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Nesting of Rooks *Corvus frugilegus* LINNAEUS, 1758, in the Cracow Area

[With pls. VIII—XI and 2 text-figs.]

Gnieźdzenie się gawronów *Corvus frugilegus* LINNAEUS, 1758, na terenie Krakowa

Abstract. During nine-year observations of Rooks breeding in the Cracow area (230 sq. km) their number was found to have been reduced to 30 rookeries and 1082 nests. Most of the nests (66%) belonged to five rookeries set up in manorial parks before they had been incorporated in the town area in 1941; the other ones were situated in regions already built up, less than 20 sq. km in area.

The following factors are conducive to the formation of rookeries: 1. a rich macrofauna in the rhizosphere, even if rather distant from the nest, nest, 2. the presence of trees with suitable crowns, 3. easiness of access from the air and 4. the nearness of buildings.

Some internal and external stimuli which govern the behaviour of Rooks in the breeding season are discussed and so are the measures for preventing them from nesting.

CONTENTS

I. Introduction	502
II. Estimation of the total of rookeries	503
III. Survey of rookeries	504
Group A — very strong rookeries	504
Group B — rookeries in single big trees	511
" C — rookeries in streets	512
" D — thriving rookeries	514
" E — declining rookeries	518
IV. Principles of Nesting of Rooks	522
1. Properties of a suitable habitat	522
2. Choice of nest site	523
3. Urbanization	525
4. Decline of rookeries and possibilities of controlling them	529
V. Acknowledgments	534
References	534
Streszczenie	536

I. INTRODUCTION

Cracow constitutes an urban-industrial agglomeration, about 230 sq. km in area, extending over a space of 25 km in the west-east direction and 15 km from north to south. The built-up districts lie chiefly in the old valley of the Vistula, at an altitude of about 210 m a. s. l. In the north, however, they ascend the slopes of the Małopolska Upland, its ridges of Pasternik, Witkowice, Mistrzejowice and Krzesławice, which range from 220 to 260 m. In the south-west the town area includes the Sowiniec Uplift (355 m) and the detached blocks

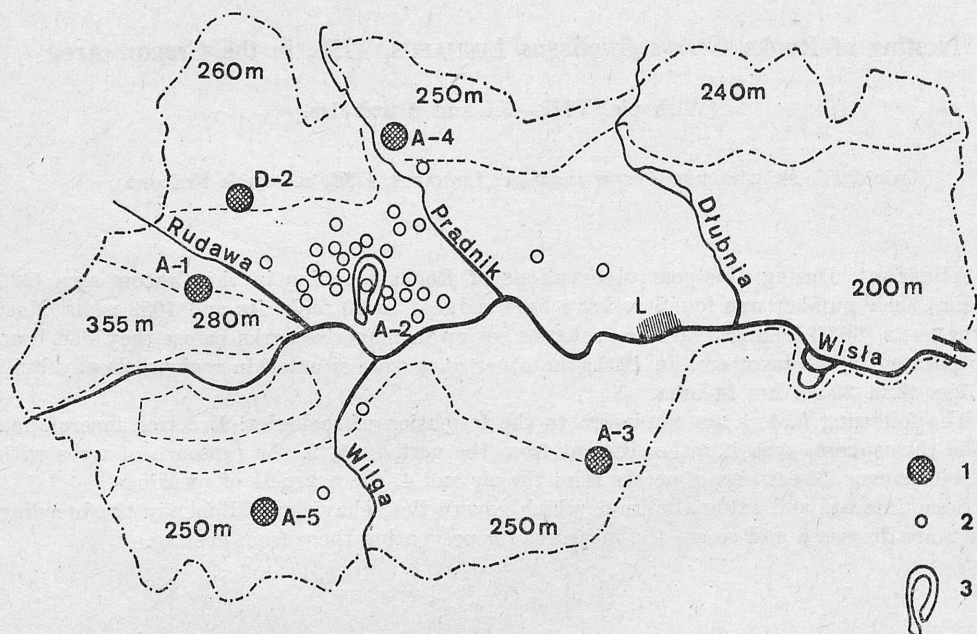


Fig. 1. Distribution of rookeries in the Cracow area in 1976. Dash-and-dot line — administrative boundary of town area; dash line — edge of the old Vistula valley. The figures (355 m) indicate altitudes above sea level (after TYCZYŃSKA, 1967). 1 — the rookeries set up in parks of former manors: A-1 — Deczusz Park, A-3 — Prokocim, A-4 — Górka Narodowa, A-5 — Kobierzyn, D-2 — Smełna St.; 2 — single rookeries present in the built-up urban zone in 1976; 3 — Planty (A-2); L — winter roost at Łęg

of the Cracow Gate, passing into the Cracow Upland, which in places (Kobierzyn) exceeds 250 m in altitude (TYCZYŃSKA, 1967). The left-bank tributaries, Rudawa, Prądnik and Dłubnia, and the right-bank Wilga open into the Vistula in this region. In the Cracow area there are various groups of trees, e. g. small woods, parks, avenues, gardens, cemeteries and rows of trees that line streets. Rooks show concern in only few of these tree groups.

The diagrammatic map in Fig. 1 gives a general idea of the topography and configuration of the Cracow area within its present-day administrative boundaries. Only the rivers in the old valley of the Vistula and the hills rising

north and south of it are represented. The rookeries, according to the state in 1976, are plotted on this highly simplified map. The breeding Rooks took no interest in the eastern part of the town, called Nowa Huta, which up to 1952 was occupied by cultivated fields. In the western part most rookeries were concentrated round the Planty Gardens, between the lower course of the Prądnik, the Vistula and the line formed by Krasiński Ave., Mickiewicz Ave. and Słowacki Ave., in an area of less than 20 sq. km, i. e. one-eleventh of the total town area.

I have been carrying out regular observations of Rooks and Jackdaws in the Cracow area since 1968. Their results were published in papers on the migration of wintering birds, on the rookery in Krakowski Park and on the annual cycle in Jackdaws and Rooks (GRODZIŃSKI 1971, 1976, 1980). The present paper, the last in the series, is given to the distribution of the rookeries. Here, I am not so much concerned in listing the rookeries existing at present, as in the picture of the dynamics of a Rook population in their setting up new rookeries or abandoning the old ones and in their reacting to the developing town or to the destruction of their nests by people. It also seemed expedient to make attempts to find out when and where the first rookeries appeared, when small rookeries began to be set up in the central part of the town and what attracted Rooks and induced them to settle. The sources of the data used in discussing these problems were my own notes, taken down currently, the literature of the subject, not very abundant, and the accounts of old events given by rare eye-witnesses.

II. ESTIMATION OF THE TOTAL OF ROOKERIES

During eight-year observation I counted 55 rookeries in the Cracow area; some of them disappeared leaving no trace, while new ones turned up to stay permanently or only temporarily. Eventually, in 1977, I saw 30 of them. I do not claim that I perceived all the rookiers each year. Being concerned with such a large study area, I may easily have overlooked a single nest or even a small group of nests.

The rookeries observed in 1969—1977 can be divided into five conventional size groups (Table I). There were only five very big rookeries, consisting of a hundred or more nests. Each of the remaining size groups (I—IV) contained 9—15 rookeries of 1—80 nests each. Further, the table shows that during the last four years (1974—1977) altogether four rookeries ceased to exist; in fact, their number was higher, but at the same time some new rookeries were started and they compensated for the losses. Also the number of nests built decreased from 1216 in 1974 to 1082 in 1977, i. e. by as much as 10·9%. Not all the counts of nests come from the end of the period of nest-building, which as a rule occurs towards the end of April (GRODZIŃSKI, 1976), but counting was continued from the second half of March throughout April. The autumn checks of the

Table I

Numbers of rookeries and nests in Cracow during the period of observations

Rookeries		No. of rookeries		
Class	No. of nests	1969—1977	1974	1977
I	1—5	14	12	10
II	6—10	9	6	4
III	11—30	15	10	9
IV	31—80	9	2	4
V	above	5	4	4
Total of rookeries		52	34	30
Total of nests		2277	1216	1082

number of nests showed some increments in several rookeries in relation to the spring counts. Hence, the data are far from being absolutely precise, nevertheless they sufficiently reliably support the statement about a decrease in the number of nests in the Cracow area.

The division of rookeries into five size groups needs some explanation. The number of rookeries, equal to 55, has been obtained from the whole period of observations, the highest yearly counts with the number of nests actually existing in them at that time being included in each group. If the group of the biggest rookeries (V) contained at first five and next four colonies, it does not mean that one of them had disappeared completely. It had simply been transferred to a lower size group. The utter decline of rookeries in group IV has been noted only in five cases. Considerable fluctuations characterize groups I—III: some rookeries decline, others break up, and new ones arise.

III. SURVEY OF ROOKERIES

The rookeries observed in the Cracow area will be discussed in five qualitatively varied groups. The division into groups is based on definite characteristics that they have in common, such as their size, situation, manner and time of origin, and reaction to human intervention. According to these characteristics and to the availability of observational material, the history of the rookeries presented may be enclosed in several short sentences or stretched out over several pages.

Group A. Very strong rookeries

A—1. Wola Justowska — Decjusz Park

The park at Wola Justowska was founded as a four-terraced park in the Italian style in the sixteenth century. Two terraces were levelled and the park

was re-arranged in the French style in the eighteenth century to be given its present form towards the end of the nineteenth century. The species of trees planted in the park have been changing for all this time. They successfully survived World War I (CZAS, 1917), but only few two-hundred-year-old limes, hornbeams and poplars have persisted until now. Most of the big trees come from the 1880—1930 period (BOGDANOWSKI, 1966). A part of the much neglected park, 5 out of the 9 hectares of its area, has recently been adapted as a public resort place: lawns, footpaths and a children's playground have been laid out.

According to oral information obtained from people living in the neighbourhood of the park, Rooks nested in it even before the Second World War, and during one of the breeding seasons at the time of the war German soldiers went bird's-nesting in the park. The records of a rookery existing here as early as the nineteenth century will be discussed under "Urbanization" in Section IV. The nests have not been removed from the trees probably since the war. In 1971—1977 I checked the number of nests in this rookery every spring and in most of the years also in autumn, after the leaves had fallen. The results were plotted on a topographic map of the park, divided into four sections to facilitate the survey of the rookery and thus to make it easier to decide whether Rooks changed their partiality for particular parts of the park or particular trees. At that time the winds blew down three badly rotten old trees, of which one was bearing nests. No nests were knocked off the trees during that period.

The nest-carrying capacity of the rookery in the park during the seven-year period of observations is illustrated in Table II. The number of nests in the rookery fluctuated between 300 and 400 in 1972—1977, exceeding this level distinctly in the last years. The number of nests (365) found in 1974 is probably lowered owing to the retarded breeding cycle of Rooks in that year (GRODZIŃSKI, 1976). Some more pairs settled there by the end of April. Assuming that 400 nests are an average number, the rookery in Decjusz Park should be regarded as the greatest concentration of nests in which Rooks breed unrestrained. In 1974—1977 the number of trees in which they built their nests oscillated about 70. Only a few of these trees measure more than 2 m in circumference at breast height, this measurement being 110—180 cm in most of the remaining trees.

