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Breeding biology of the Hooded Crow *Corvus corone cornix* in Warta river valley (W Poland)

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Abstract. The study area (16 km^2) in "Ujście Warty" National Park, W Poland — was the valley of a lowland river at its confluence with the River Odra, covered by a mosaic of grassy vegetation and willow scrub. 111 breeding attempts were recorded during 2000–2002. The mean nest density (3.2 nests/km^2) was higher than that recorded by other authors in agricultural landscapes, but lower than in urban areas. The nest construction was adapted to fit young willow trees. The mean clutch size was similar to that recorded in other populations (4.43), but eggs were smaller (41.2 mm x 29.1 mm). The hatching success was lower (76%) in comparison with other studies, but the mean number of fledglings (2.15 per nest and 2.96 per nest in successful broods) was relatively high. The main reasons for losses were unhatched eggs, predators, starved nestlings and poor nest construction. We hypothesise that the smaller egg size and lower hatching success recorded in this population was due to unfavourable and unpredictable feeding conditions (floods) during the period of egg formation and egg laying. Later in the season, receding floodwaters laid bare areas suitable for foraging on invertebrates; waterfowl eggs also became readily available. Predation was low (lack of nonbreeding stock of Hooded Crow). As a result of good conditions during chick rearing, the overall reproductive output was relatively high in comparison with other populations.

Key words: Hooded Crow, *Corvus corone cornix*, breeding biology, breeding success, clutch size, egg size, „Ujście Warty" National Park

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INTRODUCTION

Majority of data on breeding biology of crows is limited to the Carrion Crow *Corvus corone corone* (e.g., Wittenberg 1968, Yom-Tov 1974, Tompa 1975, Richner 1992). The Hooded Crow, recently recommend by Knox et al. (2002) as a separate species *Corvus cornix*, has drawn much less attention. Studies focused exactly on the Hooded Crow were carried out in habitats regarded as secondary for this species, i.e. fishponds (Grabiński 1996), farmland (Sondell 1976, Loman 1977, 1980) or coast (Tenovuo 1963). The primary habitat for the Hooded Crow was probably lowland river valleys, but to date, none of investigations were placed in this habitat.

Aims of this paper were to describe breeding biology of Hooded Crow under conditions, we believe, are the primary for this species (i.e. lowland river valley), and to discuss how the breeding biology, especially breeding performance, differ between habitats.

STUDY AREA, MATERIALS AND METHODS

The study was carried out in the National Park "Ujście Warty" (52°34'N, 14°43'E) in Western Poland, on the Warta river at its estuary into the Odra river. This area is the wildfowl refuge of international importance (Grimmet & Jones 1989, Gromadzki et al. 1994). Moreover, it is under protection of the RAMSAR convention.

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The study plot (16 km^2) was located in western part of the Park, on the most wettest (partially permanently flooded) area of the Warta river estuary. This area is covered by a mosaic of herbaceous vegetation, dominated by Reed-canary Grass *Phalaris arundinacea* and arborescent vegetation, consisting exclusively of old willows *Salix* sp. and willow shrubs. Additionally, on this area occur shallow lakes, old river-beds, ditches and dikes. The characteristic feature of the Park's area is very changeable and unpredictable water-table. Details of the study area can be found in works of Chmiel et al. (2000) and Choiński (2000).

The nests searches begun in the beginning of April, when willow trees were still without foliage. The majority of nests were found during this time, others were detected on the basis of bird's behaviour. Crows were not conspicuous near their breeding sites and nests could be easily localized by observing them from some distance. When climbing the tree was possible, nests were inspected directly. Inaccessible nests were checked by means of a mirror attached to the aluminium tube.

The data were collected during the breeding seasons 2000–2002 and come from 633 inspections of 111 nests. The mean inspection rate was 5.7 visits per each nest per season. In some cases it was not possible to acquire the complete set of information for each nest, and thus sample sizes may differ in different analyses. The complete data, from egg laying up to fledging or failure, were obtained for 103 nests.

