town (Fig. 4). In the case of Hooded Crow one may state a seasonal change of feeding places and the utilization of additional food niches during greatest problems. Manners of feeding on waters (picking food from water surface, capturing fishes) indicate that Hooded Crows had to master certain skills to which they are not morphologically adapted. On the other hand descriptions of pulling strings with bait from below ice by Hooded Crows (Tenovuo 1963) and breaking molluscs (Mühl 1954) and wallnuts (Pinowski 1968) evidence that Hooded Crows very easily learn activities connected with gaining food and that this ability enables them to utilize diverse food niches.

Under conditions of central Europe river is only one of many feeding places. Its importance grows periodically during the most difficult for birds seasons of year, but in more severe climate the importance of rivers and sea shores increases to an extent enabling the colonization of hardly accessible areas (Tenovuo 1963) or wintering under hard conditions beyond the polar circle (Bianki et al. 1967). This indicates that the importance of the same food niche is different in various locations of the geographical range of the discussed species.

4. Food competition between Hooded Crow and Black-headed Gull

Hooded Crow utilizes river as a feeding place in a way similar as the Black-headed Gull does (observation of water surface from air and picking food from its surface). These facts may indicate the occurrence of food competition between the two species, while a direct evidence of the competition is provided by the antagonistic behaviour towards each other of the representatives of the two mentioned species.

Bianki et al. (1967) also express an opinion of the existence of food competition between the Hooded Crow and Herring Gull in the region of sea coasts of the White and Barent's Sea

On the Odra River I recorded many cases of Hooded Crows attacking Black-headed Gulls and by far more seldom opposite cases. In most cases Hooded Crows were winning in such encounters and chased Gulls.

Similar observations are cited also by other authors (Anonymous 1947), the attacking side being sometimes Gulls (Trelfa 1954, Roberts 1955) and in one case Carrion Crow was attacked by Herring Gull (Roberts 1955). Mutually antagonistic behaviour between two species may occur only when some competition occurs and in the case when such state of affairs lasts for long and mutual encounters of representatives of the two species occur rather frequently there may come to the formation of the reflex of attacking representatives of the antagonistic species.

Food competition between Crow and Black-headed Gull on rivers depends on numbers of these species on river during individual seasons of year.