Table II

Size of rookery and number of trees with Rooks' nests in Decjusz Park in 1971—1977

Date	1 May 1971	22 Apr. 1972	7 Apr. 1973	8 Apr. 1974	13 Apr. 1975	1 May 1976	22 March 1977
No. of nests	234	324	397	365	421	423	421
No. of trees	46	38	54	73	73	74	69

Table III

Number of Rooks' nests per tree
in Decjusz Park in 1977

No. of		Total of nests
nests	trees	
1	7	7
2—5	34	100
6—10	14	111
11—15	9	106
16—19	—	—
20—27	4	97

It can be seen from Table III that the numbers of trees with one nest as well as those with 20—27 nests were small (7 and 4, respectively). Most trees (34) bore 2—5 nests each. Only 14 trees had 6—10 nests and 9 trees 11—15 nests. Strikingly, there were no trees with 16—19 nests. Four out of the seven single nests were in trees whose crowns touched the crowns of other trees with nests. Did they thus seem single nests to the Rooks? On the other hand, numerous groups of nests occurred in big branchy trees, for the shape of crown influences the nest-carrying capacity of trees. However, each year Rooks omit some big trees, while the trees bearing many nests are probably colonized from year to year.

In four park sections, varying in size, the numbers of nests, compared with each other at analogous phases of breeding, presented themselves as characteristic of particular sections. In the southern section this number considerably exceeded 100, while in the eastern section only slightly. In the western section the number of nests oscillated about 50 and in the northern about 80 in singular years. No major shifts of the numbers of nests were observed between particular park sections.

Starting from the breeding season till the fall of the leaf and later in the winter till the end of February the nests undergo partial destruction or even disappear utterly. One-third of the nests existing in spring were destroyed completely. At the same time the number of trees with nests was on the decrease. To be sure, the nests decayed in all trees, but only the trees which had had small numbers of nests, and then the weakest ones, became stripped of them. Thus, the number of trees with nests decreased from 73 to 58 in 1974 and from 73 to 60 in 1975.

A—2. Planty

In the middle of the nineteenth century town gardens were laid out in the place of the medieval defensive walls and moats of Cracow. Now they form a loop-shaped park, called the Planty and stretching out round the old central part of the town. The Planty are 4 km long and 20.5 ha in area. They are

sectioned transversely by 13 streets which connect the central part of the town with the rest of it (ŚRODOŃ, 1977a, b). As the segments of these streets within the bounds of the Planty are not lined by houses, they do not break the continuity of the park.

On account of this continuity all the Rooks which nest in trees all over the Planty are treated as a single group despite the fact that their nests are placed in less or more numerous, irregularly distributed groups (Fig. 2). Only between some of the neighbouring groups there may be beginnings of co-operation, e. g. if one of the nests has been endangered. We might speak of some dozen rookeries, but it would be difficult to mark out reasonable boundaries between them.

For censusing the whole Planty were divided in accordance with the course of some streets into sections, not quite equal (Fig. 2, A—G), and each of these into 2 or 3 subsections. The number of nests in them was examined several times a year and the results were entered in appropriate places of the table. The nests that had persisted from the previous year were counted in January or February. In March and April the rebuilding of the rookery and in autumn, after the leaves had fallen, the number of nests still remaining in trees and their state of preservation were observed. Information how many nests and in which section of the Planty had been demolished was obtained from the Department of Town Gardens each year. The seven-year observations (1971—1977) make it possible to find the approximate number of nests the Rooks build in one breeding season and where they build the most nests. It is also possible to compare the annual fluctuations in the numbers of nests and to determine the influence of the destruction of nests on their number in the given year and in the next.

Table IV is to explain the question whether there are any sections of the Planty in which Rooks build their nests more readily than in the other parts. If the nests had not been demolished, it would be possible to compare their

Table IV

Distribution of Rooks' nests in seven sections of the Planty (A-G)
on the basis of the counts preceding their removal

Date	Section							Total
	A	B	C	D	E	F	G	
1 Apr. 1971	—	6	52	20	31	7	—	116
7 Apr. 1972	28	36	23	47	22	27	—	183
12 Apr. 1973	35	12	14	67	71	18	—	217
10 Apr. 1974	49	1	23	7	23	22	—	125
19 March 1975	23	14	20	49	16	16	—	138
26 March 1976	15	14	—	8	11	6	4	58
17 April 1977	36	1	7	35	56	32	—	167
Totals for sections	186	84	139	233	230	128	4	—

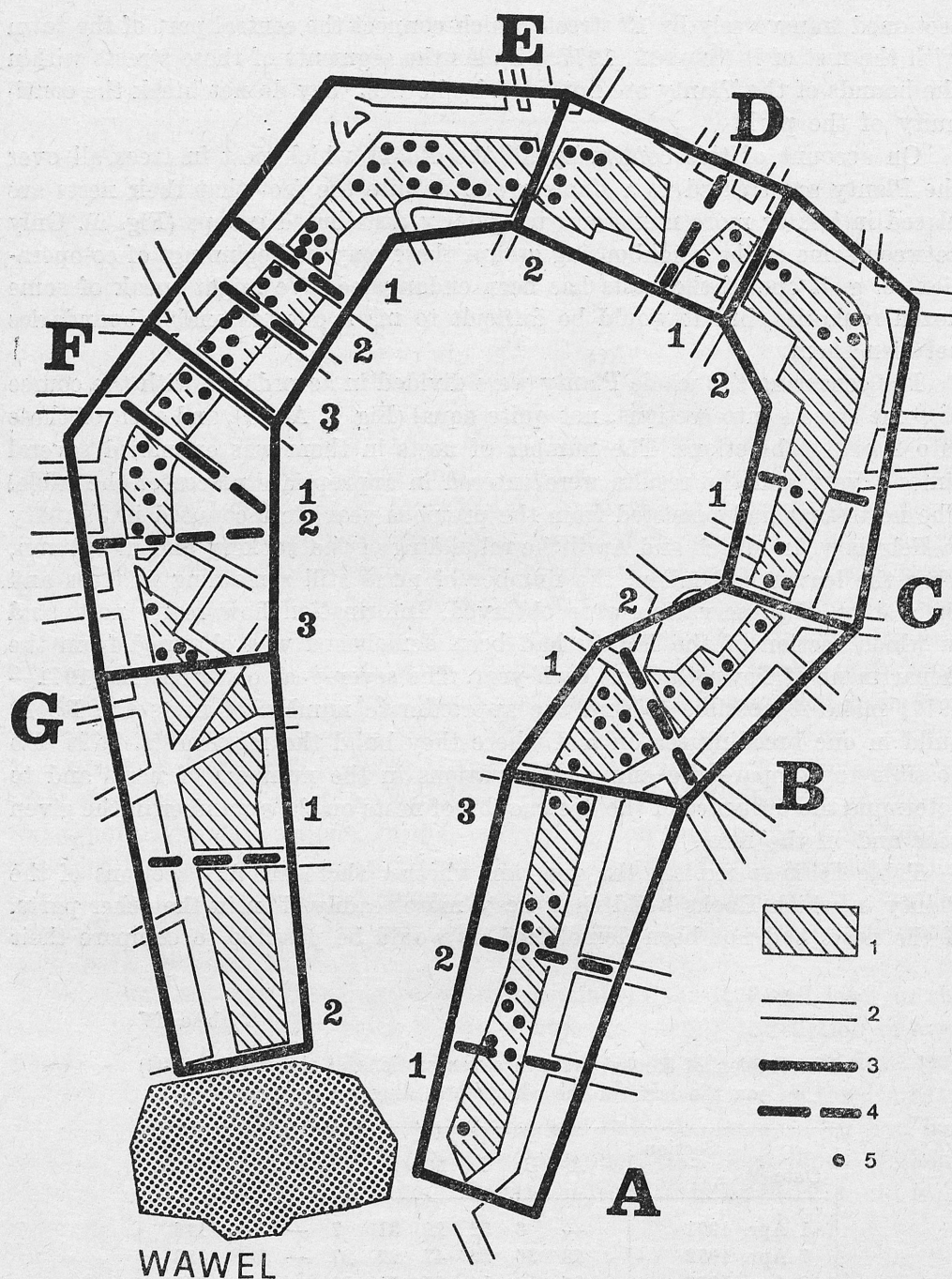


Fig. 2. Rookeries in the Planty (A-2). A map showing the Planty Gardens (1), the streets which cross them and the streets which form their external margin (2). The thick line frames (3) enclose the Planty and their close neighbourhood. Similarly the thick lines divide the whole area into seven sections (A—G) and broken lines (4) divide the sections into subsections (1—3). The trees in which there were nests on 12 Apr. 1973 are marked with closed circles (5)

numbers for any day or even better for several successive terms. The data given in the table are, of necessity, the last results obtained before the demolition of the nests. They certainly reflect the birds' early interest in the Planty, early because limited to the first weeks of nest-building. Some observations come from March (1975—1976), the others from the first half of April (1971—1974 and 1977). The numbers of nests built in April are obviously higher than those from March. On the whole, the numbers of nests indicate that their density in particular sections was various, though none of them was the leading one in all the years of observation. However, the total of nests in each section obtained by adding up the numbers found in particular years of the observation period shows clearly to what degree Rooks are concerned with it. Three sections are visibly predominant in this respect: sections D and E come in first (233 and 230 nests) followed by section A (186), whereas, C, F and B are left far behind. In section G a few nests appeared as late as 1976. The size of sections plays some part here, but it is not decisive, for the smallest section, D, was inhabited most densely.

Detailed observations made in the subsections show that the extreme parts of the colonies are sometimes extended over the areas uninhabited until then. In 1948 the Rooks had already colonized subsection F_2 (FERENS, 1957) but in subsection F_3 their first nests, several in number, appeared as late as 1973. In 1974 and the following years there were more than ten nests there. Still later, towards the end of April 1975 the first nests appeared in subsection G_1 and in 1976 also in G_2 . Similarly, the first nests did not turn up in A_1 before 1972.

The number of nests built in the consecutive years of the study period is another problem which can be elucidated only with limited exactness. Table V is constructed in such a way that the number of nests existing in the trees at the end of the nest-building season is augmented by the number of nests knocked off in that year. It should be emphasized that not all the nests were demolished and never in all the parts of the Planty. The sums for particular years range within wide limits, exceeding 600 nests in 1972, 1973 and 1975 and not reaching half of this number in 1971, 1974, 1976 and 1977. The number of pairs nesting in the Planty was naturally smaller than that of the nests. Some of the birds deprived of their nests in March, and then in the period when they were still hormonally fit for breeding, probably built new nests. The number of such birds cannot be determined even approximately. On the other hand, if the nests were destroyed in the second half of April, only few Rooks had chance to rebuild them. Observations made in November, after the leaves had fallen, showed in accordance with expectations that at that time there were fewer nests than in April except in 1974, marked by the retardation of the breeding season. A considerable number of nests must have been built at the end of April in that year, because in autumn there were still 137 nests instead of a remainder from the 113 nests counted in April.

