Acta zool. cracov. **43**(1-2): 177-184, Kraków, 30 July, 2000

Ravens *Corvus corax* LINNAEUS, 1758, nesting on electricity pylons in the Wielkopolska region

Jan BEDNORZ

Received: 16 Dec., 1999

Accepted for publication: 5 Apr., 2000

BEDNORZ J. 2000. Ravens *Corvus corax* LINNAEUS, 1758, nesting on electricity pylons in the Wielkopolska region. Acta zool. cracov. **43**(1-2): 177-184.

Abstract. In Europe the Wielkopolska region is the most westerly localized area over which Ravens nest in considerable numbers on electricity pylons. In the years 1996-1998 116, 115, and 114 pairs were observed to nest on pylons. Over the distance of 1850 km of the electricity lines controlled, there were 356 nests. The mean density of Ravens was 0.6 birds per 10 km of the line, while the maximum density was 4.0 birds per 10 km of the line. The Ravens preferred farmland – 95.4% nests. The population observed was characterized by a high nesting success of 78.8% in 1997 and 92.0% in 1998, and high productivity of young birds of 3.3 juveniles per one nest with the known number of nestlings. The Ravens are faithful to once-chosen pylons and even to specific sites on them. It has been shown that the Ravens nest on pylons in considerable numbers only over the area in which there is a population of Ravens living in pine forests.

Keywords: Raven, *Corvus corax,* nesting adaptation, electricity pylons, farmland, W Poland.

Jan BEDNORZ, Departament of Avian Biology and Ecology, Adam Mickiewicz University, Fredry 10, 61-701 Poznań, Poland.

I. INTRODUCTION

The nesting of Ravens on electricity pylons is a relatively recent phenomenon in Europe. The first such cases were reported in the early 60s from the European part of Russia (KONSTANTINOV & LEBIEDIEV 1989), in 1969 from Great Britain (RATCLIFFE 1997), and 1970 from Germany (STEGEMANN 1971). In Poland the first Rawen's nest on a pylon was spotted in 1981 in the Mazowsze region (S. POPIS in litt.) and in the Wielkopolska region in 1983. In 1990 in the latter region 13 such nests were known (Kartoteka Ptaków Wielkopolski, J. BEDNORZ, unpubl.). To check whether this chioce is becoming more common, a study was undertaken in the years 1996-1998 and all the electricity lines in the region were controlled. The aim of the study was to find out

- what was the scale of the possible increase in the population of Ravens nesting on electricity pylons,
- what was the distribution of the nests along the lines,
- what was the relation between the construction and voltage of the line and the choice of particular pylons,

– what is the nesting success of the pairs, their productivity, and what are the reasons for nesting failure,
– what is the mechanism of choosing pylons as nesting sites.

II. STUDY AREA AND METHODS

Wielkopolska (Greater Poland) is the region lying in the central part of western Poland, between Pomorze (Pomerania) and Śląsk (Silesia). The landscape of the area is dominated by large agrocenoses and agriculturally used land covers about 64% of the region. Forests cover about 25%, but larger forest complexes occur in certain spots, mainly in the north-western part (KUŹNIAK in BEDNORZ et al. 2000).

The field study was conducted in the years 1996-1998 on the major part of the region (about 35 000 km^2) up north to the river Noteć. Farther to the north only a 55 km section of electricity line from Piła to the northern border of the region was checked (Fig. 1). All electricity lines of high and medium voltage were controlled. In the first year of the study it was found that Ravens did not build nests on concrete pylons of medium voltage line. Such lines were not controlled in the following years, only the few metal pylons on them which were used to raise the lines at road and railway crossings being visited. For all three years only the lines hanging on metal pylons were checked while travelling in a car. The total length of the regularly controlled lines was 1850 km. In 1996 only one control of all lines was made in the period from the end of February to the beginning of May. The route was too long for the control to be repeated, the aim being only to determine the number and distribution of Ravens' nests on pylons in this region. In the second and third year of the study (1997 and 1998) two controls were made each year: the first at the time of nest construction and breeding – from the third decade of February till the end of March, and the second when the nestgs already appeared in the nests – until the first decade of May. Those nests in which breeding was delayed or repeated were visited again in May. The nesting was assumed to be successful when they hosted big juveniles able to fly off the nest and survive in the event of nest destruction. Observations were made using 11×50 binoculars and a 40 telescope making possible analysis of the material used for the nest construction and the nestling count. It was hardly possible to count the juveniles, since because of strong winds they were very close to one another. Only when the young were already strong enough to sit on the pylons was their count exact.