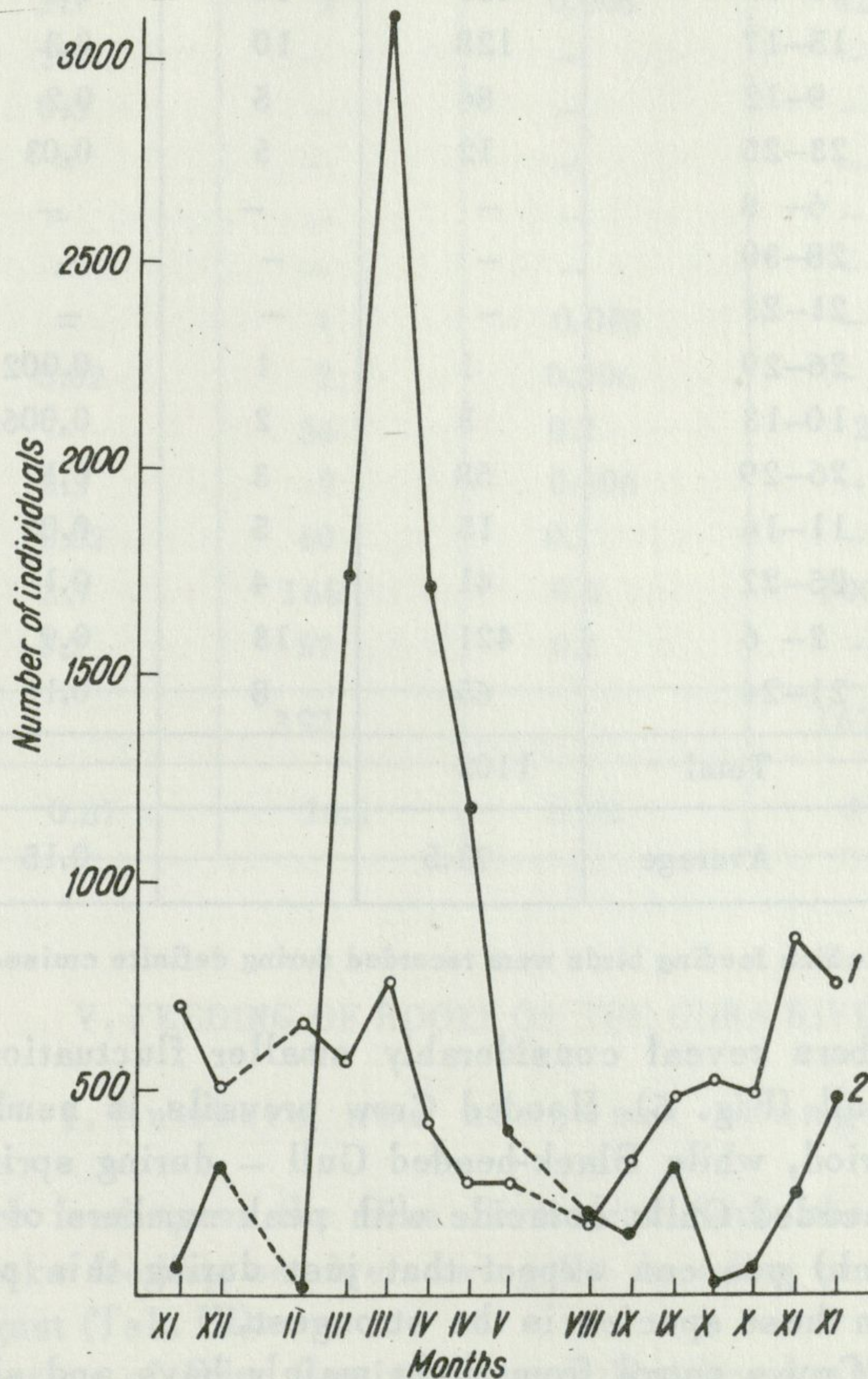


Fig. 6. Total number of Black-headed Gulls and Hooded Crows observed on the Odra River along the route from Wrocław to Szczecin

1 - number of Hooded Crows, 2 - number of Black-headed Gulls

Number of Rooks feeding on the Odra River along the route from

No.	Date of cruise	Route Wrocław-Szczecin 482 km			
		number of individuals	km*	number of individuals per 1 km	
				numbers	
				total	ecological
1	November, 27-30	142	9	0.3	15.7
2	December, 15-19	131	11	0.3	12.0
3	February, 15-17	128	10	0.3	12.8
4	March, 9-12	86	5	0.2	14.2
5	" 23-25	12	5	0.03	2.4
6	April, 6-8	—	—	—	—
7	" 28-30	—	—	—	—
8	May, 21-23	—	—	—	—
9	August, 26-29	1	1	0.002	1.0
10	September, 10-13	3	2	0.006	1.5
11	" 26-29	58	3	0.1	19.3
12	October, 11-14	15	5	0.03	3.0
13	" 25-27	41	4	0.1	10.2
14	November, 2-6	421	13	0.9	32.4
15	" 21-24	65	8	0.1	8.1
Total		1103			
Average		73.5		0.15	

* Total kilometers on which feeding birds were recorded during definite cruise.

Hooded Crow numbers reveal considerably smaller fluctuations than those of Black-headed Gull (Fig. 6). Hooded Crow prevails in numbers during the autumnal-winter period, while Black-headed Gull — during spring. Since peak numbers of Black-headed Gulls coincide with peak numbers of Hooded Crows during spring (March) one can expect that just during this period the food competition between these species is the strongest.

It is true that Crows patrol from flight mainly bays and shallow, near to bank portions of water, while Black-headed Gulls mainly the centre of river-bed. In this way these two species could avoid each other in a strip of river width. Under this line I took only fragmentary observations and this problem requires an additional work.

Wrocław to Szczecin and within individual sections of river

Tab. III

Municipal sections (41 km) 8.5%		Open area sections (347 km) 72.0%		Forest sections (94 km) 19.5%	
number of individuals	number of individuals per 1 km	number of individuals	number of individuals per 1 km	number of individuals	number of individuals per 1 km
	total number		total number		total number
78	1.9	41	0.1	23	0.2
105	2.4	26	0.08	—	—
84	2.1	2	0.006	42	0.4
86	2.1	—	—	—	—
12	0.3	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	1	0.003	—	—
1	0.02	2	0.006	—	—
—	—	56	0.2	2	0.02
13	0.3	2	0.006	—	—
1	0.02	40	0.1	—	—
152	3.7	165	0.5	100	1.1
10	0.2	57	0.2	—	—
542		392		167	
36.1	0.87	26.1	0.08	11.1	0.1

V. FEEDING OF ROOKS ON THE ODRA RIVER

1. Numbers and seasonal changes

Rooks were feeding on the Odra River from September until March. I did not record Rooks feeding on river during the breeding period from April until the end of August (Tab. III).