The number of the nests built must therefore be distinguished from that

Table V

Total number of nests built by Rooks in the Planty. The number for each year is split into numbers of nests knocked off, breeding nests and these observed in autumn. The last column confirms the small number of breeding nests

Date	Fate of nests	No. of nests	
		in spring	in autumn
1971 — 19 April	knocked off	99	167
29 April	breeding	68	55
1972 — 25 March	knocked off	189	
16 April	" "	359	637
28 April	breeding	89	87
1973 — 17 March	knocked off	124	
17 April	" "	406	622
3 May	breeding	92	69
1974 — 13 April	knocked off	125	
20 April	breeding	113	238
1975 — 14 March	knocked off	320	
28 March	" "	195	639
24 April	breeding	124	95
1976 — 20 April	knocked off	73	
26 April	breeding	116	189
1977 — 16 April	knocked off	125	109
28 April	breeding	105	230
			96

of the nests in which young had been reared. The number of these last nests is very low, ranging between 68 and 124 in particular years. According to OWEN's (1959) indices, i. e. 4.3 eggs per nest and the 30% mortality of nestlings, the increase of the Rock population size in the Planty would have been from 204 to 374 birds yearly. Thus the destruction of nests reduced it considerably for the time being. In 1976 and 1977 the number of nesting pairs decreased markedly, which may be considered to have been due to the destruction of nests in preceding years.

A—3. Prokocim

A large post-manorial park, 4.24 ha in area. Rooks nested in it before observations had been started. In 1970 (20 April) there were 35 nests; this number rose to and maintained at about 100, according to the April counts in the following five years, reaching a peak of 138 in 1974. In 1976 there were less than 100 nests and at the end of March 1977 only 45. Scarcely 23 nests were counted in the autumn. Similarly, small numbers of nests were observed in the autumn of 1972 (36 nests) and 1974 (17 nests). They were built in 18—30 trees of medium size. The Rooks never nested in two oaks, above 500 cm in breast-height circumference, and in a lime-tree, above 370 cm. No reports of nest demolition have been brought in by local inhabitants.

A—4. Górka Narodowa (Siewna St. — Wł. Natanson St.)

A formerly manorial park, about 1 ha in area. The rookery existed probably as early as 1920. It is said to have been destroyed several times after World War II. My observations covered only the years 1975—1977. In April in these years there were, respectively, 81, 86 and 115 nests, of which 16, 31 and 44 persisted till November; the natural losses were thus very great. The nests were distributed in 7—19 deciduous trees and 1 spruce. There were at the most 10—20 nests in one tree and only in one case as many as 30.

A—5. Kobierzyn — Hospital

The hospital park, 36 ha in area. The hospital was founded in 1917. The rookery has existed for a long time and is obnoxious to the patients. At the beginning of May 1977 I counted 154 nests in 43 trees. The trees being already fully leaved, the nests were hidden from sight and the counts could not be exact.

Group B — Rookeries in single big trees

B—1. No. 15 Kochanowski St.

A big poplar, 1.40 m in diameter, growing in the front garden of a two-storied house. The whole crown of the tree overtops the roof of the house. Its branches stretch nearly as far as the house on one side and the pavement on the opposite side. The nearest ash-tree, rather small in size, grows 20 steps away. On the other side of the street there is a row of maples, which reach to the first-floor windows. There is only light traffic in this street. The rookery existed here before 1970. I started regular spring and autumn observations in 1974, when there were 13 nests. Since the noise made by the Rooks annoyed people living in the close vicinity, the nests were destroyed on 4 April. The birds moved restlessly about in this region for two days. Eventually, a new nest appeared and persisted until the autumn. In the following years 10, 16 and 14 pairs, respectively, nested in the tree. The nest-carrying capacity of the tree may be estimated at about 15 nests.

B—2 Pawia St. and Worcell St. — outside the bus station

A poplar, 3.5 m in breast-height circumference, with its top reaching above the fifth storey of the neighbouring house. It grows in a garden at the corner of two streets, now built-up with frame-houses. Its branches touch the side wall of the adjacent building or spread over the pavements of both these streets. There is heavy bus traffic in Pawia St. The rookery existed before observation had been started. In 1970 there were 12 nests and their number kept up at this level till 1975 except 1972 when they were 16. Half the nests usually lasted till the autumn, only in 1971 there was not a nest in autumn, because they had been knocked off earlier (KMIETOWICZ, 1972). Only 8 nests were built in

1976 and 5 in 1977. This decreasing capacity of the tree can be referred to two causes. The branches of the tree are somewhat rotten and several have been broken off by winds in the last few years. Moreover, a competitive concentration of nests arose in a group of five young poplars, 25 cm in diameter, growing in a close line round the corner, 90 steps away from the old poplar. Two pairs settled here as early as 1973, their number growing from 5 to 11 pairs in the next years. At any rate, the old poplar has clearly lost in its attractiveness.

B-3. Dominikański Square — at the tram stop

In the middle of April 1970 nine nests turned up in a big black poplar, 35 cm, in diameter, growing at the tram stop, its top reaching the height of the 3rd storey of the neighbouring houses. Their presence being a nuisance to people waiting at the stop, the nests were removed from the tree in early May. The rookery did not even last for a month, it did not exist in the preceding year and did not reappear in following years until the end of this study in 1977. In 1975 a short-lived rookery (E. 5) was started in its neighbourhood, but probably irrelative to its existence.

B-4. Kleparz Market Place

This is a very busy market place, rectangular in shape. Its margins are lined with trees, chiefly poplars, growing close to each other. Five nests were first built in a tree growing near a news-stall at the south-east end of the market place in April 1974. They were at the height of the floor between the 3rd and 4th storey of the nearest house. Four nests lasted till November and the remains of one till January. There were 2, 1 and 9 nests in subsequent years. In the autumn of 1977 there were no nests (they had been destroyed), but a belated nest was found in a nearby young poplar.

Group C — rookeries in streets

Nests built mostly in trees of medium size, growing in the pavements of streets.

C-1. Paderewski St.

Five poplars, two of them quite small, grow in the pavement of this short street. The time of origin of the rookery is not known. There must have been about 10 nests in 1974, since there were the remains of seven nests in January. In 1975—1977 there were 7, 5 and 6 nests, respectively, always in the same two trees. In 1976 none of the nests persisted till November; their fate is unknown. There were two nests in the autumn of 1977.

C-2. Syrokomla St.

Two nests were observed in a tree at the western end of this street in 1974. I saw them, heavily damaged, in the autumn, but they had not been there in the previous year. In January they disappeared definitively. In 1975 a rookery

of 9 nests appeared in four trees at the opposite end of the street, 200 m away from the previous nests. In 1976 there were nine nests and in 1977 five in two trees. A half of the number of nests in this region usually persisted till the winter. It may be supposed that the first rookery moved from the western end of the street to the eastern and at once began to develop more intensely. In the new place the number of nests lasting till the winter became much higher. The poplars growing in both places are the same age. The removal was not caused by the qualities of the branches but perhaps by the microclimate or the access to the nests from flight.

C-3. Nos. 2 and 4 Sołtyk St.

Towards the end of March 1976 ten nests were found in two trees growing near the junction of Blich St. and Sołtyk St. There were no nests there in the preceding year. In 1977, 17 nests were observed in four trees in the same street at the beginning of April and ten in the autumn. The access to the first tree was wide and open over the railway embankment from the Blich St. side, while the remaining trees were rather easily approached through a gap in the row of houses on the opposite side of the street.

C-4. Sienkiewicz St.

Two pairs settled in two neighbouring trees near the southern end of the street in 1976. The damaged nests outlasted the winter. Their rebuilding was started as early as the beginning of March 1977 and about the middle of this month a third pair settled there. In the autumn (24 Oct.) there were four nests in three trees.

C-5. Rajska St.

In 1974 some nests of Rooks appeared in the trees growing along one side of this street. At the beginning of April 1975 they were ten in number in trees growing at various distances apart. These nests were destroyed. However, in the autumn there was one new nest in a tree opposite the junction with Szujski St. There were no nests in 1976 and only one in 1977.

C-6. Dolne Młyny St. and Hanka Sawicka Sq.

In the autumn of 1976 the falling leaves uncovered two nests in a Canadian poplar, 55 cm in diameter, growing in the pavement of H. Sawicka Sq. Its branches extend over the roadway up to No. 1 Dolne Młyny St. In mid-April 1977 there were three big nests in it and four nests were seen when the leaves had fallen in the autumn. A nest built by a belated pair had thus been added to their number.

C-7. Dolne Młyny St., opposite No. 10

Two nests were built in a tree behind the wall of a house in this street in the middle of April 1977. In August the tree was cut down. After the autumnal fall of leaves two nests were visible, but in another tree, outside the wall.

C-8. Kopernik St.

This is a street with limited car traffic (hospitals). Medium-sized trees grow in the pavements over a distance of 900 m (from the railway bridge to the Botanical Gardens). Along this street there are hospital buildings, churches and gardens, including large convent gardens. In 1970—1974 Rooks built their nests, 20—30 in number, in 12—16 trees. Some of them, placed near the hospital windows, were repeatedly removed (1971, 1974 and 1975). In 1976 their number decreased to 3 in April and in 1977 there were no nests either in early April or in the autumn. The harassment of the birds by knocking off their nests for a few years discouraged them from settling here.

There were 10 nests in the garden adjacent to the Jesuits' Church in 1970. All these nests were knocked off from the trees and the same procedure was repeated in 1971—1973. In 1974 the rookery was no longer existent, although there were still the remains of a nest in February; neither was it restored again to 1977.

C-9. Topolowa St.

When I was in this street for the first time, in the autumn of 1975, I saw three nests in two trees outside houses Nos. 36 and 46. In 1977 an inhabited nest in a tree at No. 36. It persisted till the autumn.

C-10. No. 9 Rakowicka St.

There were four nests in a tree growing near the pavement in a monumental mason's yard in 1975. It is not known when this rookery came into existence. In 1976 there were two nests and in 1977 none, either in the spring or in the autumn.

C-11. No. 7 Świerczewski St.

A nest appeared here in April 1974 and, however heavily damaged, lasted out the winter. In March 1975 it was rebuilt and another nest was placed in a neighbouring tree. There was not a trace of them in December and no other nests were built in two subsequent years.

C-12. Łobzowska St. x Garbarska St.

There are four trees growing here between the roadway and the blind wall of a house. In 1970—1973 there were, respectively, 5, 4, 11 and 7 nests in them. In the last year the nests did not persist till October, they may have been destroyed. Neither did any nests appear in the following four years.

Group D — thriving rookeries

D-1. Krakowski Park

A history of this rookery from its origin in 1968 to 1975 has already been given in a previous paper (GRODZIŃSKI, 1976), where the influence of photoperiodism, climatic changes, "passive cooperation", properties of trees, hormo-

nal preparation of birds and deterrent actions of man upon the fate of the rookery is also discussed. If the numbers of nests in 1976 and 1977 are added to earlier data, the nest-carrying capacity of the park may be estimated at about 60 nests.

D-2. Smętna St. — Youth Park

This is a small grove-park, about 1 ha in area, squeezed in between Smętna St. (Bronowice) and a group of villas and consisting chiefly of deciduous trees. A group of coniferous trees occurs in its south-eastern part. Examination for nests was carried out regularly every spring and twice every autumn starting from 1970. According to Mrs. K. WIŚNIEWSKA, who has lived in its vicinity since her childhood, a large manorial park (about 30 ha) was laid out in 1880—1890. One of its walks, bordered with oaks, runs across the present grove. In 1901—1918 the estate was sold piecemeal. Several houses were built in this place. In 1941 Bronowice Wielkie was included in the town area of Cracow. In the first year after the war Mrs. WIŚNIEWSKA observed a fairly large number of breeding Rooks in this grove, which was later turned into a youth park. Rooks may have nested here in small number still earlier. Since 1974/1975 nests have been appearing also in Mrs. WIŚNIEWSKA's garden, which forms the extension of the grove, directed towards Radzikowski St. There were three nests in it in 1977.