In 2000 and 2001, during the first intrusive visit, measurements of a nest (height, depth and diameter) were taken. Also, information about nest construction and nest material were collected. Several characteristics of the nest site were measured, such as the height of a nest above the ground and distance from the nests to the top of a tree.

Egg length and breadth were measured to the nearest 0.1 mm using the sliding callipers. Totally, during 3 seasons, 206 eggs from 47 nests were examined. Only eggs from complete clutches were included in the analysis.

Data processing and analysis

Nest coordinates were transferred from a GPS receiver to a GIS system. Geographic coordinates (WGS 84) were transformed into a geodetic system "Pulkovo 1942" to allow distance computations. The distance to the nearest neighbouring nest was used as a measure of the local nest density.

The length of breeding season was defined as the time lapsed from the date of the earliest egg was laid in the population till the date of the last chick was hatched. For each nest the relative date of nest initiation was calculated as residual from yearly population median.

Egg volume index was calculated from the length and breadth using the formula (Hoyt 1979):

$$V = 0.51 \times L \times B^2/1000$$

where V is volume (in cm^3), L is length and B is egg breadth (in mm). An index of egg elongation was calculated by dividing L by B.

Incubation time was defined as the time interval between the date when the first egg was laid and the date of hatching. Hence, the time was actually longer than the true incubation time. We assumed that crows lay one egg per day (Cramp 1998).

Hatchability was defined as the ratio of the number of nestlings hatched, to the number of eggs laid. The number of nestlings was estimated basing on the first inspection of a nest after hatching. The number of fledglings was defined as the number of nestlings present in the nest during the last visit before fledgling, providing that they were older than 25 days, and that the next inspection did not show any evidence of the nest failure. Nests were considered as successful, when at least one juvenile fledged. Proportion of nests surviving incubation was defined as nesting success and proportion of successful nests (i.e. with at least one juvenile fledged) as breeding success.

Throughout the text, we use the abbreviation CL for the 95% confidence limits.

RESULTS AND DISCUSSION

Nest density

The mean nest density (Table 1) on our study plot (3.2 nests/km^2) was higher than recorded in agricultural landscape in Sweden (study plot: 21 km^2) — 1.9 to 2.5 pairs/km^2 (Loman 1975, 1980), Slovenia (study plot: 13.7 km^2) — 1.5 pairs/km^2 (Vogrin 1998) and Norway (study area: 7.1 km^2) — 2.0 pairs/km^2 (Parker 1985) as well as on fish ponds in Poland

Table 1. Number of nests, nest densities and mean distance to the nearest neighbour (95% CL) in the studied population.

Year	No. of nests	Pairs/km^2	Distance (m)
2000	45	2.8	323 (263–383)
2001	62	3.9	291 (256–325)
2002	46	2.9	323 (276–370)
Total	153	3.2	310 (284–336)

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(study area: 25 km^2) — 1.7 pairs/km^2 (Grabiński 1996). In contrary, densities recorded during our study are lower than in Israel at the Mediterranean Sea (study plot: 3.5 km^2) — 18 pairs/km^2 (Erez & Yom-Tov 1995) and in urban population in Switzerland (Richner 1992), where in area of 0.86 km^2 mean concentration reached up to 36 pairs per km^2.

Location of nests

Crows built their nests on White Willow *Salix alba* and old specimens of the Crack Willow *Salix fragilis*. Nests were placed in forks of branches, by the trunk, in upper part of a tree. The average height of nests above the ground (Fig. 1) was 9.90 m (CL: 9.36–10.44, n = 156, range 4–19) and no significant differences were found between breeding seasons (Kruskal-Wallis test, H = 1.47, p = 0.480). The average distance from nest to the top of a tree (Fig. 1) was 2.43 m (CL: 2.23–2.62, n = 156, range 1–7), also without any differences between years (K-W test, H = 3.72, p = 0.155).