On the section of Odra flowing through Wrocław I also failed to observe Rooks feeding during the breeding season. This would indicate that river is utilized by this species only periodically.

The way of gaining food from the area of river strip is in the case of Rook quite different from that in Hooded Crow. Rooks search river banks and collect wastes cast on them by waves and look after food when the water retreats and exposes certain portions of bottom. On the other hand I never saw Rooks picking food from water surface and in literature I also failed to find any information on it. In winter time, when river is ice-bound, Rooks and Crows search after food on the ice surface, particularly near air-holes. During early spring the two mentioned species frequently float on ice floes and collect food thrown by water on their surface.

In Rooks, similarly as in Crows, there is marked predisposition for river sections with diversified shore-line. On the 5 km long section of the Odra River within boundaries of Wrocław, along which banks are flat and stony groynes enter the stream, during all counts there fed altogether 275 individuals, while in the section with steep, smooth, and enforced banks there fed altogether 100 birds.

In the course of 15 cruises I recorded in total 1103 Rooks feeding on the Odra River and 73 individuals on average during one cruise. The peak numbers occur during November and December (Tab. III), what is also confirmed by results obtained on the area of Wrocław. The mean number for the whole study period amounts to 0.15 individual per 1 km, while for Crows it amounts to 1.1 individuals per 1 km. In distinction to Crows, which frequently fed singly or in small groups, Rooks were feeding on the Odra River in numerous flocks so that the mean ecological number of this species is almost twice as great as in Crows and amounts to 11.1 individuals per 1 km.

From among the three identified biotopes situated along river banks the highest percentage of birds, since no less than 49.2 was feeding in municipal sections. Sections, where river flows through open areas, are on the second position, while forested sections are used in the third order (Tab. III). The mean total number amounts to 0.87 individual per 1 km, while the mean number for municipal sections amounts to no less than 8.0 individuals per 1 km. On the Odra section within boundaries of Wrocław Rook was the most numerous species and Hooded Crow was only on the second position.

On the basis of cited results one may state that Rooks utilize the open zone of river belt as a feeding place, but to a considerably lesser extent than Hooded Crows do. Rook feeding on rivers is of seasonal character and the manner of gaining food is less active than in the case of Hooded Crows. Rooks are also much closer connected with municipal sections of river than Hooded Crows.

VI. FEEDING OF JACKDAWS ON THE ODRA RIVER

1. Numbers and seasonal changes

Jackdaw was the least numerous species feeding on the Odra River and as a rule occurred in mixed flocks together with Rooks. The manner of feeding alone indicated that this species only casually feeds on river. For Jackdaws did not look after food on the river bank itself, but most often fed in places where river washed away banks and exposed thus large patches of bare soil.

Jackdaw, similarly as Rook, fed on Odra River exclusively during the period from September until March (Tab. IV). This seasonal occurrence on the Odra River is confirmed also by results obtained within the Wrocław section of river. In total during all cruises I recorded 342 individuals feeding near water and the mean for one cruise amounted to 22.8 individuals. Peak numbers of Jackdaws coincide with peak numbers of Rooks and occur in November (Tab. IV). In the course of the three cruises carried out during November I recorded 72.8% of all Jackdaws. This was most probably connected with the arrival of Rook and Jackdaw flocks from the regions situated on the north-east to areas included by observations.

Jackdaws fed on river mainly in municipal sections and observations of them in other types of sections are of sporadic nature, e.g. on two occasions I found the presence of Jackdaws in forest sections in mixed flocks with Rooks. In municipal sections in the course of 15 cruises I observed 55.0% of feeding Jackdaws and for 11 cruises during which I recorded the feeding of Jackdaws on the Odra River, this percentage amounted to no less than 75.0. On the Odra River within boundaries of Wrocław Jackdaw was feeding in rather small numbers and in the course of 11 counts I recorded in total 15 individuals.