In 1970—1971 the nests were placed exclusively in pine-trees. In 1972 the first nest was seen in a deciduous tree. As the nests in pine-trees are hard to see, their number can be estimated only in approximation; they were about 20 in the first three years and about 30 later. Table VI gives the number of nests in deciduous trees and shows that it increased faster (1—20) than the number of trees occupied by them (1—11).

Table VI

Number of Rooks' nests in deciduous trees in the park in Smętna St. in 1971—1977

Year	1971	1972	1973	1974	1975	1976	1977
No. of nests	—	1	2	5	6	13	20
No. of trees	—	1	2	3	6	6	11

D-3. No. 24 Łobzowska St.

This site is a large garden, bordered by the pavement of the named street on one side. From 1970 to 1976 there were always 30—40 nests in 4—6 trees growing in a close group near the street. In 1977 there were 12 nests in three trees in March and 26 in four trees in November. A half or a third of the nests usually lasted, naturally, in very bad condition, till the beginning of February. Both the advantageous ramifications of the trees and the continuous row of houses on the opposite side of the street, screening the nests from winds, were conducive to this situation. People did not destroy the nests. In 1972 a nine-

-storeyed block of flats was built in the garden, 20 m away from the group of trees with nests. In successive years Rooks placed their nests in 11 fairly big trees, including all the horse-chestnuts, a lime-tree and an acacia.

D-4. Plan 6-letni Ave. — Park of Culture and Recreation

In 1974 a new rookery arose in a small group of trees on a hillock outside the old Austrian fort. At any rate there were no remains of nests there in the preceding autumn. At once a big group of 21 nests was formed in four trees (6 Apr. 1974). In three subsequent years 33, 22 and 30 nests, respectively, were observed in 7—8 trees. More than ten damaged nests used to persist till the autumn, e. g. they were 19 in 1977. Single Rooks would stop in the garden for a short time, while on their flight for roost, from the north towards Łęg.

D-5. No. 8 Rydlówka St. — Mateczny

The west end of the park of the Municipal Physiotherapeutic Establishment (Mateczny-Swoszowice), 36 ha in area, extends towards the river Wilga, near its mouth into the Vistula. Observation was started in April 1970. More than ten nests were always counted in the spring except in 1972 and maxima of about 30 nests occurred in 1974 and 1976. At least a half of the nests usually persisted till November, only in 1974 out of the 27 nests scarcely two remained. This was so supposedly because the nests had been knocked off from the trees. In 1977 there were 12 nests in the spring and nine in November. At the best, only vestigial remains of nests were observed in February or at the beginning of March. The decisive factors are here both the manner in which the nests are placed on branches and the winds prevailing in the wide valley of the Vistula, there being no ground elevations or big buildings to screen the nests from them.

D-6. No. 52 Grodzka St.

A rookery consisting of 30 nests existed in the trees between St. Peter and Paul's church and the neighbouring house as early as 1971. The nests were destroyed after a few weeks (KMIETOWICZ, in litt.). I watched the rookery starting from 1974; in that period it was composed of 9—13 nests distributed in 2—5 trees. Twelve fairly big trees, chiefly ashes and maples, grew here, their tops reaching the height of the third storey of the buildings. In 1977 there were 8 nests in March and 12 in November. The decrease in the size of the rookery in relation to the size in 1971 is striking.

D-7. No. 5 Waryński St.

Several trees (5 ashes, 3 acacias and a chestnut) grow in a close group in the courtyard of this house. Rooks nested in them unmolested by people for five years (1970—1974). There were always 10—15 nests in April; several damaged nests (3—5) were still present in November. In April 1975 all the nests were knocked off and only one was rebuilt. Next year 12 nests were present, and in 1977 in mid-March 4.

D-8. Nos. 8 and 10 Jaracz St.

Five slender poplars, overtopping the five-storeyed houses in the courtyard of which they grow. These trees are well seen over a low wall from the neighbouring street. The nests are screened by the houses in the south and easily approached from flight from the north. In April 1974 I first saw 7 nests in 4 trees; they probably made the beginning of a rookery. In the following years there were 6, 3 and 12 nests, respectively.

D-9. Czyżyny — Cigarette Factory

A rookery has existed on the factory premises for a long time. Observation was started in 1975. In late April there were 29 nests, none of which persisted until the autumn, they had probably been demolished. At the beginning of April 1976 there were 24 nests in 12 trees growing on the factory grounds but close to Plan 6-letni Ave., bordering upon them. After the nests had been knocked off the trees, the traces of three of them were left there. In late April 1977 there were 46 nests in the same row of trees and 3 in the factory yard; 13 nests outlasted until November.

D-10. No. 10 Woronicz St. x 29 Listopada Ave.

An old rookery occurs in the garden of the Albertine nunnery. Twelve nests were placed in 6 trees in late April 1975. After their demolition no new nests appeared in the autumn. In early April 1976 there were 42 nests in 8 trees and again none of them was rebuilt after destruction. At the end of April 1977 18 nests were found in a very tall tree, while the nests in lower trees had been knocked off; seven nests outlasted till November.

D-11. St. Florian's Church x No. 1 Warszawska St.

A loose ring of big trees grow round the church. In 1973 there must have been many nests in them on the Kurniki St. side, because in early February 1974 there were still 19 nests damaged to a various degree. In April 1974 all the nests (unknown number) were destroyed. Rooks did not nest here for two years; four nests appeared as late as April 1977. In 1974 two nests, independent of that group, were placed in a chestnut tree growing in front of the church on the Warszawska St. side; these nests were also knocked off. Later, seven nests appeared in 1976 and 5 in 1977. Nest destruction stopped the Rooks from building nests for one or two breeding seasons. It must be emphasized that they did not build nests in any of the five big ash-trees.

D-12. Głowacki St.

According to local inhabitants, Rooks have been nesting in trees sparsely distributed among the houses for a long time. In 1976 there were 22 nests in 8 trees. In January there were still as many as 19. In April 1977 the nests, in a number unknown to me, were demolished. One was again observed in early May, probably rebuilt.

D-13. No. 4 Waryński St.

In a garden surrounded by a wall and low houses, situated behind the yard of the Monopol Hotel, I perceived some nests of Rooks. I did not count them before April 1974, when they were four in two trees. In mid-March three years later there were three nests also in two trees (see rookery D. 7).

D-14. No. 80 Prądnicza St.

A rookery arose in well-seen trees on the hospital grounds before I had started observation. In the autumn 1974 there were 12 nests and in April in two following years 9 and 11, respectively. In 1977 only one nest was seen in late April, the others had probably been destroyed. There were three nests in the autumn.

D-15. Nos. 13—15 Siemiradzki St.

In November 1977 I saw 7 nests in a tree right beyond the convent wall between these two houses. I failed to determine the time of origin of this rookery, but I should be inclined to assume it to be 1974, when 11 nests (E-4) were demolished on the other side of this garden in mid-April.

Group E — declining rookeries

E-1. Borek Fałęcki — No. 62 Zakopiańska St.

In the trees near the office buildings and dwelling-houses of the Cracow Soda Works (Solvay) there were about 30 nests in 1970 and 1971. In connection with road-building some of the trees were cut down in 1972 and 1973. In 1972—1975 the number of nests decreased to below 10 yearly. In mid-March 1976 there were still some remains of 3 nests, which disappeared without a trace in April. Next year there were no nests at all.

E-2. Nos. 4—8 Mikołaj Rey St.

In a garden situated in the gap between two houses there were 16 nests in several medium-sized trees in 1970 and slightly fewer in the following two years. In 1973 the neglected garden was re-arranged and some trees were cut down. Neither that year nor in the subsequent four ones did the Rooks nest in it.

E-3. Borek Fałęcki — Jugowicka St.

In a small grove behind the church there was a distinct group of pines among other trees. In 1972 there were about 24 nests in these pines. At my next visit in 1974 they were only 6. In the spring and autumn 1977 there were no nests, since most of the pines had been cut down.

E-4. Łobzowska St.

In late March 1975 a rookery was started in a convent garden. All its nests, 11 in number, built in 3 trees were demolished in early April. This rookery was not rebuilt either that year or in following ones (see D. 15).

E-5. No. 12 Stolarska St.

In two trees (lime and maple) growing at the entrance to the Dominican Church a rookery of 3 nests was founded in March 1975 and lasted for about 3 weeks. Then it was destroyed and has never been rebuilt again.

E-6. Dietl St.

Wide Dietl St., with two roadways separated by a green belt planted with trees, extends for a distance of about 1000 m from the railway viaduct to Stradom St. Starting from 1970, Rooks were observed to nest in numerous trees, the largest number of which being 24 widely scattered trees yearly. A tramway line was constructed in the middle of the green belt all along the street. This however had no unfavourable effect on the size of the rookery.

In the third decade of April 1970 there were 19 nests. In the full breeding season of 1973 they must have been considerably more numerous, since 34 nests were still present in early November. The peak year was 1974 despite heavy tramway traffic. After 5 April 23 nests were demolished, but 19 new nests had appeared by 21 April. They were probably knocked off again, because only two nests outlasted until November. In late April 1975 there were 15 nests in three trees. They were probably destroyed since 19 nests were seen in 14 other trees in November. It may well be that some Rooks deprived of nests and with a belated breeding cycle scattered to settle in many other trees. At the end of March 1976 there were as many as 11 nests, which were probably knocked off together with those built in April, as there were only two preserved in November. There were no nests in March and April 1977. In November three nests were seen near house No. 75. They had been built by some pairs belated in their breeding cycle in the area where two nests had escaped destruction in the preceding autumn.

E-7. Rakowicki Cemetery

In the old part of the cemetery (2.5 ha), overgrown by big trees, there occurred a rookery in 1970. It consisted of two groups of nests, a larger (49 nests), near the wall in the south-western corner, and a smaller (11 nests), in the vicinity of the cemetery chapel. In the subsequent years the number of nests fell rapidly to 6 in early April 1971 and 19 in mid-April 1972, of which 14 in the group near the wall. In April 1973 four nests were built in the site near the wall and one by the chapel. Only the nests near the wall outlasted until the autumn, the other group may have been destroyed. In 1974 there were only four nests near the wall and their remains were still present in the autumn.

In the next year no nests were visible either in the spring or in the autumn. At the beginning of April 1976 four nests were been near the wall and disappeared in the third decade of that month. There were no nests in the autumn of that year nor in the whole year 1977. Out of the two groups of nests, the stronger, situated near the cemetery wall, persisted longer. In my opinion, the decline of the rookery was caused by the destruction of the nests, especially those in the proximity of the chapel, and the cutting down of one of the nest-trees near the wall. As this rookery did not yet exist in 1955 (FERENS, 1957), its age, at the best, approximated to 20 years.

