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Habitat structure and breeding parameters of the White Stork *Ciconia ciconia* in the Kolno Upland (NE Poland)

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Abstract. An investigation of the habitat structure in nesting territories and the breeding success of the White Stork population in an agriculture landscape of the Kolno Upland adjoining the Biebrza river valley was conducted in 1994–1997. From 85.7% (1997) to 96.8% (1994) of nests were occupied by pairs of storks. The percentage of nests without nestlings was exceptionally low (0%–5.7%). Broods with three nestlings made up the highest proportion, c. 41.7–44.6 % of all the nests occupied by pairs. The average number of nestlings in nests with fledged young was lowest in 1997 (2.53); in 1994–1996 it had been significantly higher (2.84–3.06). Pairs with nests sited up to 100 m from the nearest wet meadows in the river valley have a higher average breeding success in comparison with the pairs whose nests are sited farther away. The White Stork population tended to inhabit the area near the edge of the river valley. In the nesting territories (an area of 1 km radius around the nest site) cereal crops, meadows, green crops, pastures and wet meadows constituted the greatest proportion of the habitat structure. The proportions of these habitat types varied significantly between the nests. There was a significant positive correlation between the number of nestlings raised and the proportion of wet meadows, peat bogs and water bodies in the nesting territories.

Key words: White Stork, *Ciconia ciconia*, habitat structure, breeding success, nesting territories

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INTRODUCTION

Among the topics concerning the White Stork that require closer attention are the mechanisms by which the sizes of populations are regulated. In the 1970s and 1980s the species suffered a serious decline in numbers in many parts of its range; only in a few regions have White Stork populations shown significant long-term fluctuations or a tendency to increase in recent years (Profus 1993, 1994, Jakubiec & Guziak 1998, Peterson et al. 1999).

Intraspecific competition and its influence on reproduction in the White Stork population have been relatively well described by Wojciechowski & Ogrodowczyk (1978), Górski et al. (1980), Wojciechowski (1992), Wojciechowski & Markowski (1992) and Ptaszyk (1994). The evident competition observed in the last ten years is thought to be the result of a crisis of biotope conditions (Wojciechowski 1992, Wojciechowski & Markowski 1992).

Some authors consider food to be the deciding factor as regards breeding success, and hence, the trends in population size (e.g. Mrugasiewicz 1972, Górski et al. 1980, Profus 1986, Struwe & Thomsen 1991). Dallinga & Schoenmakers (1989) show that the changes in the numbers of storks in Europe since the 1950s have generally been related to food resources. In the Obra river valley (Western Poland), for example, the total numbers of fledglings produced in the local stork population were correlated with the density of the Common Vole *Microtus arvalis* (Tryjanowski & Kuźniak 2002).

The White Stork's home range, its use of its foraging habitat, and the impact of the feeding habitat on dietary composition were investigated by Pinowska

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& Pinowski (1989), Pinowski et al. (1991), Struwe & Thomsen (1991), Dziewiaty (1992), Schneider-Jacoby (1993) and Ożgo & Bogucki (1999).

However, little attention has been paid to the biotope structure. Like other environmental factors, this can affect both the mechanisms of number regulation and the intensity of intraspecific competition. The study of this issue is addressed in the present paper.

STUDY AREA

Observations were carried out in part of the Kolno Upland (Jedwabne district, Łomża province, NE Poland) adjoining the Biebrza river valley and in part of the valley itself within the southern basin of the river. The study area included c. 2 km wide stretches of land on either side of the river, between the villages of Ruś — at the confluence of the Biebrza with the Narew — and Klimaszewnica.

The main part of the study area was situated in Kolno Upland on the western, elevated, riverside of Biebrza. It is a mosaic-like farmland landscape with several small villages, undeveloped agriculture on poor sandy soils. Main land use form include small arable fields with various crops, orchards and fallow land. Patches of woodland meadows, pastures and forests lie usually along the small tributaries of the Biebrza.

The eastern part of the study area included some villages and farmland but is mainly the Biebrza flood plain. Its vegetation consists of wet meadows (*Molinio-Arrhenterea*), some of which are mown for hay or grazed by horses and cattle, and of sedge moor (*Caricetum*). In places willow bushes (*Salix* sp.) grow among the sedges. In the river valley there are many ox-bow lakes and water-filled depressions. In spring, the flood plain of the Biebrza is inundated, in places up to a distance of c. 2 km from the river channel. The floodwaters recede late, usually in June sometimes even in early July. In a few places along the edge of the river valley there are small forests and peat bogs.

METHODS

The fieldwork was conducted in July of the years 1994–1997. 20 villages in 1994–1995 and 24 in 1996–1997, located on either side of the river and the area of valley were monitored.

During the censuses the location of nests, the number of occupants (parent birds and young, if any) and the breeding success was noted for each one. The international standard symbols (Schüz 1952, Jakubiec 1985) were used for describing the White Stork's parameters of reproduction:

HO — unoccupied nest,
HE — nest occupied by one bird,
HPa — nest occupied by a pair,
HPo — nest occupied by a pair, no breeding success
HPm1–5 — nest with 1, 2…5 nestlings,
JZG — number of nestlings in all nests,
JZa — average number of nestlings in HPa type nests,
JZm — average number of nestlings in HPm type nests.

For all nests in 1996 and 1997, the following habitats were distinguished and mapped in an area of 1 km radius around the nests: 1) peat bog, wet meadows, 2) green crops, pastures, 3) root-crops, 4) cereal crops, 5) woodlands, 6) water bodies, 7) built-up areas and roads.