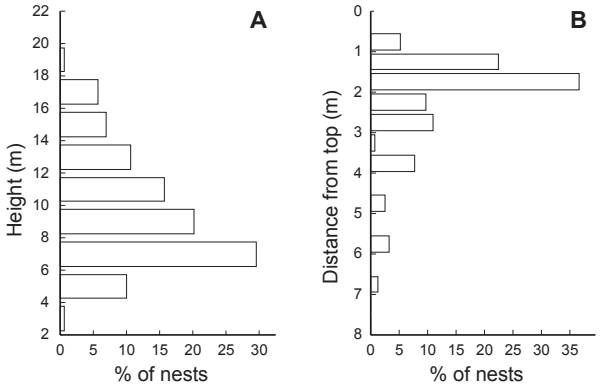


Fig. 1. Location of nests on trees (A — height above the ground (N = 156), B — distance to the top (N =156). Data from all years were pooled.

Nest construction and its measurements

Nests were built from two distinct layers. The outer layer contains dry and fresh sticks, whereas inner layer was build from dry bark and dry grass. Other nest components recorded in crow nests were: fur (88.1% of all nests checked), down (66.7%), feathers (61.9%), fresh grass (19.0%) and man-made materials such as string, fabric, foil and paper. The mean height of the nest was 18.8 cm (95% CL: 18.0–19.7 cm, min.–max.: 14–25 cm, Table 2).

Timing of breeding season

The breeding seasons in 2000 and 2001 lasted for around 82 days. In 2002, the breeding season was shorter and lasted for 70 days. The median date of laying the first egg (Fig. 2) varied from 9.5 (8/9 April) in 2000 to 14.0 (13 April) in 2002 and was not significantly different between years (Median test χ^2 = 2.23, df = 2, p = 0.337). In 2002 breeding season started 12 days later than in remaining ones. The majority of females laid eggs at the beginning of each breeding seasons (Fig. 3). During three breeding seasons no replacement clutches were recorded.

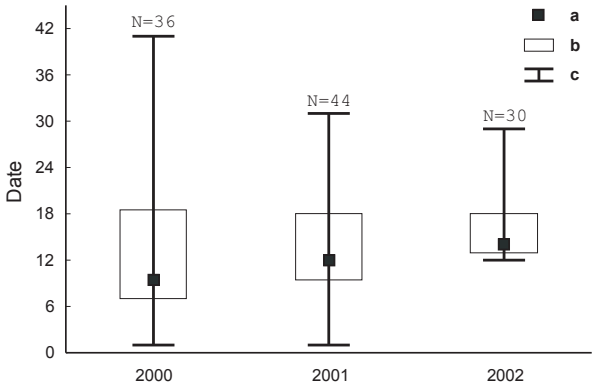


Fig. 2. Median dates (number of days after 31 March) of laying the first egg. a — median, b — 25%–75%, c — min-max.

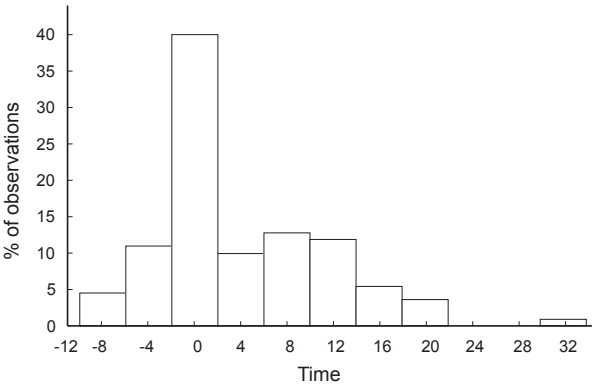


Fig. 3. Relative dates (residuals from the yearly median) of laying the first egg (all data pooled, N = 110).

Clutch size

Mean clutch size was 4.43 (CL: 4.24–4.62, n = 107) and ranged from 2 to 9. Modal clutch size was 5 (Fig. 4). We found significant differences in clutch size between years (K-W test, H = 6.39, p = 0.041). Mean clutch size recorded in 2002 was smaller than noted in years 2000 and 2001 (Fig. 5).