E-8. Jewish Cemetery

The observations concerning this cemetery, the entrance to which was difficult because of the wall, surrounding it, and the gate, locked more often than not, were inexact and sporadic. In the third decade of April 1972 there were several tens of nests in it. In 1973 their number was considerably smaller, only 11 being observed at the beginning of April. In 1975 and 1976 Rooks nested normally, according to the reports of the inhabitants of neighbouring houses. There were no nests in February and April 1977.

E-9. Słowacki Ave. (corner of Karmelicka St.)

The courtyard of the corner house is bordered by several sheds and outhouses and among them there is a close group of tall trees (ashes, poplars and acacias). There were, respectively, 9, 9, 7 and 6 nests in the spring in 1970—1973, their conspicuous remains being present in the trees up to the winter. In 1972 the Rooks brought twigs for their nests from the nests in Krakowski Park. In 1974 the rookery ceased to exist. There were no changes in the stand of trees, nor were there any traces left after the destruction of nests.

E-10. No. 6 Zygmunt August St. — Strzelecki Garden

In the spring of 1970 16 nests were placed in two trees of Strzelecki Garden near the Z. August St. — Lubicz St. crossroads. In the next year there were no nests, nor did they appear there up to 1977.

E-11. No. 90, 29 — Listopada Ave.

On 27 April 1975 there were ten nests in three trees outside the garages of the Polmozbyt. Later they were knocked off, but two new nests appeared in the autumn. Similarly, in 1976 all the nests were destroyed (14 nests on 4 April). None of them was rebuilt. In 1977 no nests were seen either in the spring or in the autumn.

E-12. Szlak St. x Warszawska St.

A rookery was observed in the trees, chiefly in horse chestnuts, growing at the corner between these streets and the railing of the Politechnic University campus as early as 1972. In the autumn of 1973 there were 32 nests and

at about the same time in 1974 only 13. In the spring of 1975 the nests were destroyed and only three were seen in late April. In the next year at least 8 nests were demolished in four trees and none was rebuilt. In March and April 1977 there were no nests.

E-13. No. 8 Siemiradzki St.

An irregular small garden with 5 trees (2 acacias, 2 maples and a horse chestnut) was squeezed in between two houses. There were 3 nests in these trees in the spring for several years (1970—1976). They had decayed by November. Finally, in 1977 they did not appear in the spring nor in the autumn.

E-14. Cystersów St.

In the autumn of 1975 there were seven nests in four trees growing in the pavement, but none in April 1976 and in 1977.

E-15. Szczepański Sq. x Jagiellońska St.

Two nests were situated in a relatively small tree, over a news-stall, in April 1970. They were still seen in the autumn and disappeared once for all in the winter.

E-16. No. 1 Siemiradzki St.

Two nests were built in a big ash-tree in the courtyard of this building in 1975. One of them outlasted till the autumn. It disappeared in the winter to be rebuilt in March 1976. It did not outlast the next winter and no nests were observed in 1977.

E-17. Mogiła — old church

In the spring two nests were observed in two trees growing close to an old church in 1972—1975. No nests have appeared since 1976.

E-18. Plan 6-letni Ave. — near the Museum of Aviation

There were several nests in trees with which the avenue is lined: three in 1974, two in 1975 and none at all in 1976 and 1977.

E-19. Szlak St. — new building of the Politechnic University

In April 1974 Rooks' nests appeared for the first time in the trees growing between the pavement along the new building of the Politechnic University and the roadway; in the autumn they were seven. In late April 1975 nine nests were seen in three horse chestnuts, one of them extremely large, such as is rather encountered in old rookeries. As early as the end of March there were seven nests in 1976 and they were all knocked off in April. In 1977 Rooks did not nest here. The trees growing here have dense robust crowns, in which the nests persisted in relatively good condition throughout the autumn and winter. Their tops reach above the fifth storey of the adjacent houses.

IV. PRINCIPLES OF NESTING OF ROOKS

1. Properties of a suitable habitat

In the foregoing presentation the rookeries of Cracow are divided into five groups (A—E) so that the essential conditions of their formation, existence and decline shall be brought out. The chief purpose is to emphasize the attractiveness of the site, responsible for the appearance of nests in the same place, even in the same trees and often also on the same branches from year to year. Great importance has been ascribed to the size of the area with trees, the properties of the tree crown and the easiness of access to the nest from flight.

The five strongest permanent rookeries (Group A) are situated in parks, ranging from 1 to 21 ha in area. Four of them are old postmanorial parks in villages once lying in the vicinity of Cracow: Wola Justowska, Kobierzyn, Prokocim and Górka Narodowa; only one, the Planty, is situated in the town centre, in the place of the demolished old fortifications. Rooks were drawn by two basic attractions to nest in them: suitably old, even very old, trees and unimpeded access to the nests from flight.

Single big trees (Group B) are marked by their thick trunks and large crowns uniformly developed in all directions. They, too, are easy of access from the air. In a crowded park community the trees touch each other or even their crowns are tangled with each other and they differ much from the paragon of a nest tree. Such a group of trees may sometime form a common shelter for Rooks.

Trees growing in pavements (Group C) resemble those paragons in shape, but for the most part planted not long ago, they are inferior to them in size. Their tops do not usually jut above the continuous rows of houses, which makes it difficult for birds to alight from flight, whereas the manner in which Rooks settle on branches demands an open and suitably large space. Coming to a tree, Rooks fly gliding and describe a wide curve to approach the chosen branch from below. At the last moment they set the wings slantingly upwards, which slows down their flight and lifts them to the height of the branch, on which they settle lightly. With the weight of an adult bird ranging from 392 to 574 g according to its sex and age (GREOBELS, 1932; STEINER, 1969), this slowing down of flight is necessary for safe landing. However, Rooks can also check the momentum of flight by flapping the wings at the level of the chosen branch to alight on it directly, as the fast moving forwards Jackdaws always do (HERZOG, 1968).

Rooks must therefore have wide air zones for approaching their rookeries. For this reason, when building their nests in trees growing in the pavement, they choose the extreme trees of the row, at the end of the street, where it is intersected by another wide open street. The access to the nest from this side is easy and generally used by the birds (C-3, C-12, C-4). The situation of a rookery far from the end of the street may be equally advantageous as regards

access, provided that in this place there is a gap in the row of houses, or the houses are lower than the trees (C-2, C-10, E-19). None-the-less, I know two rookeries (C-11, C-9) marked by a difficult access from the air, to which the Rooks flew along the street, descending gradually to land.

The prosperous rookeries of Group D always keep up an adequately high quantitative level. Their size corresponds chiefly to the area occupied and the number of trees.

2. Choice of nest site

The location of a new colony sometimes begins with the lingering of one or two Rooks in a chosen tree on several successive days. Eventually, a bunch of twigs appears as the nucleus of a nest in a suitable place (C-11). Thus the birds have made their choice of the nest site. More often, however, a new rookery consists, from the very beginning, of several and even some dozen nests, which appear near each other within a short time. In Cracow such rookeries are described in items C-3, D-4, D-8 and E-4. Somewhat different beginnings were observed in the case of a rookery at Legnica, where in 1962, 30 pairs first appeared in two neighbouring villages. No nests were seen there in the next year, while 14 pairs settled at Legnica itself. The rookery was established and in 1967 numbered 77 nests (TOMIAŁOJC, 1970).

Another factor of Rooks' communal life that plays an important role in the setting up of a rookery in addition to the selection of the nest site is their "passive cooperation". It consists in that Rooks take interest in each other and readily join individuals which are foraging, flying in a flock, perching in trees, gathering together for roost or, as in this case, building nests (PINOWSKI, 1976).

The return of Rooks to large rookeries of last year is a different and more complex problem. Some of them visit their nests or their remains from the late autumn throughout the winter. Others, and these may form a majority, appear at their breeding sites guided by memory. An indeterminable number of quite alien pairs settle on the principle of "passive cooperation", seeing the bustle of nest building in trees (GRÓDZIŃSKI, 1976).

The selection of a site for a big rookery in Wrocław proceeded in a different way. In 1943 a rookery arose at Podwale Świdnickie, but it was utterly destroyed the birds had reared their progeny. A new big rookery was not started here before 1951 (SZARSKI, 1955). The birds decided on this situation, no doubt prompted by the appearance of the site and not by their memory of it. This is also supported by observations from Cracow. Here some newly founded medium-sized rookeries (E-4, B-3) did not last a month, destroyed by people.

They were not rebuilt until the end of observation, for 3 and 7 years, respectively. Apparently, the places themselves were not as attractive as that in Wrocław, for the Rooks were not activated by their memory of successful breedings.

A certain number of Rooks therefore return to the rookery in which they have successfully reared their offspring. This might be regarded as an expression of habit or traditional behaviour. In his study of Rooks in New Zealand BULL (1957) states that they show a "strong tradition of breeding" in the same place. However, this tradition does not play such a preponderant role in them. Rooks ringed as nestlings were seen to nest in rookeries hundreds of miles away from their sites of hatching (WÜST, 1970). If a rookery is big, it can persist for many years owing to this tradition; if it consists of several nests (2—3) it may disappear, its tradition being unestablished.

Rooks build nests in various species of trees. Data given by DYRCZ (1966), LUNIAK (1972), KULCZYCKI (1973) and BERESZYŃSKI (1974) show that these nests occur virtually in most tree species growing in this country, providing their crowns are of suitable size.

Naturally, there are tree species that are preferred while others are rarely used; to be sure, they are various in different parts of the country. Regarding the whole country, 53% of the rookeries are situated in poplars and pines and the rest in 18 other species of trees (DYRCZ, 1966). In southern Poland 51% were in poplars, alders and sycamore maples (KULCZYCKI, 1973). Similar situations prevail as regards the distribution of nests if smaller areas are studied. In the Siedlce District 78% of the nests built by Rooks were in pines and the remaining ones in trees belonging to ten other species (LUNIAK, 1972). In town areas e. g. at Poznań 60.6% of the nests were in sycamore maples and poplar and at Lublin 53.4% in poplars (BERESZYŃSKI, 1974). The black poplar and larch belong to the trees most rarely chosen by Rooks and named also by those authors.

These statistical data reflect the local abundance of preferable trees (pines in the Siedlce District, poplars at Lublin) rather than the degree of attractiveness of the nesting tree species. Observations made in Krakowski Park permit the statement that the number of preferable trees belonging to one species depends not only on the shape of these trees but also on the fact how many trees of this species are in the park.

The main condition of the nesting of Rooks in any region is the presence of food in the upper soil layer (rhizosphere), necessary to rear their young. The soil must be soft and fertile so that the Rooks can pick food out of it (BERNDT and MEISE, 1962). The feeding grounds may be as far as several miles away from the rookery. If this condition is fulfilled, the psychic plasticity of Rooks allows them to nest even low above the ground, e. g. at a height of 1.5—2.5 m in a lilac shrub (GAVRILOV et al., 1968) instead of high up in trees (7—30 m; KULCZYCKI, 1973). Contrariwise, in intensely urbanized regions Rooks begin to nest in towers, belfries and on high-voltage transmission line pylons (after KULCZYCKI, 1973). The existence of a nesting tree is an important condition for the origin of a rookery, but only secondary, compared with the presence of food of specific kind. In the Cracow area both are available in abundance and hence such a great number of Rooks nest here.