It results from the above data that Jackdaw as a bird strongly connected with human settlements feeds on river only occasionally and even then most frequently within human settlements (as a rule in mixed flocks together with Rooks). Autumnal months are the period of the most intensive feeding of this bird on rivers.

VII. DISCUSSION OF RESULTS AND CONCLUSIONS

1. Results obtained on the Odra River indicate that Crows regularly utilize river as a place of gaining food, although among the three species discussed there are marked distinct differences. Hooded Crow reveals the closest relation with river, while in the two remaining species this relation is looser. For Hooded Crows river provides a permanent place of food gaining, what is confirmed by: feeding near rivers throughout a year, diverse forms of gaining food in river habitat and the relationship between numbers of birds feeding in individual phenological periods and the daily rhythm of feeding.

Number of Jackdaws feeding on the Odra River along the route

No.	Date of cruise	Route Wrocław-Szczecin 482 km			
		number of individuals	km*	number of individuals per 1 km	
				numbers	
				total	ecological
1	November, 27-30	106	4	0.2	26.5
2	December, 15-19	6	1	0.01	6.0
3	February, 15-17	1	1	0.002	1.0
4	March, 9-12	10	3	0.02	3.3
5	" 23-25	16	5	0.03	3.2
6	April, 6-8	-	-	-	-
7	" 28-30	-	-	-	-
8	May, 21-23	-	-	-	-
9	August, 26-29	-	-	-	-
10	September, 10-13	2	1	0.004	2.0
11	" 26-29	16	2	0.03	8.0
12	October, 11-14	1	1	0.002	1.0
13	" 25-27	41	3	0.1	11.6
14	November, 2-6	135	6	0.3	22.5
15	" 21-24	8	2	0.01	4.0
Total		342			
Average		22.8		0.05	

* Total kilometers on which feeding birds were recorded during definite cruise.

2. Outside breeding season are the periods of the most intensive feeding on rivers for all Crows and peak numbers of birds feeding on the Odra river occur in November (Tab. I, III, and IV). Rooks and Jackdaws feed on the Odra River exclusively from September until March and it is only Hooded Crow which feeds there throughout a year (Fig. 3). A considerable increase in numbers of Crows feeding on rivers occurs during late autumn and early spring and is connected with the period of migration.

3. There are marked obvious differences in the daily rhythm of Hooded Crow feeding during individual phenological seasons. The peak of feeding

from Wrocław to Szczecin and within individual sections of river

Tab. IV

Municipal sections (41 km) 8.5%		Open area sections (347 km) 72.0%		Forest sections (94 km) 19.5%	
number of individuals	number of individuals per 1 km	number of individuals	number of individuals per 1 km	number of individuals	number of individuals per 1 km
	total number		total number		total number
4	0.1	—	—	102	1.1
6	0.1	—	—	—	—
1	0.02	—	—	—	—
10	0.2	—	—	—	—
14	0.3	2	0.006	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
2	0.04	—	—	—	—
8	0.2	8	0.02	—	—
1	0.02	—	—	—	—
19	0.5	22	0.07	—	—
51	1.2	50	0.1	34	0.4
8	0.2	—	—	—	—
124		82		136	
8.3	0.19	5.5	0.01	9.0	0.1

activity during the winter period and during the spring migration occurs in these times of a day when birds intensively feed also in other biotopes, but the simultaneous remarkable increase in the number of individuals feeding on river indicates that river plays then a role of an important food source. During the breeding season and during autumnal migration the importance of river as a food resource decreases.

4. From among the three identified types of riverside landscape the sections where river flows through towns are particularly willingly visited by the discussed species of Crows (Tab. I, III, and IV). Jackdaw is at most connected

with towns and its feeding on rivers is rather casual. On the other hand Rooks, although most numerous feed in municipal sections, occur also on the Odra far from towns and their aggregation near river indicates that it provides them with attractive place of gaining food in certain seasons of year. River sections with forested banks were obviously avoided by all the three corvine species.

5. Sections of river below towns were more numerous visited by feeding birds than sections above them. Sections downstream from towns in which birds feed more numerous constitute a zone of town influence and include 4–5 km long section of river.

6. Crow numbers in individual sections of river depend on the availability of food in a given section. Portions of river with flat banks and diversified shore line and a broad belt deprived of vegetation are most willingly visited (Tab. II). Exclusively Hooded Crows pick up food from water surface and the remaining two species collect only the food available on river bank. The manner of picking food by Hooded Crows from water surface depends on its location and size of food item. Small pieces are picked with beak and big ones – with the aid of legs.