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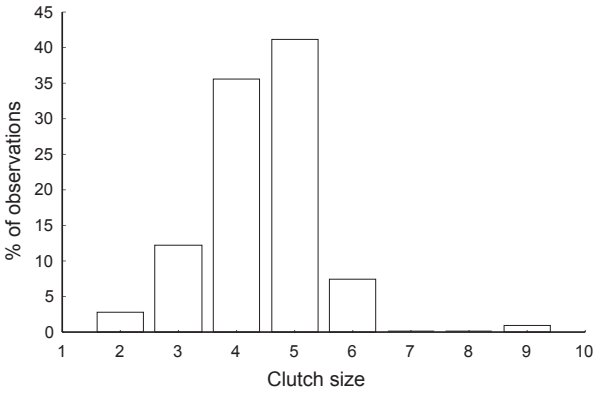


Fig. 4. Frequency distribution of clutch size (N = 107).

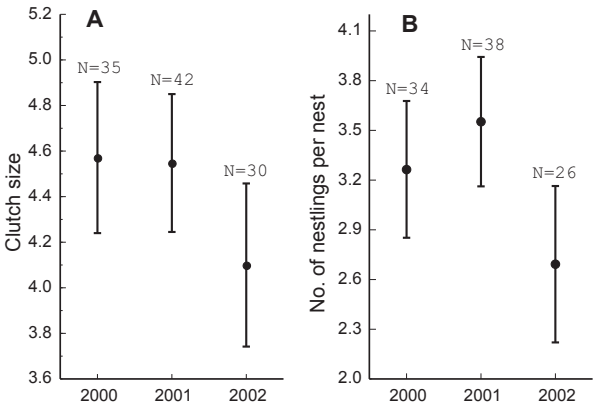


Fig. 5. Mean clutch size (A) and mean number of nestlings per nest with hatching success (B). Means with 95% confidence limits.

The clutch size recorded in the present study falls into the range reported by other authors. The smallest clutches of 4.1 eggs were reported in Switzerland (Tompa 1975) and in Scotland (Yom-Tov 1974, Picozzi 1975). In Scandinavian populations, the mean clutch size was reported from 4.3 (Tenovuo 1963, Sondell 1976, Loman 1980) to 4.7–4.8 (Tenovuo 1963, Parker 1985). In central Europe clutch size was 4.4–4.8 (Wittenberg 1968, Grabiński 1996, this study).

Eggs measurements

None of egg measurements (Table 3) differed significantly between years. Additionally, no significant correlation between mean egg volume and nest initiation date was found, neither correlation between mean egg volume and clutch size. Significant correlation between mean egg length and mean egg breadth was found ($r = 0.67$, $p = 0.001$, $n = 47$).

Dimensions of eggs reported here are smaller than that noted by Rofstad & Sandvik (1985) as well as Grabiński (1996), where the mean measurements were 41.9 mm x 29.4 mm, 18.4 cm^3 and 41.8 mm x 29.4 mm, 18.1 cm^3 for length, breadth and volume, respectively.

Incubation time and hatchability

Incubation time lasted on average for 20.9 days (CL: 20.4–21.3, n = 16) and varied from 20 to 22 days. There was no significant correlation between time of incubation and clutch size ($r = 0.205$, $p = 0.446$, $n = 16$).

Table 2. The comparison of nest measurements (cm) in European populations of the Hooded Crow.

Locality	N	Diameter		Min–Max	N	Depth		Min–Max	Source
		Mean	95%CL			Mean	95%CL		
Finland	57	19.8	19.6–20.0	18–22	52	12.6	12.3–12.9	10–15	Tenovuo (1963)
Sweden	29	18.5	18.2–18.8	17–20	29	10.4	9.9–10.8	7–13	Loman (1975)
Poland	31	19.4	18.7–20.1	15.5–25.0	31	10.35	9.6–11.0	8–15	Kulczycki (1973)
"UW"	42	18.3	17.7–18.8	15–22	42	11.0	10.5–11.4	9–15	this study

Table 3. Means and ranges of egg measurements.