To be suitable for extra-urban rookeries, a biotope must in addition be marked by the nearness of water, the neighbourhood of human settlements and some elevations of ground or at least tall trees from which Rooks would have the whole region in view (PORATH, 1964). In the Siedlce District big rookeries occur mostly out of towns and villages, small ones in and out of them (LUNIAK, 1972).

3. Urbanization

Rooks lived in Europe as early as the Pleistocene and in the Holocene, as proved by the fossil remains found in Poland (BOCHEŃSKI, in litt.) and France (MAURER-CHAUVIRÉ, 1975). Now *Corvus frugilegus frugilegus* L. occurs as a breeding bird in the palaearctic plains from the Atlantic up to the Yenisey in Asia. The northern nesting range does not go beyond the July isotherm of $+12^{\circ}\text{C}$ (VOOUS, 1962) and the southern boundary is formed by the Pyrenees, Alps, high mountains of the Balkans and the Black Sea. Thus Rooks are an immemorial element of the ornithofauna of Europe. In these extensive areas the primary rookeries were set up in grasslands, in the vicinity of rivers. Here the birds found soft soil with a low plant cover, from which using their beaks to bore in earth, they obtained animal food for themselves and their young. They built nests mostly in groups of loosely growing trees or at the edge of forests. As man appeared in these areas, spreading agriculture (agrocenoses) and clearing forests, their living space increased, for which they repaid with decreasing distrust of him (synanthropism). Finally, they started to enter and nest in inhabited areas. These may have been small groups of houses, villages or towns (urbanization).

In western Europe Rooks have stationary ways of life or, in winter, nomadic ones. In eastern and northern Europe they migrate westwards and southwards in autumn, in Central Europe, including Poland, the number of migrating Rooks exceeds that of residents (BUSSE, 1969; GRODZIŃSKI, 1976). Some of the autumnal newcomers have been stopping in Polish towns for year (Warsaw — Ogród Saski; TACZANOWSKI, 1882), finding food and relative safety in them.

In the urban population of Poznań BERESZYŃSKI (1974) includes the Rooks which appear by the nests in urbanized areas also in the winter. The non-urbanized population avoids such places at all. In Cracow a slight proportion of breeding Rooks visit their nests in the winter, some stay in the vicinity. Most of the birds fly westwards to their winter quarters (BUSSE, 1969). In the spring the nomadic birds appear and roost by the nests 2—3 days later than do the Rooks which visited them in winter. Having returned, the migrants do not begin roosting by the nests before the lapse of a week (GRODZIŃSKI, 1976).

When we consider the future fate of the Rooks of Cracow, we may frame the hypothesis that a group of stationary birds is becoming isolated from the originally homogeneous population. The initial stage of this evolution would

be urbanization, followed by the loss of drive to undertake seasonal migrations. It is hard to determine what proportion of the urbanized birds have already become stationary. At any rate, the rise of a new, no doubt genetically conditioned, race of stationary Rooks is under way. BERESZYŃSKI (1974) calls it an urban population.

DYRCZ (1966) dealt with the distribution of rookeries in Poland. His numerical data show that the former province of Cracow is one of six provinces with the greatest density of rookeries. However, the former Warsaw, Lublin and Kielce Provinces exceed it markedly as regards the number of big rookeries (19% in the Cracow Province against 29, 31 and 31%, respectively). It might be inferred that Rooks began to settle down in the Cracow Province several tens of years later than in the other three provinces and therefore there have not been enough time for the rookeries to develop and get old.

Cracow itself is characterized by several features attractive for Rooks. Having few green areas on the whole, it however abounds in parks and groups of trees suitable for the nesting of these birds. The situation of the town in the old valley of the Vistula, with extensive lawns and meadows secures plenty of animal food easy of attainment. Soil samples taken from Blonia (pasture), Jordan Park (meadow) and Łęg (peat pasture) show that 1 sq. m of superficial soil layer, 5 cm thick, contains 232—325 earthworms, which forms 60—87% of the fauna. The rest consists chiefly of insects (SKOCZEŃ, 1966). Similar data have been given for the green areas of England (BURGES and RAW, 1970). Earthworms are besides regarded as the basic food of young Rooks (LOCKIE, 1955; MARSHALL and COMBS, 1957; VOOUS, 1962). Lastly, Cracow has two convenient roosting sites, one in the Planty and the other at Łęg (GRODZIŃSKI, 1976).

Table VI

Numbers of Rooks' nests in four towns of Poland, varying in area

Town	Area, in sq. km	Number of nests in the year		Author
Lublin	94	1970: 913	1971: 872	BERESZYŃSKI (1974)
Łódź	212	1970: 498	1971: 310	"
Poznań	220	1970: 132	1971: 117	"
Kraków	230	1974: 1216	1977: 1081	GRODZIŃSKI (this study)

Table VII shows that the number of Rooks' nests in Cracow is several times as high as their numbers at Łódź and Poznań, although all these towns resemble each other in area. On the other hand, Lublin, the area of which is considerably smaller, is inhabited by nearly three times as many pairs as is Łódź. The explanation of this state is perhaps the fact that unlike the fertile Lublin soils the soils of Poznań and Łódź may be poor in macrofauna. Another conclusion that

may be drawn from the data in Table VII, however, concerns all the four towns and points to a distinct decrease in the number of nests in two or four years covered by observation.

In this century the administrative boundary of Cracow has changed by leaps. Appropriate regulations simply record the fact that the town margin have expanded, whereas the suburban hamlets and villages have also grown, nearing to the town. In discussing the history of the Cracow Rooks, as urbanized we regard the rookeries that have existed in the area of the former villages for a long time. The shift of the administrative boundary of Cracow and the inclusion of these villages adds nothing to the characteristics of the rookeries. They were situated in inhabited areas, varying in size, and this very fact gave them the character of urbanized colonies. The fate of a few such rookeries is presented further.

The earliest records of the nesting of Rooks in the present area of Cracow are given by SCHAUER (1878), who twice stayed in Cracow for a fairly long time, in the years 1844—1851 and 1862—1868. His observations noted on the spot were later published without major changes. Under *Corvus frugilegus* he writes, "brütet an den westlichen Grenzen des Krakauer Gebietes. Junge überwintern nicht selten in den Dörfern mit *cornix* gesellschaftlich". At that time the western boundary of the Cracow area ran between the primary bed of the River Rudawa and Wola Justowska. There had been a park there since the sixteenth century, now called Decjusz Park, the only place where Rooks could nest west of Cracow, as they still do now (A-1). Further to the west and north in the Rudawa Valley and on the northern slopes of Sowiniec there were and there are no suitable trees at all, without which no rookeries could be set up there. Breeding Rooks observed by SCHAUER as well as the migrants from the east had not yet appeared among the houses of Cracow in winter, but they lived together with crows in villages.

It is much more difficult to establish the date when SCHAUER (1878) observed the nesting of Rooks between 1844 and 1868. In the concise text he makes no difference between the two periods of his stay in Cracow. If Rook had begun to nest in the second period, i. e. after 1862, he would certainly have emphasized that. As regards other birds, especially rarer ones, he gives the dates of appearance or shooting. Thus it might be assumed that Rooks probably nested in Decjusz Park as early as the middle of the nineteenth century, or a few years later as WODZICKI (1850) does not mention those birds in his paper. Together with Wola Justowska the rookery was included in the territory of Cracow in 1941.

The rookery in Górka Narodowa (A-4) was set up in a manorial park. The park is about 1 ha in area and once there was also a half-hectare orchard adjacent to it for several years. The whole borders on cultivated fields, which extend over an area of about 200 ha. Mr. F. ŻABA, administrator of the estate in 1945—1964, claims that the Rooks nesting there were not persecuted in the post-war

period. Basing himself on the statements of some old workers, he alleges that a strong rookery existed in the park as early as about 1920. After the Second World War the nests were occasionally destroyed and the birds shot. Górka Narodowa was included in Cracow in 1941.

The history of the rookery in Smętna St. in Bronowice Wielkie is given in item D-2. Also this rookery arose in a manorial park about the time when Bronowice was incorporated in Cracow in 1941.

According to Mr. URBANOWICZ of the District Department of Town Gardens, Prokocim (A-3) was included in Cracow in 1941. The former fields are now built up chiefly with one-family houses, whereas the manor house has been converted into a State Home for Waifs. The area of the park is 4.24 ha. A stream forms its natural southern boundary. The age of several oaks in the park is estimated at 300—400 years, most trees — alders — being about 120 years old. Now the park is utilized as a district centre of rest and recreation. Rooks nested in it before the war; since the war the nests have not, in all probability, been destroyed by people.

GALLUS (1967), Director of the Hospital at Kobierzyn (A-5), has informed that the grounds now occupied by the Hospital were bought about 1905. The negotiations in the Austrian Governorship in Lvov concerning the building of this hospital, the completion of the design and building itself took so long that it was only in 1917, i. e. during the First World War, that the hospital pavilions were successively opened for admission of patients. Now the hospital pavilions and the chapel are surrounded by a park, about 36 ha in area, which was laid out simultaneously with the commencement of building. Rooks have been nesting here for a long time; anyway, the nests were constantly destroyed, though not all of them, from the Second World War until 1960. Now this procedure has been given up, although the noise made by the Rooks interferes with some sorts of occupations with patients. Kobierzyn was included in the area of Cracow in 1941 (Mr. KASPRZYK, in litt.).

The nesting of Rooks in the Planty was first reported by FERENS (1957). He observed 156 nests in this part of the town in the spring of 1948 and 139 in the autumn of 1955. The nests were regularly removed from the trees until these measures were given up in 1950. Long before, the Town Council of Cracow gave dispositions to remove the nests of Rooks and Jackdaws from trees in the town parks and gardens before the hatching of young (*Zarządzenia władz komunalnych*, 1933). Thus, the breeding Rooks were harassed in the Planty as early as the inter-war period. The urbanization of Rooks in this part of the town may date from the beginning of the present century.

Out of the rookeries built in trees among the town buildings, the most numerous one is situated in the Planty and it persists permanently although the nests have been destroyed regularly. Twenty-five other rookeries were observed in 1971 (Table I), of these 13 were in trees growing in street pavements and thus in the close neighbourhood of human habitations. The rookeries

belonging to this group are generally composed of a small number of nests, the total being 288 nests irregularly distributed among them. Ten rookeries consisted of 1—5 nests and only two of about 50 each. All these rookeries were in areas built up for a long time and with big trees. Most of them were distributed over an area of nearly 20 sq. km. It should be emphasized that breeding Rooks always avoid some large parks, gardens and group of trees, in which wintering birds can forage.

No nests were seen either in Krakowski Park or in Jordan Park, which were laid out more or less at the same time (1887 and 1889), up to 1956 (FERENS, 1957). In 1969 the first nests appeared in Krakowski Park and a medium-sized rookery developed (GRODZIŃSKI, 1976). In Jordan Park, larger in area (21 ha) than Krakowski Park and situated near it, Rooks have not settled down up to now. Krakowski Park is surrounded on all sides by close rows of several-storey houses. The part of Jordan Park with old trees is widely open to the east, west and south and it is only recently that some houses have been built on its northern side. The Botanical Gardens of the Jagiellonian University, 9.6 ha in area, the beginnings of which go back to the eighteenth century, have no buildings at their borders and no rookeries, either. Has the insulation zone of houses around Krakowski Park made it attractive for Rooks lately?