III. RESULTS

1. Distribution of nests and their number

In the years 1996, 1997, and 1998 the number of breeding pairs spotted on the pylons was 116, 115, and 114, respectively. The total number of nests built in these three years was 356, of which 226 (63.5%) were built on the pylons of the 220kV line, 122 (34.4%) on the pylons of the 110 kV line and 8 (2.2%) on the pylons of 15kV line (Table I). The distribution of the nests was very uneven (Fig. 1). Their occurrence was centred in the vicinity of Poznań. The majority of the nests were distributed in the central part of the region to the east and west of Poznań. To the south and in particular to the north, the number of nests quickly decreased. Most of the nests were distributed, similarly as the main electricity lines, along busy roads. The density of pylons did not have much effect on the number of nests; for instance near Konin with the main electric power plant in the region, despite a large number of pylons, the number of nests was small (Fig. 1).

The Ravens unquestionably preferred farmland. Only 4.6% of the nests were built on pylons in forest clearings (in the margins) and in open areas closer than 100 m to the forest wall. All nests were placed on metal pylons of open work construction. They were found on 9 kinds of pylon (Fig. 2), more often on higher ones of the 220 kV line (69.2% of all nested pylons) than on lower py-

Table I

Distribution of Ravens' nests on different type electricity pylons in Wielkopolska

Pylons type	Height (m)	Voltage (kV)	Number of occupied pylons		Number of nests	
			n	%	n	%
a	31	220	111	63.5	204	57,3
b	31	220	9	5.1	19	5.3
c	31	220	1	0.6	3	0.8
d	22	110	34	19.4	78	21.9
e	22	110	10	5.7	26	7.3
f	22	110	4	2.3	12	3.4
g	22	110	2	1.1	6	1.7
h	12	15	3	1.7	6	1.7
i	12	15	1	0.6	2	0.6