Measurement	Clutch	95% CL	Range (clutch)	Range (eggs)
N	47	47	47	206
Length (mm)	41.17	40.55–41.79	35.98–44.25	34.70–46.70
Breadth (mm)	29.05	28.76–29.33	26.78–31.44	26.20–32.30
Volume (cm^3)	17.77	17.25–18.30	13.17–22.28	12.15–24.31
Elongation	1.42	1.40–1.44	1.29–1.57	1.27–1.68

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The incubation times noted by different authors are 18–19 days (Loman 1980, Rofstad & Sandvik 1985, Snow & Perrins 1998). These values are not directly comparable with our estimates, since we defined the incubation time as the time between laying the first egg and the time of hatching. However, Loman (1980) reports that crows start incubation when there are still two eggs to be laid. After this adjustment, our results are comparable with that recorded in other studies. Also Grabiński (1996) reports, the incubation time (estimated in the same way as in the present study) varied between 19 and 23 days.

During the three-year study, total number of eggs laid in inspected nests was 467. From this, to the end of incubation, survived 416 eggs (89.1%; CL: 85.9–91.8). Proportions of surviving eggs were similar during the consecutive years, and differences between them were not significant (χ^2 = 4.90, df = 2, p = 0.087).

Overall hatchability was 76.0% (CL: 71.6–0.80, n = 316) and was not different among breeding seasons (χ^2 = 1.05, df = 2, p = 0.593). This value is lower than reported by Tenovuo (1963), Wittenberg (1968), Loman (1980), were hatchability was higher than 88%. Moreover Parker (1985), Grabiński (1996) as well as Erez & Yom-Tov (1995) showed that the hatchability was 84.1%–86%. However, significant differences in hatchability among different clutch size classes were found (χ^2 = 11.64, df = 3, p < 0.01, Fig. 6).

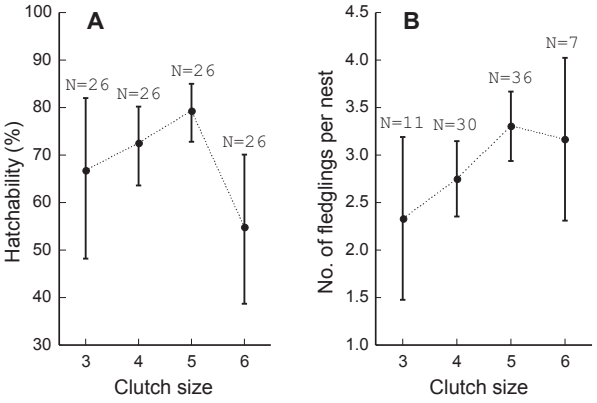


Fig. 6. Hatchability (A) and mean number of fledglings per successful nest (B) in relation to clutch size. Means with 95% CL.

Number of nestlings

The mean number of nestlings per all inspected nests was 2.92 (CL: 2.64–3.21, n = 108) and 3.22 (CL: 2.97–3.47, n = 98, range 1–5) per successful nests. As a consequence of yearly differences in clutch size, the mean number of nestlings was also different among breeding seasons (K-W test, H = 6.99, p = 0.030). Similarly to the clutch size the same pattern was observed: in 2002, the number of nestlings was lower than in 2000 and 2001 (Fig. 5).

The mean number of hatched nestlings per nest with hatching success was lower than that obtained in other countries (3.7–3.9, Olstad 1935,Yom-Tov 1974, Loman 1980).

Number of fledglings and breeding success

During the three-year study, 70% (CL: 65%–75%) of all nestlings (316) fledged. This proportion differed significantly between years (χ^2 = 17.60, df = 2, p < 0.001). The highest percentage of nestlings that survived till fledgling was recorded in 2000: 80% (CL: 71%–87%, n = 89), then in 2002: 78% (CL: 67%–87%, n = 55) and 2001: 58% (CL: 49%–62%, n = 78).