A temporary invasion of Rooks has been investigated closely at Salwator, situated on a hill rising 230 m a. s. l. above the Vistula west of Wawel. The first 16 nests appeared in the gardens of this residential district as late as 1959. There were already 34 nests in the next year. Another rookery, numbering 47 nests, arose in the Salwator Cemetery (2.1 ha). Both these rookeries were abandoned in 1962, probably owing to the mass poisoning of Rooks, and have not been restored any more (BOCHEŃSKI and HARMATA, 1962).

Two ways may be distinguished in the process of urbanization of Rooks in Cracow. The older one leads to the rise of rookeries in manorial parks in neighbouring villages, e. g. at Wola Justowska, Górka Narodowa, Kobierzyn, Prokocim and perhaps Bronowice Wielkie, which were included in Cracow in 1941. The other, direct, way consists in Rooks' invasion of tree groups in built-up town areas. At least 714 nests observed in 1977, i. e. 66% of the total for the whole town, should be numbered in the first group. These figures indicate how attractive the situation of the old rookeries is still for these birds.

4. Decline of rookeries and possibilities of controlling them

Rooks' nests decay to a various degree every year owing to unfavourable climatic conditions (wind, rain and snow). This process occurs in all rookeries but does not lead to their disappearance. Here I mean average rainfall and winds typical of the local climate. BULL (1957), however, mentions an instance of strong wind in New Zealand, after which about 500 young birds blown off

together with the nests were found on the ground under a rookery. In Cracow the decaying nests are rebuilt in the next mating season (GRODZIŃSKI, 1976).

On the other hand, it has been found that some of the rookeries observed in Cracow disappeared for good (Group E). Attempts have been made to determine the time and course of this process, but only for some of them the results were successful. There is no information at all about the causes that made the Rooks abandon the following Cracow rookeries: C-12, C-13, E-8, E-9, E-10, E-13, E-14, E-15, E-16, and E-17.

The felling of nest-trees results in the complete annihilation of the rookery, even though some other big trees have been left in its close neighbourhood. This is exemplified by rookeries E-3, E-2 and E-1. In a close group of nine birches in Krakowski Park (D-1) Rooks originally built 12—23 nests each year (1971—1973), but when in the winter the wind blew down the main, central, tree, the birds did not decide to nest here before early April 1975 and even then there were only 6 nests and not 23 as previously. This shows that the birds treated the close group of trees as a single habitation (GRODZIŃSKI, 1976).

Another procedure, questionable in consequences, in the removal of Rooks' nests as onerous to people. Nests may be removed at the beginning or towards the end of the building period, in old as well as just arising rookeries. The early destruction of a new rookery gives a clear and indisputable result: the rookery disappears and is not rebuilt in the next few years. This is true of the rookeries in the convent garden (11 nests, E-4) in 1975, at the tram-stop (9 nests, B-3) in 1970 and outside the Dominican Church (3 nests, E-5) in 1975. The Rooks had not yet been emotionally attached to the nesting site, since they had not succeeded in going through with their reproduction cycle and in rearing their progeny.

Early in the spring (19 March 1973) the Rooks of an old colony in Krakowski Park (D-1) lost 15 nests, which were knocked off. However they did not leave the site and, more numerous than before, started rebuilding the nests on the very next day. On the other hand, in April 1975, 40 nests were destroyed and on the next day only one pair began to build a new nest and several other Rooks were hanging about in the neighbourhood. Eventually, probably 39 pairs had left the nesting site. It may well be that single pairs moved to nest elsewhere (DYRCZ, 1969). In the first case, in accordance with LEHRMAN's (1959) opinion, the hypophyses of the birds still secreted FSH, the hormone stimulating the ovary to produce eggs. In the second case the hypophysis had already switched over inadvertently to the production of prolactine, which inhibits oögony (GRODZIŃSKI, 1976).

The thorough and repeated removal of the nests of an isolated part of a rookery (C-8, 10 nests) led to its utter disappearance in three years' time, while another part, extending over a considerable length of the same street (C-8), withstood the pressure much longer. This situation lasted from 1971 to 1976 and in 1977 no nests appeared there. In Dietl St. (E-6) the rookery stretched

itself over a space of several hundred metres and it even survived the introduction of a tram-line in the territory without any shocks. The removal of nests, carried out regularly but every year, led to a decrease in their number and to the rise of new groups of nests in other parts of that area. Finally, in the spring of 1977 no nests were seen in the leafless trees. Nevertheless, in the autumn there were three nests in the region where in the previous autumn there occurred the only two nests saved from destruction. It may be surmised that the last year's pairs settled there traditionally.

The single removal of all the nests in two several-year-old rookeries in Szlak St. (E-19 and E-12) turned out unexpectedly effective in 1976. In 1977 no nests appeared here either in April or in November.

The removal of only some nests gives unstable results. This problem is most knotty in the Planty (A-2). Their elongate loop became an interesting experimental area, in which the Department of Town Gardens tried to prevent the Rooks from nesting by removing their nests. They were removed at the request of some institutions and inhabitants of houses adjacent to the Planty in very obnoxious places and at various times. The simultaneous destruction of nests in the whole area of the Planty went beyond the technical possibilities of the Department. As a result, the Rooks managed to resist these assaults, repeated regularly every spring all through the seven-year period of observations.

Table V shows that owing to the removal of nests their number in the Planty has decreased to about a hundred. Consequently, the birth-rate of Rooks has been reduced to 200—400 yearly (estimated acc. to OWEN, 1959). The mortality rate of Rooks in the second year of life is also high, reaching 51% (HOLYOAK, 1971), i. e. only 100—180 two-year-olds lived to breed. No wonder that number of the nests in 1976 and 1977 decreased visibly, for there were not many candidates for nesting in this place among the young birds which had hatched and had been raised in it. The decrease in the number of breeding Rooks is also caused by natural losses among older birds. Some of these last may have been discouraged by their experiences connected with the loss of the nest and their young.

In spite of the destruction of nests their number in some parts of the Planty kept at a higher level than in the other parts (Table I). The removal of Rooks from the endangered areas to those not occupied by the rookery so far may have been another side effect of the destruction of their nests (Fig. 2). This happened in sections F-3, G, and G₂ successively in 1973, 1975 and 1976 and coincided with a period of very intense destruction of nests in their neighbourhood, as has been described in item A-2.

In large areas of France and Germany the number of Rooks' colonies and nests decreases owing to their being destroyed systematically. The methods used are mainly the shooting of birds, then their poisoning, knocking off of nests and even cutting down of trees. However, the number of Rooks increases readily in periods of tolerance, at least in some regions. This may be exemplified

by Mecklenburg (G. D. R.) situated on the Baltic Sea. Table VIII shows instructive observations made there during 60 years of this century.

It may be seen from it how rapidly the number of nests decreased in two periods of persecution and how quickly it increased in the period of tolerance. The number of rookeries, too, diminished or rose, but in a less regular manner and not always proportionally to the numbers of nests. The essence of changes is elucidated by the numbers of nests calculated for a statistical rookery in particular years. It appears that the number of nests in a statistical rookery falls gradually during the periods of persecution to increase rapidly in the pe-

Table VIII

Fluctuations in the size of Rook population in Mecklenburg (G. D. R.) in the periods of suppression and tolerance after HERBERG (1956) and MANSFELD (1965)

Year	Procedure	No. of rookeries	No. of nests	Mean number of nests per rookery
1900	suppression	43	36585	850
1911	"	14	8000	571
1937	"	20	3000	150
1941	tolerance	31	8000	258
1951	"	72	29000	402
1960	suppression	61	4681	76

riod of tolerance. Repression leads not only to the destruction of a population of Rooks but also to its splitting into smaller rookeries (years 1937 and 1960). Tolerance favours the formation of larger groups (1951).

In the Netherlands Rooks were protected until 1942, when people began to fight against them by destroying their nests in masses and then by shooting them, especially the birds at nests. From towns this campaign was extended over the rural regions, which in 1970 led to the reduction of the Dutch populations of Rooks to 20% of the number for 1940. Now Rooks have disappeared completely from the western part of that country, while in the other parts they occur only in small numbers (FEIJEN, 1976). In these last twenty years Rooks have enjoyed relative tolerance in Schleswig-Holstein (FALLET, 1978).

No country-wide campaign of suppression of Rooks has been conducted in Poland, however much people complain of them. In town parks the din of breeding birds and their excrements become periodically unbearable and farmers suffer grievous losses because the Rooks peck out germinating seeds. In forming an opinion about these birds, we should take into account three other points. Rooks eat a great many earthworms, especially when they feed the nestlings, which, in view of the general role played by these animals in soil biology, is very harmful (KORNALEWICZ, 1978).

It is striking that earthworms are a less attractive foodstuff for the Rooks bred in an aviary (LUNIAK, 1977). On the other hand, Rooks take many insects

and other members of the soil macrofauna and thus contribute to the improvement of crops. Aesthetic experiences we have seeing Rooks circling over villages or strutting in meadows are not unimportant especially nowadays when the use of insecticides more and more reduces the numbers of small birds.

It has been shown above by the example of Mecklenburg and Holland that an anti-rook campaign conducted in an appropriate way at an appropriate time and repeated for many years results in the marked reduction of these birds. Similar measures can be taken in Cracow to dislodge the importunate rookeries. They should however be modified according to the size and age of a rookery and different local conditions.

In the first place, the shooting of birds at nests is out of question. The shooting of Rooks roosting at Łęg in winter, as was done several years ago, is abortive, because these birds are chiefly immigrants from the north and east and not breeding birds. The offer of poisoned eggs and grain to the Rooks is dangerous for dogs and cats and many other birds foraging in the fields. There remain only two measures: cutting down of trees or removal of nests.

Several trees were cut down in the garden with rookery E-2 (Rey St.) in the spring and this was enough for the Rooks to stop nesting there starting from the following year. The situation in E-3 (Jugowicka St.) was similar, when a group of nest pine-trees had been felled in the grove, the Rooks did not move to single big pines but disappeared completely as nesting birds. When Zakopiańska St. was being widened and different trees had to be felled during a period of 2—3 years (E-1), the number of nests fell from 30 to several and there have been no nests at all recently. In Krakowski Park a similar effect followed the loss of the biggest tree in a group of birches. The reaction of Rooks to the loss of nest-trees depends on how many such trees have been lost in the rookery.

The observations made in Cracow show that the removal of newly founded small rookeries, still before the hatching of young, makes the birds give up nesting in this place for good (E-4, E-5). Weak rookeries, existing for some time, can be liquidated by the systematic and complete destruction of nests early in the spring for several consecutive years (C-8).

Used for many years, the method of fighting against big rookeries, e. g. in the Planty (A-2), resulted in the scattering of groups of nests all over the Planty and the simultaneous reduction of breeding pairs to about 100 yearly (Table V). However, none of the sections of the Planty was quite abandoned by the Rooks, even in the year in which the nests had been knocked off from the trees early.

Starting from the autumn, small numbers of breeding Rooks visit the nests regularly in the morning and stay by them for a long time. In the spring some other Rooks, either the birds wintering in this place or those returning from their winter-quarters, join them at various time intervals. I have therefore suggested (GRODZIŃSKI, 1976) that the nests should be knocked off in the autumn, when they have been abandoned, and not in the spring, when they are

being built. Such a procedure will prevent the Rooks from cherishing their concern in nests in winter. If this notwithstanding some pairs decide to build their nests in the spring, they will be only few, there being no long-range action of "passive cooperation".