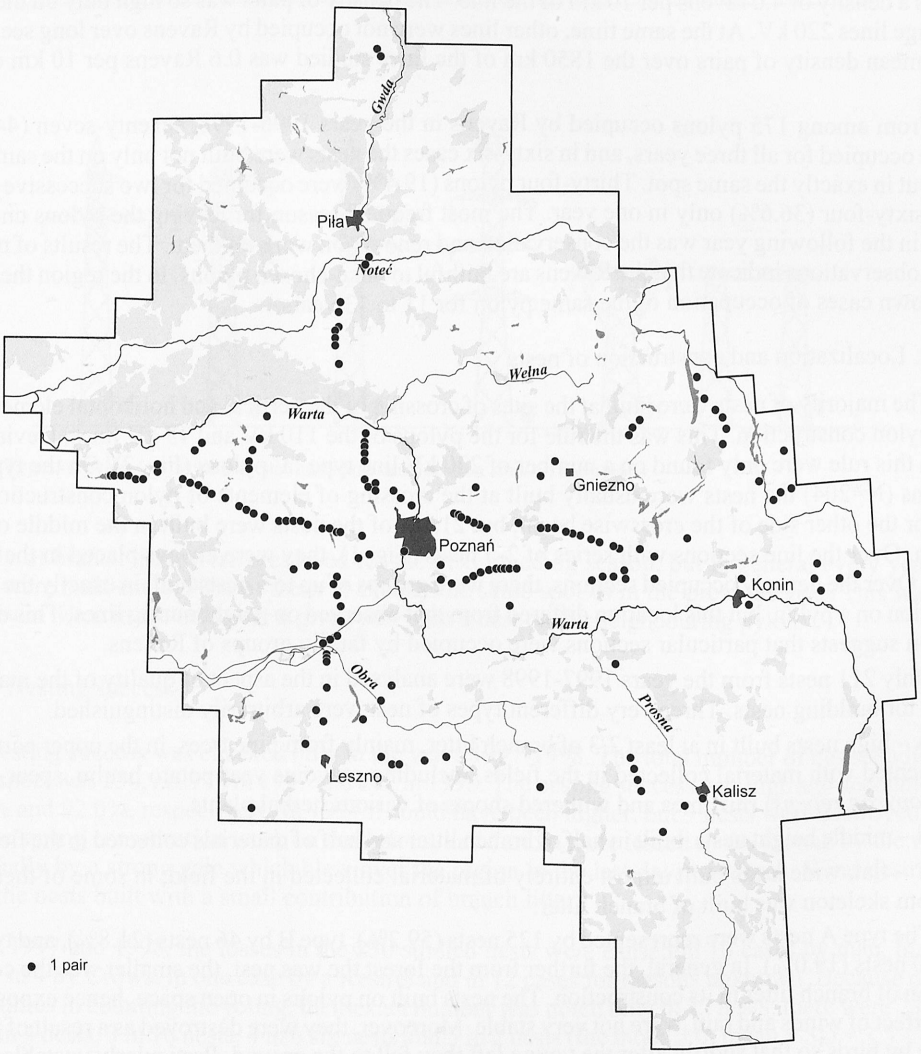

Fig. 1. Distribution of Ravens' nests on electricity pylons in Wielkopolska in the years 1996-1998.

lons of the lower voltage lines (Table I). Along the sections where lines ran parallel to each other lower pylons were never occupied. The distribution of nests along particular lines was highly unequal (Fig. 1). Sometimes single nests were at great distances from one another, more often groups of a few nests were noted over short distances, sometimes nests being found at every second or third pylon at distances of 300 –500 m. In four instances nests were found at neighbouring pylons, but they always belonged to the same pair. In two cases the nests were alternately used, and in the other two, although the birds built two nests, they used only one. This character of nests distribution followed from the mechanism of occupation of pylons. According to the observations made at the turn of the 80s and 90s, at first single nests appeared at different, sometimes very distant sites. In subsequent years near the already existing nests new ones appeared, and considering that pylons of the same construction were chosen, the new ones must have belonged to the offspring of the first pair. In this way series of nests were established, which then became longer, sometimes very long as shown in Fig. 1. Over such sections the density of the nests was maximum. For instance, in 1996 over a section of 85 km, 19 pairs were found to nest, which gives a density of 2.2 Ravens per 10 km of the line. In 1997, along another section of about 25 km, the nests of 10 pairs were found, which gives a density of 4.0 ravens per 10 km of the line. The density of pairs was so high only on the high voltage lines 220 kV. At the same time, other lines were not occupied by Ravens over long sections. The mean density of pairs over the 1850 km of the lines studied was 0.6 Ravens per 10 km of the line.

From among 175 pylons occupied by Ravens in the years 1996-1998, seventy-seven (44.0%) were occupied for all three years, and in sixty-six cases the nests were built not only on the same pylon but in exactly the same spot. Thirty-four pylons (19.4%) were occupied for two successive years and sixty-four (36.6%) only in one year. The most frequent reason for leaving the pylons unoccupied in the following year was the conservation and renovation work on them. The results of many-year observations indicate that the Ravens are faithful to once-chosen pylons. In the region there are 5 known cases of occupation of the same pylon for 11 to 13 years.