7. River is a biotope in which occurs food competition between Hooded Crow and Black-headed Gull. The competition is most stringent during the spring migration of Black-headed Gulls and Hooded Crows. At this time Gull by many times exceeds Crow in numbers, but at the same time both species attain their peak of numbers on river in an annual cycle. During the remaining seasons of year Crows are more numerous than Black-headed Gulls.

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REFERENCES

1. Allee, W. C., Emerson, A. E., Park, O., Park, T., Schmidt, K. P. 1958 – *Zasady ekologii zwierząt* – Warszawa, T. I i II.
2. Allen, S. J. H. 1948 – Carrion Crow Taking living fish from water – *Brit. Bird.* 41: 278.
3. Anonymus, 1947 – Carrion Crow taking food off water – *Brit. Bird.* 40: 245.
4. Bent, A. C. 1964 – *Life histories of North American Jays, Crows and Titmice* – New York, 495 pp.
5. Bettmann, H. 1954 – Rabenkrähen (*Corvus c. corone*) als Fischer – *Orn. Mitt.* 6:34–35.
6. Bianki, V. V., Boiko, N. S., Kokanov, V. D., Tatarinkova, I. P. 1967

- Ob ekologii seroj vorony (*Corvus cornix* L.) na ostrovach i pobereže Belogo i Barenceva morej – Zool. Žurn. 46:1269–70.
7. Bösenberg, K. 1957 – Kann die Rabenkrähe mit den Füßen greifen? – Vogelwelt 78:198.
 8. Bromley, F. C. 1947 – Carrion Crow taking food off water – Brit. Bird. 40:158.
 9. Dobrowolski, K. 1959 – Badania rytmu dziennego pewnych gatunków ptaków wodnych – Ekol. Pol. A, 7: 22–54.
 10. Fitter, R. S. R. 1948 – Carrion Crow taking food off water – Brit. Bird. 41: 95.
 11. Florczyk, H. 1969 – Porównanie stanu czystości wód rzeki Odry w latach 1964 i 1967 – Gosp. wodna 29: 209–214.
 12. Hell, P., Soviš, B. 1958 – Prispevok k poznaniu trofickych vzťahov havranoviteho vtactva k polnohospodarstvu v zimnom odbobi na slovensku – Zool. Listy 7:38–56.
 13. Holmberg, L. 1957 – Fiskande krakor – Fauna och Flora 52: 182–185.
 14. Hulse, D. C., Atkeson, T. Z. 1953 – Fishing by the Common Crow, *Corvus brachyrhynchos* – Auk 70: 373.
 15. Imhof, T. A. 1962 – Alabama birds – Alabama, 591 pp.
 16. Jones, H. 1955 – Carrion Crow taking fish from water – Brit. Bird. 49: 91.
 17. Kirchner, H. 1957 – Kann die Rabenkrähe mit den Füßen greifen? – Vogelwelt 78: 198–199.
 18. Kurockin, E. N., Gerasimova, T. D. 1960 – Zimnye i rannievesennye nabludenia nad morskimi pticami vblizi Murmanskogo pobereža – Tr. Kandałk. Zapov. 3.
 19. Levitsky, P. F. 1958 – Pitanie voron ryboj – Zool. Žurn. 37: 1263.
 20. Luniak, M. 1968 – Niektóre problemy związane z metodyką badań liczebności ptaków w środowisku rzeczonym – Ekol. Pol. B, 14: 161–170.
 21. Luniak, M. 1971 – Ptaki południowej części środkowego biegu Wisły – Acta orn. 13:17–113.
 22. Mańczak, H. 1966 – Ocena przebiegu procesu samooczyszczania rzek skanalizowanych na podstawie kryterium tlenowego i wyników badań rzeki Odry – Zesz. Nauk. Pol. Wr. – Inż. Sanit. 12: 1–48.
 23. Mester, H. 1959 – Noch etwas über fischende und schwimmende Krähen – Falke 6: 200–201.
 24. Moeller, J. 1954 – Fischende Rabenkrähen (*Corvus c. corone*) – Orn. Mitt. 6:234.
 25. Mühl, K. 1954 – Fischende Rabenkrähen (*Corvus c. corone*) – Orn. Mitt. 6: 234.
 26. Nečajev, W. A. 1969 – Pticy južnych Kurilskich Ostrovov – Leningrad, 247 pp.
 27. Odum, E. P. 1963 – Podstawy ekologii – Warszawa, 560 pp.
 28. Pinowski, J. 1954 – Wpływ obszarów zadrzewionych na awifaunę terenów otwartych i związane z tym zagadnienie adaptacji populacyjnych – Ekol. Pol. 2: 379–446.
 29. Pinowski, J. 1968 – Wrony rozbijają orzechy włoskie – Wszechświat 16: 240.
 30. Pinowski, J., Wasilewski, A. 1962 – Czynniki wpływające na liczebność wron (*Corvus corone cornix*) w różnych środowiskach – Acta orn. 6: 231–251.
 31. Rettig, K. 1965 – Zum Wintergast-Vorkommender Nebelkrähe (*Corvus corone cornix*) bei Hannover – Orn. Mitt. 17: 40.
 32. Richter, D. 1955 – Aaskrähen (*Corvus corone*) als Fischer – Orn. Mitt. 7: 135.
 33. Roberts, E. L. 1955 – Carrion Crow taking fish from water – Brit. Bird. 48: 91.
 34. Spenner, W. 1956 – Rabenkrähe (*Corvus corone*) als Fischer – Orn. Mitt. 8: 52–53.
 35. Taczanowski, W. 1882 – Ptaki krajowe – Kraków, T. I i II.
 36. Tenovuo, R. 1963 – Zur brutzeitlichen Biologie der Nebelkrähe (*Corvus corone cornix* L.) im äusseren Scherenhof Südwestfinlands – Ann. Zool. Soc. „Vanamo” 25; 5: 1–147.