The regulation of the number of Rooks in the Cracow area should be based on the restriction of the number of nesting birds and only in some places in their complete dislodgment. To obtain this end it is advisable (1) to remove the nests in the autumn, (2) to destroy newly founded rookeries early in the spring, (3) to repeat this procedure, if needed, for several consecutive years and (4) to remember that the felling of nest-trees is out of question in Cracow, where each single tree is so valuable.

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STRESZCZENIE

Kraków rozrastał się w bieżącym stuleciu skokowo przez wchłanianie okolicznych wsi i osiągnął powierzchnię około 230 km². Przy tej okazji weszły w skład miasta także parki dworskie: Woli Justowskiej, Kobierzyna, Górki Narodowej, Prokocimia i Bronowie Wielkich, razem ze znajdującymi się tam silnymi koloniami gawronów. Druga liczniejsza grupa kolonii powstała na miejskich terenach zabudowanych, najsilniejsza z nich na Plantach (ryc. 1). W ciągu obserwacji prowadzonych w latach 1968—1977 stwierdzono, że za-

równą liczbą gniazd, jak i kolonii ostatnio maleje (tabela I). Na wiosnę 1977 doliczono się 30 kolonii z 1082 gniazdami, z czego większość gniazd (719 sztuk, 66%) należy do grupy pierwszej.

Gawrony wykazują dużo tradycjonalizmu w zajmowaniu terytorium gniazdowego i doboru drzewa pod gniazdo. Gawrony lęgowe tolerują bliskie sąsiedztwo człowieka, czy to będzie okno w odległości kilku metrów od gniazda (fot. 7), czy tramwaj jadący z trzaskiem popod drzewami gniazdowymi (kolonia E-6). Te same ptaki żerujące na terenie pozamiejskim utrzymują zdecydowanie dużą odległość od człowieka. Po gwałtownej stracie gniazda zachowują się jak automaty, albo gniazdo odbudowują, albo porzucają miejsce lęgowe, zależnie od swojego stanu neuro-hormonalnego.

Największa, licząca około 400 gniazd, i prawdopodobnie najstarsza kolonia powstała około połowy ubiegłego stulecia, znajduje się w Parku Decjusza (A-1). Przeszłość trzech dalszych kolonii w parkach podworskich (A-3, A-4, A-5) dała się prześledzić do pierwszych dziesięcioleci bieżącego wieku. Wszystkie te kolonie znajdują się na obrzeżu miasta i byt ich jest dość ustabilizowany. Kolonie obszaru zabudowanego, z wyjątkiem Plant, odznaczają się małymi lub średnimi rozmiarami i wszystkie skupiają się na powierzchni około 20 km² (ryc. 1). Jedne z nich trwają latami, inne znikają, inne wreszcie się pojawiają. Na tle tych zmian rysują się wyraziście główne zasady powstawania kolonii.

Już jedno gniazdo może dać w następnym sezonie impuls do budowania dalszych (kolonia C-12). Częściej od razu kilka gniazd tworzy zaczątek kolonii (C-3, D-4, D-8), które mają większe szanse przetrwania lub nawet na rozrost w następnych latach. Ptaki zakładające kolonię kierują się w doborze lokalizacji dwoma cechami biotopu: (1) wyglądem drzewa i (2) łatwym do niego dostępem z lotu. Żerowiska, niezbędna przesłanka do założenia kolonii, mogą znajdować się w odległości nawet kilku kilometrów. Wzorcowe drzewa omówiono w zespole "B". Odznaczają się one wysokim wzrostem i bogatą koroną, rozrośniętą we wszystkich kierunkach. W braku takich drzew gawrony mogą korzystać z krzewów (GAVRILOV et al., 1968), co dowodzi plastyczności ich zachowania. Gatunek drzewa nie decyduje o założeniu kolonii. Losy przeszło pięćdziesięciu kolonii stwierdzonych w Krakowie przedstawiono w osobnym rozdziale.

Gawrony o przeciętnym ciężarze ciała około 480 g (GROEBELS, 1932) i poruszające wolniej skrzydłami niż kawki (HERZOG, 1968) siadają na gałęziach przeważnie z lotu ślizgowego. Celując poniżej gałęzi, na której zamierzają usiąść, w ostatniej chwili ustawiają skrzydła pod kątem ostrym do kierunku lotu, co je hamuje, podnosi do góry i sadza lekko na wybranym miejscu. Do takiego sposobu lądowania muszą mieć otwartą przestrzeń. W związku z tym gawrony budują gniazda powyżej dachów sąsiednich domów. Głównie jednak wybierają drzewa rosnące na szerokich placach, w ogrodach i parkach. Jeżeli budują je na drzewach chodnikowych, to albo w miejscach, gdzie domy nie tworzą zwartego szeregu (C-2), albo na skrzyżowaniu z drugą ulicą, co zapewnia niehamowany dostęp lotem do gniazda (C-3, C-4).

Kolonia w Parku Decjusza (A-1), najsilniejsza i nie niszczona, daje obraz naturalnej regulacji stanu liczbowego. W pięciu ostatnich latach pojemność gniazdowa parku ustaliła się na poziomie około 400 sztuk (tabela II), pomimo że miejsc na gniazda jest znacznie więcej. Mechanizm tej regulacji wymyka się próbom wyjaśnienia.

Odmienny obraz daje kolonia na Plantach (A-2), stara, ale od wielu lat w różnym stopniu niszczona (Tabela V). Zrzucano tutaj setki gniazd na różnych odcinkach Plant, w trzech latach nawet dwukrotnie. Istotne dla rozrodu są liczby gniazd lęgowych tzn. takich, w których ptaki wywiodły młode, a których liczba waha się około stu sztuk rocznie. Z tych gniazd w trzecim roku życia, zgodnie z formułą HOLYOAKA (1971), dochodzi do rozrodu 100—180 sztuk. Tymaczy to, iż w latach 1976 i 1977 znacznie mniejszy był napływ gawronów lęgowych na Planty.

Na tle bezwzględnej walki z lęgowymi gawronami w Meklemburgii, NRD (tabela VIII) i Holandii, oraz na podstawie uchwyconych przyczyn, które doprowadziły do zanikania niektórych kolonii gawronów w Krakowie, proponuje się stosować następujące zabiegi, aby ograniczyć liczbę gnieźdzących się ptaków: (1) zrzucać gniazda jesienią, (2) niszczyć na wiosnę po raz pierwszy powstałe kolonie, (3) w niektórych przypadkach powtarzać akcję przez kilka lat.

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Plate VIII

Phot. 1. A group of nests in the top part of an elm in Krakowski Park (D-1). There were up to 30 nests in this tree at the same time in some years

Phot. 2. A concentration of nests at the top of a poplar in the neighbourhood of St. Florian's Church (D-11)



Phot. 1



Phot. 2

Plate IX

Phot. 3. A group of relatively young trees in Decjusz Park (A-1), the branches of which are tangeled with each other. There are single nests in the trees

Phot. 4. A poplar in Krakowski Park (D-1) with a thin crown composed of long branches; there were never more than 11 nests in it during the four years of observation. The nests broke up every year (winds). Since 1975 they have not been rebuilt any more



Phot. 3



Phot. 4

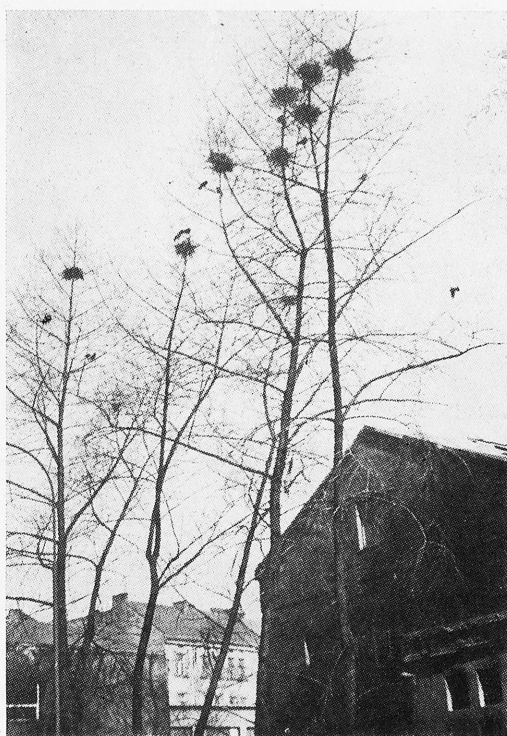
Plate X

Phot. 5. A poplar in the Kleparz Market Place (B-4), where much business is done on market days. It became the seat of a rookery consisting of 9 nests at the most

Phot. 6. A group of five young poplars in Worcell St. (B-2). Growing along the inner edge of the pavement, some dozen steps away from the windows of houses, they began to win the first pairs of breeding Rooks away a big poplar at this corner of the street in 1973



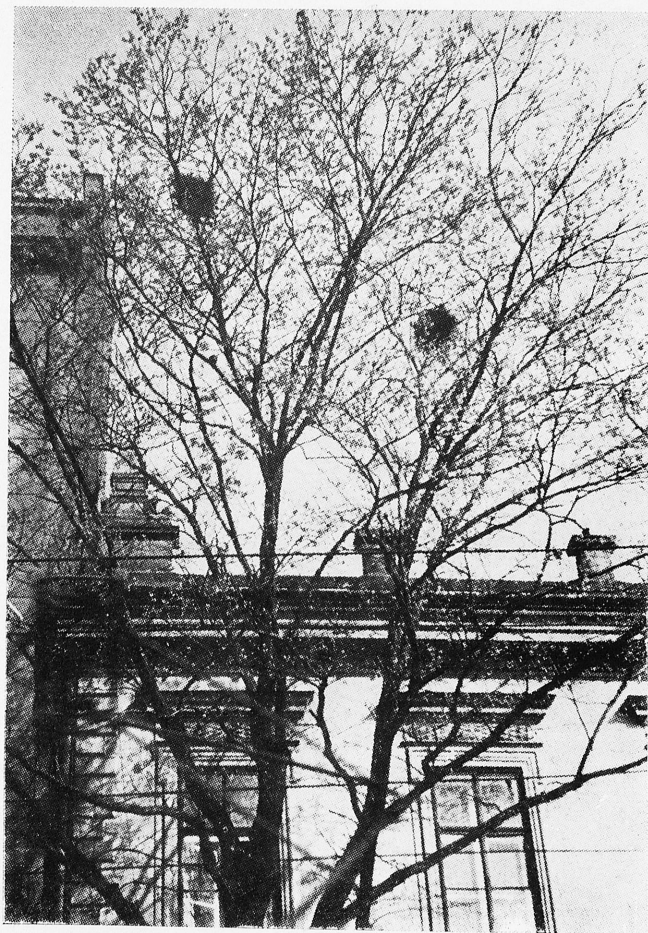
Phot. 5



Phot. 6

Plate XI

Phot. 7. Nests in a tree growing in the pavement of Basztowa St. in the close neighbourhood
of the windows of a house



Phot. 7