2. Localization and construction of nests

The majority of nests were built at the sites of crossing of the vertical and horizontal elements of the pylon construction. This was the rule for the pylons of the 110 kV and 15 kV lines. Deviations from this rule were only found on a number of 220 kV line type 'a' pylons (Fig. 2). On the type 'a' pylons (N=204) the nests were usually built at the crossing of elements of pylon construction, on one or the other side of the crosswise beam, but 21.1% of the nests were built in the middle of this beam. Over the line sections with series of 2-5 nests (Fig. 1), they were always placed in the same way. Over the densely occupied sections, there were groups of up to 5 nests built in exactly the same location on a pylon, but this location differed from that observed on neighbouring lines. This observation suggests that particular sections were occupied by family groups of Ravens.

Only 211 nests from the years 1997-1998 were analysed in the aspect of quality of the material used for building nests. Three very different types of nest were arbitrarily distinguished.

A – high nests built in at least 2/3 of branch litter, mainly from pine trees, in the upper part supplemented with material collected in the fields, including prevoius year potato haulm, spear-grass (*Agropyron repens*) rhizomes and withered shoots of various herbal plants.

B – middle height nests, built in half of branch litter and half of materials collected in the field.

C – flat, wide nests built almost entirely of material collected in the field; in some of them the bottom skeleton was built of branch litter.

The type A nests were represented by 125 nests (59.2%), type B by 46 nests (21.8%), and type C by 40 nests (19.0%). In general, the further from the forest the was nest, the smaller was the contribution of branch litter in its construction. The nests built on pylons in open space, hence exposed to the effect of winds and rain, were not very stable. Moreover, they were destroyed as a result of trampling by birds so that shortly after the young left they fell to the ground. Particularly unstable were those nests built with a small contribution of branch litter. In seven instances the nests were thrown

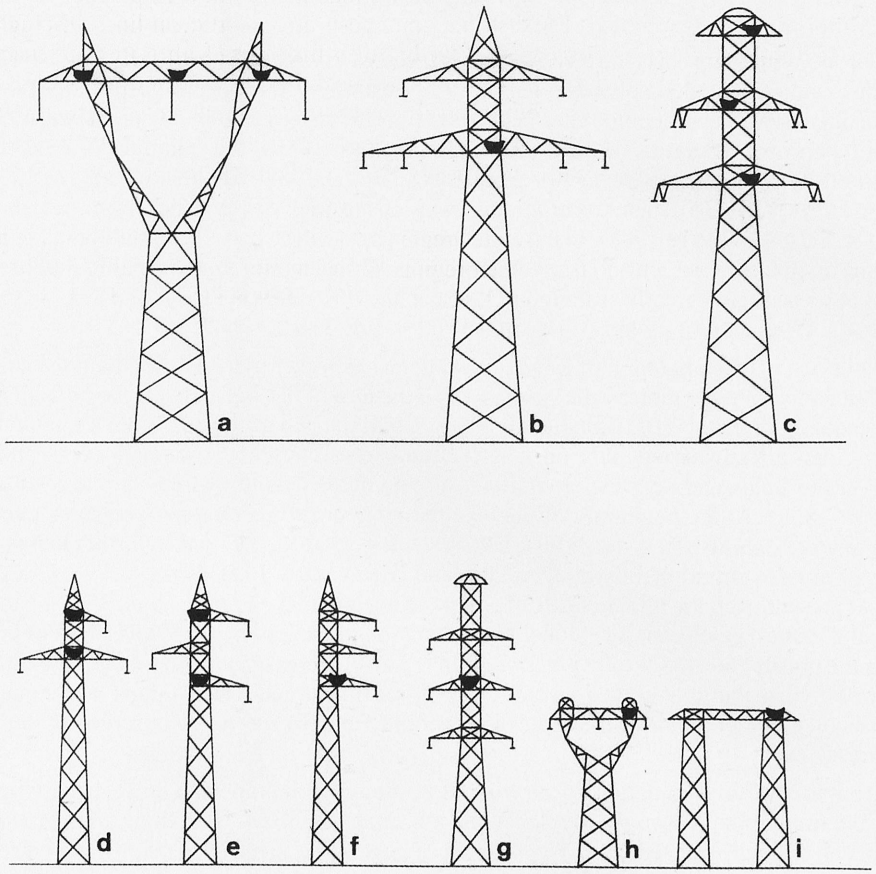

Fig. 2. Types of pylon (a-i) with Ravens' nests and nest location sites on the pylons.

mainly of branch litter were preserved for the next breeding season, but in general every year the nests were built anew, 90% of them at exactly the same spot as in the previous year. This was the case even when in the next year a given pair built a nest on the neighbouring pylon.