37. Trelfa, G. 1954 – Carrion Crow alighting on water and taking fish – Brit. Bird. 47: 405–406.
38. Tully, H. 1951 – Carrion Crow taking fish – Brit. Bird. 44: 323.
39. Vietinghoff-Riesch, F. 1954 – Fischende Rabenkrähen (*Corvus c. corone*) – Orn. Mitt. 6: 234.
40. Wendland, V. 1957 – Einiges vom Verhalten der Nebelkrähe (*Corvus corone comix* L.) – J. Orn. 99: 203–208.
41. Westerfrölke, P. 1957 – Kann die Rabenkrähe mit Füßen greifen? – Vogelwelt 78: 100.
42. Wolter, A. 1957 – Rabenkrähe als Fischer – Orn. Mitt. 9: 169.
43. Zedler, W. 1958 – Kann die Rabenkrähen mit den Füßen tragen? – Vogelwelt 79: 55.

RZEKA JAKO MIEJSCE ŻEROWANIA KRUKOWATYCH (*CORVIDAE*)

Streszczenie

Badania prowadzono na 482 km odcinku Odry na trasie Wrocław-Szczecin. Materiał zbierano w trakcie 15 rejsów barkami motorowymi. Metoda polegała na liczeniu wszystkich żerujących lub znajdujących się bezpośrednio nad wodą ptaków należących do badanych gatunków (*Corvus corone comix* L., *Corvus frugilegus* L. i *Corvus monedula* L.). Obserwacje prowadzono od świtu do zmroku.

Całą trasę podzielono na trzy typy odcinków: odcinki miejskie (stanowiły łącznie 8,5% trasy – 41 km), odcinki przestrzeni otwartych (72,0% trasy – 347 km), odcinki leśne (19,5% trasy – 94 km). Przeprowadzono równocześnie obserwacje na 10,5 km odcinku Odry płynącej przez Wrocław i porównano odcinek o urozmaiconej linii brzegowej i brzegach ziemno-piaszczystych (A) z odcinkiem kanału o brzegach umocnionych wysypanym kamieniem (B).

Terminy poszczególnych 15 rejsów i 11 taksacji na terenie Wrocławia podają tab. I i II.

Najliczniej nad Odrą żerowała wrona i jej powiązanie z rzeką jest najsilniejsze. Gatunek ten żeruje nad rzekami w ciągu całego roku. Gawron i kawka żerowały nad Odrą mniej licznie, tylko w okresie od września do marca. Szczyt liczebności wszystkich trzech gatunków przypada na miesiące późnojesienne, zimowe i wczesnowiosenne (tab. I, III i IV). Żerowanie krukowatych nad rzekami w tym okresie jest związane z lokalizacją pokarmu do ściśle określonego pasa terenu oraz niezamarzaniem pewnych partii rzeki i dlatego też, znaczenie rzeki wzrasta w tych okresach, kiedy zdobycie pokarmu jest trudne lub gdy ptaki prowadzą szczególnie intensywny tryb życia (wędrówka wiosenna).