The mean number of fledglings per all inspected nests was 2.15 (CL: 1.84–2.47, n = 103) and 2.96 (CL: 2.71–3.21, n = 75, range 1–5) per nest with breeding success. The number of fledglings per all inspected nests was not different among breeding seasons (Kruskall-Wallis test, H = 4.15, p = 0.126). The mean number of fledglings calculated per nests with breeding success only, was also independent of the year (K-W test, H = 1.04, p = 0.595).

The mean number of fledglings in all visited nests as well as the mean number of fledglings in successful nests, were relatively high in comparison to results obtained in other populations (Table 4).

The shape of relationship between clutch size and measures of reproductive performance (hatchability and number of fledglings, Fig. 6)

Table 4. Mean number of fledglings in different populations; *studies, where nestlings above 3 weeks were regarded as fledglings.

Place of study and source	All nests		Nests with success	
	N	Mean	N	Mean
Norway (Parker 1985)	26	3.2	23	3.6
Germany (Wittenberg 1968)	—	0.9*	47	3.0*
Scotland (Yom-Tov 1974)	22	1.2*	10	2.6*
Scotland (Picozzi 1975)	—	1.7	47	2.9
Sweden (Sondell 1976)	200	2.6	174	3.0
Sweden (Loman 1980)	89	2.0*	118	2.8*
Israel (Erez & Yom-Tov 1995)	41	1.7	25	2.2
Poland (Grabiński 1996)	254	0.72	65	2.8
Poland (this study)	103	2.15	75	2.96

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suggests existence of an optimal clutch size of 5 eggs. This result is interesting in the context of "insurance policy" hypothesis (Lundberg 1985, Forbes 1990, 1991, Konarzewski 1993). It states that parents invest in additional eggs, in order to compensation subsequent, possible losses. They can results either from unfertilization of individual egg, infection or mechanical damage of embryo. However, it should be treated carefully, since the differences in mean number of fledglings among different clutch size classes were only marginally significant (K-W test, H = 7.17, p = 0.067, Fig. 5).

For all years of the study, breeding success (the probability of rearing at least one fledgling) was 0.73 (CL: 0.63–0.81, n = 103). Proportions of successful nests were not different between years (χ^2 = 4.13, df = 2, p = 0.127).

Breeding success in population studied was lower than recorded by Parker (1985), Tompa (1975) and Sondell (1976), where the estimates were 88%, 87% and 86%, respectively. On the other hand, we noted higher value than Loman (1980), Erez and Yom-Tov (1995), Yom-Tov (1974), Wittenberg (1968) and Grabiński (1996). Their estimates were: 61%, 48.9%, 45%, 30% and 23.1%, respectively.

Causes of nests failures

During three years of the study, 28 nests (27.2% of all controlled nests) failed to produce fledglings. Among nests completely destroyed, the most important cause (Table 5) was predation by American Mink *Mustela vison* (21% of all destroyed clutches). Others predators were Hooded Crow (14%) and Common Heron *Ardea cinerea* (7%). Besides predation, a very important cause of nest failures was its falling down due to wrong construction (18%). In two cases (7%), fledglings were found dead after a heavy rain. In 9 cases (33% of nests) the reasons of brood losses were unknown.

The main cause of total nests failures in Grabiński's (1996) research was marten *Martes* sp., which destroyed 42.6% of all destroyed broods. In his study predators were responsible for 89.4 % of all destroyed clutches. Loman (1980) considers as the main cause of nest failures predators like: domestic cat, Goshawk *Accipiter gentilis* and Buzzard *Buteo buteo*.

Several authors stressed importance of crows, both from non-breeding (Wittenberg 1968, Yom-Tov 1974, Tompa 1975), and breeding fraction (Tenovuo 1963, Grabiński 1996) as an important factor that may limit breeding success. In studies mentioned above, the nest losses due to predation by crows vary between 20% and 45% of all destroyed nests. In contrary, in our study, predation from conspecifics was relatively low. The cases of cannibalistic predation were recorded in 2001, in conditions of high nest density and in 2002, the only season when ca. 20 individuals of non-breeders were present. However, it is not clear if the losses were caused by breeders or non-breeders.