3. Nesting success

Nesting success was checked only in the years 1997-1998. The total number of nests studied in this aspect was 230, i.e. 118 in 1997 and 112 in 1998. The nesting success was high and accounted to 78.8% and 92.0%, respectively. In 1997 it could have been higher, but 9 nests were destroyed during the spring conservation work on the pylons, and 7 more were tossed to the ground by the wind, especially by a strong gale which blew over the region in the last days of March. Wind destroyed only the nests built with a small contribution of branch litter.

In 1997 and 1998, the losses in the 230 studied nests were caused in 10 cases by man, in 7 by wind, in 4 by Crows, in one case by a Kestrel and in 12 cases for reasons unknown. Because of the difficulties in counting the young, their exact number was noted only in 22 nests: there were 2 juveniles in 4 nests, 3 in 10 nests, 4 in 6 six nests and 5 in 2 nests (the mode 3.0; mean $\pm$ SD = 3.3 $\pm$ 0.9). Moreover, in 11 nests there were at least 2 juveniles, in 17 nests – at least 3 and in 7 nests at least 4 juveniles.

IV. DISCUSSION

In Europe Wielkopolska is the area furthest to the west in which nesting of the Raven on electricity pylons cannot be called sporadic. This way of nesting by this species, especially in an open space, is not a new phenomenon. It has been known from Eastern Europe, where it was reported in large numbers from Belarus (IVANOVSKIJ & TISHECHKIN1989), the Ukraine (KRIVICKIJ 1989, GRINCHISHHIN & SHHEMCHUK 1990) and Russia (BIELIK1989, KONSTANTINOV & LEBIEDIEV 1989, SARYCHEV 1993). Outside Europe this way of nesting was reported from Nevada U.S.A. (WHITE & TANNER-WHITE 1988), Idaho and Oregon (STEENHOF et al. 1993). In Poland the nesting of Ravens on pylons was reported from other regions of the country, but in smaller numbers (up to 20 nests at present) and greatly scattered (DYRCZ et al. 1991, JERMACZEK et al. 1995, ŚLEDŹ 1996, ZAWADZKA 1996, A. GOŁAWSKI A. DOMBROWSKI in litt., J. BEDNORZ).

An increase in the population of Ravens nesting on electricity pylons in Wielkopolska is a stage of recolonization of the region by the species. Until the turn of the 70s and 80s, the birds of this species nested only in forests (BEDNORZ et al. 2000). Up to the end of the 80s, from a total number of 473 pairs, 20% already nested in the open agricultural landscape, at first in small forests and groups of trees in the fields and, starting from 1983, also in areas devoid of trees on electricity pylons (BEDNORZ 1991). At the beginning of the 90s, the number of breeding pairs in forests reached a level of relative stability (BEDNORZ 1997, BEDNORZ & KOSIŃSKI 1997) and a further increase in the number of birds occurred mainly in open farmland (KRZYŚKÓW 1991, LOREK 1993, KACZMAREK 1999). At present from the total number of 750 pairs nesting in the region, about 35% inhabit farmlands and 15% nest on electricity pylons. The adaptation of the Raven to life in an agricultural landscape in the poorly forested Wielkopolska region led to an increase in the number of the birds and a more uniform distribution of breeding pairs. All earlier-mentioned cases of more numerous nesting of Ravens on electricity pylons in Eastern Europe and the USA were also observed in the agricultural landscape.

The number of the population of the Ravens nesting in Wielkopolska on electricity pylons, at least of the time of the study, was stable. When it became stabilized is unknown, and it is possible that it occurred relatively recently. The process of nesting on electricity pylons can be relatively rapid. For example, in the States of Oregon and Idaho in the USA, it took only 6 years from the moment of appearance of the first Ravens' nest on an electricity pylon to the time of stability in their number was reached (80-81 pairs) (STEENHOF et al. 1993).