Przeanalizowano dzienną rytmikę żerowania wron na odcinkach przestrzeni otwartych, a wyniki ilustruje fig. 5. Materiał przedstawiono jako dzienną rytmikę żerowania w czterech okresach fenologicznych. W okresie zimowym największa liczba żerujących ptaków przypada na godziny ranne (fig. 5a) i jest to jedno z pierwszych miejsc żerowania wron w tym okresie. W czasie wędrówki wiosennej największa aktywność przypada na godziny południowe (fig. 5b), jest to pora dnia kiedy wędrujące ptaki najczęściej żerują i odpoczywają. W okresie lęgowym i w okresie wędrówki jesiennej znaczenie rzeki jako bazy pokarmowej spada, i nie ma wtedy jakiegoś wyraźnego szczytu aktyw-

ności w ciągu dnia. We wszystkich czterech okresach występuje wyraźny wzrost liczby żerujących ptaków w godzinach wieczornych i najprawdopodobniej jest to związane z żerowaniem ptaków bezpośrednio przed udaniem się na nocleg lub z łączeniem się ptaków w stada w tym okresie.

Najbardziej atrakcyjnymi odcinkami rzeki były dla żerujących ptaków odcinki miejskie, w dalszej kolejności wykorzystywane były odcinki przestrzeni otwartych, a odcinki leśne były wyraźnie unikane przez wszystkie trzy gatunki, co na przykładzie, wrony ilustruje fig. 1. Istnieje sezonowa wymiana żerujących wron pomiędzy odcinkami przestrzeni otwartych a odcinkami miejskimi. W okresie wiosenno-letnim najwięcej ptaków skupia się na odcinkach przestrzeni otwartych, a w okresie jesienno-zimowym ptaki przenoszą się na odcinki miejskie i w tym czasie następuje tu 10-krotny wzrost ilości obserwowanych ptaków. Jest to zjawisko sezonowej synantropizacji. Istnieje ponadto strefa oddziaływania miasta obejmująca 4–5 km odcinek rzeki poniżej miasta. W strefie tej ilość żerujących ptaków stopniowo spada, ale jest znacznie wyższa niż na odcinkach rzeki położonych z dala od miasta (fig. 4).

Liczebność żerujących ptaków, na danym odcinku rzeki, jest związana z dostępnością pokarmu, co się bezpośrednio wiąże z budową brzegów rzeki. Najliczniej są odwiedzane brzegi płaskie o urozmaiconej linii brzegowej i szerokim pasie terenu pozbawionego roślinności (odcinek A na terenie Wrocławia, tab. II). Również liczniej są odwiedzane odcinki rzeki o słabszym prądzie, na co wskazuje porównanie liczby żerujących ptaków obserwowanych na 100 km odcinkach w górnym i dolnym biegu Odry. Na odcinku w dolnym biegu rzeki obserwowano o 20% więcej ptaków i to by wskazywało, że liczba żerujących ptaków zwiększa się w miarę nabierania przez rzekę cech rzeki nizinnej.

Sposoby żerowania nad rzeką są odmienne u poszczególnych gatunków. Wrona zbiera pokarm na brzegu rzeki, ale również podnosi kęsy pokarmu z powierzchni wody, używając do tego celu zarówno nóg, jak i dzioba. Opisywane były także liczne przypadki łowienia przez wrony żywych ryb. Gawrony i kawki zbierają tylko pokarm wyrzucony na brzeg rzeki.

Rzeka jest biotopem, gdzie istnieje konkurencja pokarmowa między wroną a śmieszką. Wskazuje na to: podobny sposób żerowania nad wodami i antagonistyczne zachowanie się względem siebie przedstawicieli obu gatunków. Konkurencja ta jest największa w okresie wiosennej wędrówki śmieszki i wrony. Mewa w tym okresie wielokrotnie dominuje liczebnie nad wroną, ale równocześnie oba gatunki osiągają swój szczyt liczebności w cyklu rocznym (fig. 6). W pozostałych okresach roku wrona nad Odrą jest liczniejsza od śmieszki.

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