Contrary to other populations, the important cause of failures (25% of unsuccessful nests) was bad location or construction of a nest. Such nets

Table 5. Causes of nests failures.

Causes	Eggs		Nestlings		Clutches	
Total failures	N = 467	(%)	N = 316	(%)	N = 103	(%)
Mustela vison	16	(3.4)	7	(2.2)	6	(5.8)
Corvus cornix	15	(3.2)	—	(—)	4	(3.9)
Ardea cinerea	6	(1.3)	2	(0.6)	2	(1.9)
Predators total	37	(7.9)	9	(2.8)	12	(11.7)
Bad location or construction of a nest	2	(0.4)	11	(3.5)	5	(4.9)
Severe weather conditions	—	(-)	8	(2.5)	2	(1.9)
Unknown	8	(1.7)	10	(3.2)	9	(8.7)
All total failures	47	(10.1)	38	(12.0)	28	(27.2)
Partial failures	N = 333	(%)	N = 255	(%)	N = 75	(%)
Unhatched eggs	71	(21.3)	—	(—)	47	(62.7)
Eggs disappeared during incubation	5	(1.5)	—	(—)	6	(8.0)
Eggs destroyed accidentally during inspection	2	(0.6)	—	(—)	2	(2.7)
Bad location or construction of nest	—	(—)	2	(0.8)	2	(2.7)
Starved nestlings	—	(—)	29	(11.4)	24	(32.0)
Disease of plumage	—	(—)	2	(0.8)	1	(1.3)
All partial failures	78	(23.4)	33	(12.9)	—	—

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fail down during windy weather. Only Grabiński (1996), during the six-year study, recorded three cases when nests were thrown off the trees.

The partial losses consisted mainly of unhatched eggs (21.3% of eggs laid in nests with success, which survived to the end of incubation) and starved nestlings (11.4% of all nestlings in nests with success). Other marginal causes of partial failures were: robbing single eggs by crows, bad location or construction of nest and disease of plumage. Considering all successful nests, 111 eggs (33.3%) failed to produce fledglings. This value is lower than that recorded by Grabiński (1996), where 40.7% of eggs laid in successful nests did not give any fledgling.

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STRESZCZENIE

[Biologia rozrodu wrony siwej w Parku Narodowym "Ujście Warty"]

Badania prowadzone były na obszarze Parku Narodowego „Ujście Warty" w latach 2000–2002. Powierzchnia badawcza (16 km^2) znajdowała się w obrębie regularnie zalewanej doliny rzecznej, porośniętej mozaiką roślinności szuwarowej i zarośli wierzbowych. W trakcie badań przeprowadzono 633 kontrole gniazd i zebrano dane dotyczące 111 lęgów.

Średnie zagęszczenie par lęgowych wyniosło 3.2 pary/km^2 (Tab. 1). Długość sezonu lęgowego (czas od złożenia pierwszego jaja do wylotu ostatniego podlota w danym sezonie lęgowym) wynosiła około 82 dni w roku 2000 i 2001 oraz 70 dni w roku 2002. Gniazda zakładane były przeciętnie między 9 a 13 kwietnia. Mediana daty złożenia pierwszego jaja nie różniła się między latami (Fig. 2). Większość par zaczynała lęgi na początku

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sezonu lęgowego (Fig. 3), nie odnotowano lęgów uzupełniających.

Średnia wysokość usytuowania gniazda nad ziemią wyniosła 9.90 m., zaś średnia odległość gniazda od szczytu drzewa wyniosła 2.43 m (Fig. 1). W obydwu przypadkach, średnie wartości nie różniły się między sezonami badań. Na wyściółkę gniazd składały się: sierść (88% sprawdzonych gniazd), puch (67%), pióra (62%), świeża trawa (19%) i różnego rodzaju materiały takie jak: sznurek, tkanina, folia i papier.