The average number of breeding pairs nesting on pylons in Wielkopolska was 0.6 birds per 10 km; and along the most densely inhabited sections 2.2 birds per 10 km (85 km section) and 4.0 birds per 10 km of the line (25 km section). In the States of Idaho and Oregon in the USA it was on the average 1.3 birds per 10 km of the line over a section of 596 km (STEENHOF et al. 1993). In Russia near Rostov, the nests were reported to be on the average every 5 km (BIELIK1989), on the River Don in the years 1985-1988, over an area of 160 km^2, at least 27 pairs nested on electricity pylons (SARYCHEV 1993) and in the West Ukraine as many as 25% of the nests found were built on electricity pylons of high voltage lines (GRINTSHISHTIN & SHMITSHEMTSHUK 1990).

The distribution of Ravens' nests along the electricity lines in Wielkopolska was not at all uniform. Undoubtedly, this distribution was affected by the types of pylon, availability of food, and historical aspects of colonization. Most frequently the Ravens built their nests on the highest pylons of high voltage electricity lines (n=226, 63.4% of all nests) and most favourably on type 'a' pylons (Fig. 2, Table 1). Although the pylons of this type occurred only on the lines with a total length of 690 km (37% of all lines studied) they hosted as many as 57.3% (n=204) Ravens' nests.

The distribution of the nests was also significantly affected by the availability of food – at least 70% of the nests were built near animal rearing farms, especially hog-breeding ones, communal waste dumping grounds, waste dumping grounds near slaughter houses, and near busy roads. The latter have become increasingly popular places for Ravens which have been feeding on the animal victims of motor accidents.

The greatest density of nests was also observed to occur in the vicinity of the sites at which individual nests were found at the beginning of the 80s, thus in the area where the settlement had lasted for the longest time. KOCH et al. (1986) claim that a new site accepted for nesting by a single pair of Ravens can start a new colony of Ravens in the vicinity. This hypothesis was confirmed in Wielkopolska. Three to four years after the first pair was observed to nest in a given site, which corresponds to the time of reaching sexual maturity by the young ravens (COOMBS 1978), other pairs of ravens were noted to build nests nearby. They built them not only on the same type of pylons but also at exactly the same sites on them. Similar observations were reported from Germany by MUSCHIOL (1985) and PRILL (1982). The latter author concluded that the next pairs must have been the offspring of the former pair and the fact of the same way of nest construction must have been a result of imprinting or a form of traditional development of a habit. This is probable, but impossible to prove without a study on marked populations.

The fact that the nests are built on the pylons, the nest construction and kind of material used indicate that the birds come from the population earlier nesting on the pine trees (GLANDT & JANSEN 1991, GLUTZ & BAUER 1993). The materials collected in the fields were used only by those birds which built nests far from the forests with a contribution of pine trees. The construction of such nests took only 2-3 days, but they were not durable. It is also important to note that all the known cases of nesting on pylons were observed only in the areas inhabited by the populations living in pine forests.

A feature characteristic of the Ravens nesting on pylons is a high breeding success. In Wielkopolska it was on the average 85.4% (n=230). A similar average of 86% (n=272) was reported from the USA by STEENHOF et al. (1993), and from Russia, from the area near the River Don, SARYCHEV (1993) reported even 92.6% (n=27). So high an average nesting success has not hitherto been reported in Central Europe (GLUTZ & BAUER 1993) in the population of Ravens nesting in forests. Moreover, in extreme circumstances the breeding success in the forest populations was as low as 45% (SELLIN 1991). The high nesting success in the Ravens nesting on pylons may result from a few factors. When the nests are in an open space, near the feeding grounds, the parents are able to take better care of their nests as they can watch them all the time. This restricts the plundering of the nests by other animals, mainly Crows. This still happens, but only along the densely nested sections. The Ravens there are busy protecting their territory against the neighbouring birds and do not take enough care of the nests to protect them against Crows. No cases were noted of destruction of the nestlings by the mustelids (Mustelidae), which plunder many nests in forests (KACZMAREK 1999, personal observations by the author). Also the destruction caused by man is much less significant in the nests placed on pylons than in those of the Raven population nesting in forests (SELLIN 1991). Even the wind, which is a more important factor limiting the breeding success in the open space than in forests, has no significant effect. The nests built on pylons are so well set in that in the breeding season only very strong gales can destroy them. Such events were observed only in the case when the nests were built without branch litter or with a low contribution of it.

The productivity of the population studied was also relatively high. It was 3.3 juveniles per successful nest (n=22), the corresponding value in tree stands in the fields being 2.9 (n=14) (KACZMAREK 1999), while in the forests of the Wielkopolska region it was only 2.7 (n=15) (BEDNORZ & KOSIŃSKI 1997), when the average for the whole Wielkopolska region was 3.0 juveniles per successful nest (GLUTZ & BAUER 1993). In Russia, in the area near the River Don, the value of this index was also 3.3 (n=16) (SARYCHEV 1993) and was even higher 3.7 (n=104) in the States of Oregon and Idaho in the USA (STEENHOF et al. 1993). The high productivity of the population of Ravens nesting on pylons in open space is most probably a consequence of the fact that the nests on pylons are less exposed to destruction (see above) while the energy and time saved because of shorter flights to feeding grounds can be used for increasing the productivity of breeding pairs.

REFERENCES

BEDNORZ J. 1991. Die Wiederausbreitung des Kolkraben (*Corvus corax*) in Polen. [In:] D. GLANDT (ed.) – Der Kolkrabe (*Corvus corax*) in Mitteleuropa. Metelener Schriftenreihe Naturschutz, **2**: 29-35.

BEDNORZ J. 1997. Birds of the Wielkopolska National Park. Prace Zakł. Biol. i Ekol. Ptaków UAM, Poznań, **8**: 68 pp. [In Polish with English summary].

BEDNORZ J., KOSIŃSKI Z. 1997. Numbers, distribution, and breeding success of forest birds of prey and the Raven *Corvus corax* in the Wielkopolska National Park in 1992-1993. Not. orn., **38**(1): 27-41. [In Polish with English summary].

BEDNORZ J., KUPCZYK M., KUŹNIAK S., WINIECKI A. 2000. The Birds of the Wielkopolska Region. Poznań. [In Polish with English summary].

BIELIK V. P. 1989. Razmeshchenye i chislennost vranovykh ptits v Rostovskoy Oblasti. In: Vranovyje ptitsy v estestvennykh i antropogennykh landshaftakh: 41-43. Lipeck. [In Russian].

COOMBS F. 1978. The Crows. A Study of the Corvids of Europe. Batsford, London.

DYRCZ A., GRABIŃSKI W., STAWARCZYK T., WITKOWSKI J. 1991. The Birds of Silesia. Wrocław. [In Polish with English summary].

GLANDT D., JANSEN M. 1991. Zusammenfassung der Diskussionsbeiträge des Kolkraben-Symposiums in Metelen. In: Der Kolkrabe (*Corvus corax*) in Mitteleuropa. Metelener Schriftenreiche Naturschutz. **2**: 113-116.

GLUTZ U.N., BAUER K.M. 1993. Handbuch der Vögel Mitteleuropas. **13**/III. AULA – Verlag Wiesbaden.

GRINCHISHHIN T.J., SHHEMCHUK V.I. 1990. Pro chiselnist ta gnizduvanija kruka na zakhodi Ukraini. [In:] I. M. GORBAN, K. A. TATARINOV, M. V. KHIMIN (eds) – Ornitofauna zakhidnikh oblastei Ukraini ta problemi ëí okhroni: 14-17., Luck. [In Russian].