Średnia wielkość zniesienia wyniosła 4.43 (zakres: 2–9). Najczęściej notowano lęgi o 5 jajach (Fig. 4). W roku 2002 zniesienia były mniejsze niż w pozostałych latach (Fig. 5). Inkubacja, liczona od momentu złożenia pierwszego jaja do wylucia się pierwszego pisklęcia w lęgu, trwała średnio 20.9 dni (zakres: 20–22). Łącznie w trakcie 3 letnich badań, wrony złożyły 467 jaj, z czego do końca inkubacji dotrwało 416 (89.1%). Proporcje jaj, które przetrwały do końca inkubacji nie różniły się istotnie między latami. Wykluwalność wyniosła 76.0% i nie różniła się między sezonami gniazdowymi. Lęgi o 6 jajach charakteryzowały się najniższą wykluwalnością (Fig. 6). Średnia liczba piskląt na każde kontrolowane gniazdo wyniosła 2.92 oraz 3.22 na gniazdo z sukcesem klucia. Ogółem, liczba wszystkich piskląt wyniosła 316, z czego 222 (70%) wyleciało z gniazd: 80% w roku 2000, 58% w roku 2001 i 78% w roku 2002. Średnia liczba podlotów wyniosła 2.15 w przeliczeniu na każde kontrolowane gniazdo oraz 2.96 na gniazdo z sukcesem. W obydwu przypadkach różnice między latami nie były istotne. Wykluwalność oraz liczba podlotów, wskazują, że optymalną wielkością lęgu było 5 jaj (Fig. 6). Wynik ten jest interesujący w świetle hipotezy „polisy ubezpieczeniowej" (Lundberg 1985, Forbes 1990, 1991, Konarzewski 1993) wg której złożenie dodatkowych jaj ma rekompensować ewentualne przyszłe straty. Razem, dla wszystkich lat badań, prawdopodobieństwo wylotu przynajmniej jednego młodego z gniazda wyniosło 0.73. Proporcje gniazd z sukcesem nie różniły się między latami badań. Ogółem, 28 gniazd (27.2% kontrolowanych gniazd) nie dało żadnego podlota (Tab. 5). Przyczynami całkowitych strat gniazdowych były: norka amerykańska, wrona siwa i czapla (Tab. 5). Innym ważnym czynnikiem obniżającym sukces gniazdowy było złe usytuowanie i wadliwa konstrukcja gniazda oraz złe warunki pogodowe (Tab. 5). Na straty częściowe złożyły się niewyklute jaja i zagłodzone pisklęta. Ogółem 111 jaj (33.3%) złożonych w gniazdach z sukcesem nie dało żadnego podlota (Tab. 5).

Dolina zalewowa — teren gdzie prowadzono badania reprezentuje prawdopodobnie pierwotny typ środowiska wron. Specyficzne cechy tej populacji, różne od innych badanych dotąd, wskazywać mogą na kierunki przystosowań populacji wrony siwej w zmieniających się szybko warunkach środowiska antropogenicznego. W porównaniu do populacji krajobrazu rolniczego, stwierdziliśmy wyższe zagęszczenia, natomiast zdecydowanie niższe, niż w warunkach miejskich. Specyficzna konstrukcja gniazda wynika z budowania ich na młodych i niewysokich wierzbach. Straty wynikające z błędnej konstrukcji gniazda, nie notowane w innych warunkach, prawdopodobnie powodują silną konkurencję o miejsca gniazdowe.

W porównaniu do innych populacji, mniejsza wielkość jaj oraz niższa wykluwalność, a także wpływ warunków danego roku na wielkość lęgu, wynikają, naszym zdaniem, z niekorzystnych i zmiennych warunków pokarmowych wczesną wiosną. Później, ustępująca woda odsłania dogodne żerowiska, i liczne są lęgi ptaków wodnych. Niewielka presja drapieżnicza, wynikająca między innymi, z braku stada nielęgowego, jest dodatkowym korzystnym czynnikiem. Efektem bardzo dobrych warunków w okresie karmienia młodych jest wysoka przeżywalność piskląt i ogólny wysoki sukces reprodukcyjny.

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