IVANOVSKIJ V.V., TISHECHKINA.K. 1989. Materialy k gnezdovoj ekologii vorona na severe Belorussii. [In:] Vranovyje ptitsy v estestvennykh i antropogennykh landshaftakh: 6-8. Lipeck. [In Russian].

JERMACZEK A., CZWAŁGA T., JERMACZEK D., KRZYŚKÓW T., RUDAWSKI W., STAŃKO R. 1995. The Birds of the Lubusian Region. Świebodzin. [In Polish with English and German summaries].

KACZMAREK S. 1999. Ptaki drapieżne i kruk *Corvus corax* w krajobrazie rolniczym okolic Śremu w latach 1998-99. Msc., Poznań. [In Polish].

KOCH A., SCHUSTER A., GLANDT D. 1986. Die Situation des Kolkraben (*Corvus corax* L.) in Mitteleuropa unter besonderer Berűcksichtigung einer Wiederansiedlungsmassnahme in Nordrhein-Westfalen. Z. Jagdwissenschaft, **32**(4): 215-228.

KONSTANTINOV V. M., LEBIEDIEV I. G. 1989. Izmenene prostranstvenno-etologicheskoy struktury populacij vranowykh pri vosrastanii antropogennykh vosdejstvij. [In:] Vranovyje ptitsy v estestvennykh i antropogennykh landshaftakh: 84-86. Lipeck. [In Russian].

KRIVICKIJ I. A. 1989. Vranovyje ptitsy Kharkovskoj Oblasti i Kharakter ikh urbanizacji. [In:] Vranovyje ptitsy v estestvennykh i antropogennykh landshaftakh: 130-132. Lipeck. [In Russian].

KRZYŚKÓW T. 1991. Ptaki drapieżne projektowanego Agroekologicznego Parku Krajobrazowego (Turew, Wielkopolska) w latach 1988-1989. Msc., Poznań. [In Polish].

LOREK G. 1993. Abundance of raptor and raven *Corvus corax* in the vicinity of Poniec (Wielkopolska, Western Poland). Przegląd przyrodniczy, **4**(2): 59-62. [In Polish with English abstract].

MUSCHIOL W. 1985. Hochspannungsmasten als „Horstbäume". Deutscher Falkenorden **1985**: 48-50.

PRILL H. 1982. Einige ökologische Aspekte beim Kolkraben im Verlauf seiner Ausbreitung. Orn. Rundbrief Mecklenburgs, **25**: 24-29.

RATCLIFFE D. 1997. The Raven. T & A D POYSER, London.

SARYCHEV V. S. 1993. Gnezdovanie vranovykh i khishchnykh ptic na oporakh wysokovoltnykh LEP. [In:] V. M. KONSTANTINOV (ed.) – Vranovyje pticy v antropogennom landshaftie **1**: 81-90, Lipeck. [In Russian].

SELLIN D. 1991. Die Bestandsentwicklung des Kolkraben (*Corvus corax*) in einem Dichtezentrum in Vorpommern. [In:] D. GLANDT (ed.) – Der Kolkrabe (*Corvus corax*) in Mitteleuropa. Metelener Schriftenreihe Naturschutz, **2**: 21-26.

STEENHOF K., KOCHERT M. N., ROPPE J. A. 1993. Nesting by raptors and common ravens on electrical transmission line towers. J. Wildl. Manage, **57**(2): 271-281.

STEGEMANN K. D. 1971. Kolkrabenbrut auf einem Hochspannungsmast in der Friedländer Grossen Wiese. Falke, **18**(2): 62-63.

ŚLEDŹ J. S. 1996. Kruk „inteligent". Przyr. pol., **1996**: 13. [In Polish].

WHITE C. M., TANNER-WHITE M. 1988. Use of interstate highway overpasses and billboards for nesting by the Common Raven (*Corvus corax*). The Great Basin Naturalist, **48**: 64-66.

ZAWADZKA D. 1996. Distribution, habitat selection, food and reproduction of the Raven (*Corvus corax*) in the National Park of Lake Wigry. Not. orn., **37**(3-4): 225-245. [In Polish with English summary].