The 1-km radius territory established in this study seemed optimal for the analysis of the formulated problem, as the biotopes favourable to the White Stork were located close to the occupied sites and the study area was optimal for the species. Evidence for this was provided by the high reproduction parameters in the population (JZa > 2.3 and JZm > 2.5). For foraging, the birds most often penetrate the area close by the nest (Löhmer et al. 1980, Ożgo & Bogucki 1999). According to Ożgo & Bogucki (1999), the actual geometric centre of the White Stork's feeding territory was some 400 m away from the nest; moreover, 53% of feeding areas were up to 800 m away. Alonso et al. (1994) showed that White Storks foraged mainly within a radius of 1300 m around the nest, and Dziewiaty (1992) in Lower Saxony noted that 80% of foraging sites were located up to 1 km from the nest.

Depending on the type of the habitat, the distance of foraging sites from the nest can vary. Pfeifer (1989) showed that in habitats sub-optimal for the White Stork only 35% of foraging sites lay within 1 km of the nest. Similarly, Struwe & Thomsen (1992) recorded that 62% of stork feeding areas were situated within a radius of 2.5 km from the breeding colony. However, the mean breeding success of these populations was very low: JZa = 1.2–1.5. In optimal habitats, the stork's feeding area lies much closer to the nesting sites (Dziewiaty 1992, Alonso et al. 1994, Ożgo & Bogucki (1999).

To explain the level of breeding success as defined by the number of fledglings, the step-

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wise linear multiple regression method was used (Sokal & Rohlf 1995). In the regression models the following characteristics were used as independent variables: the surface area (%) of wet meadows (P1), green crops (P2), root crops (P3), cereal crops (P4), woodlands (P5), water bodies (P6), built-up areas and roads in the vicinity of the nest (P7), year of studies (Year), distance to the nearest nest (Dist. 1), distance to the nearest nest with breeding success (Dist. 2). Additionally, the variables P1–P7 were inserted in the regression models in the logarithmic /ln (1+x)/, square and arc sin transformations, in order to find possible curvilinear relations besides the linear dependencies.

The General Regression Model was based on Mallow's Cp value criterion for the best-subset procedures ensured with sigma restriction of variables representing predictors. The model was then selected to yield a minimum value of the criterion, or a value that was acceptably small. The logistic binary regression model was used to explain the relationship between the breeding success of the White Stork and the structure of habitats in nesting territories (Afifi & Clark 1990). One level (binary value 0) represents pairs without breeding success (HPo), the other one (binary value 1) nests with nestlings (HPm1–5).

The differences in the proportions of the specified habitat types within the territories between the 1996 and 1997 seasons, and between the different types of nests were tested by ANOVA models for the arc sin transformed data. The ANOVA were used to test the variability of the level of breeding success in relation to the distance of nests to the edge of the Biebrza valley.

All the calculations were performed using SPSS PC+ and STATISTICA 6.0 software.

RESULTS

Characteristics of the population studied

62 White Stork nests were found in the area covered by the census in 1994, and 95 nests in 1996. Most of them were sited in built-up areas. In some villages particularly large numbers of nests (12–15) were clustered together. A very small number of nests had been constructed on trees or haystacks, a long way from the villages.

In this White Stork population, the numbers of nests occupied varied from year to year. As compared with 1994–1996, a somewhat lower proportion of nests in 1997 was occupied by pairs of birds (HPa) or by single storks (HE), and the proportion of unoccupied nests (HO) was higher (Table 1).

Broods with three (HPm3) nestlings made up the highest proportion of nests with breeding success (Table 2). In 1994 the proportions of HPm4 and HPm5 were high, while in 1995–1997 the proportion of broods with two (HPm2) nestlings among the nests with differing breeding success was also high (Table 2). In 1997 there were no nests with five offspring (HPm5); moreover, a remarkably low proportion of broods with four young (HPm4), and an increase in the frequency of nests with one nestling (HPm1) were observed (Table 2). This situation was reflected by the number of fledglings. The breeding success measured by the JZm and JZa indices was also higher in 1994–96 than in 1997 (Table 2).

The average breeding success of pairs with nests located at a distance of less than 100m to the nearest wet meadows in the river valley was higher in comparison with those pairs whose nest site was located farther away (ANOVA, $F = 2.375$, $p = 0.022$; Tukey test). Storks did indeed tend to

Table 1. Results of White Stork nest census. Data from 24 (20*) villages.

Parameters	1994*	1995*	1996	1997	Mean per year
	% (n)	% (n)	% (n)	% (n)	% (n)
Nests:					
unoccupied (HO)	–	10.0 (7)	8.4 (8)	13.1 (11)	7.9 (6.5)
occupied by one bird (HE)	3.2 (2)	1.43 (1)	4.2 (4)	1.2 (1)	2.5 (2.9)
occupied by a pair (HPa)	96.8 (60)	88.6 (62)	87.4 (83)	85.7 (72)	89.6 (69.25)
total number (HO + HPa + HE)	62	70	95	84	
Breeding success:					
nests occupied by a pair, no breeding success (HPo)	–	5.7 (4)	3.2 (3)	4.8 (4)	3.4 (2.75)
nests with breeding success (HPm)	96.8 (60)	82.9 (58)	84.2 (80)	81.0 (68)	86.2 (66.5)

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Table 2. Productivity parameters of the White Stork population studied. Data from 24 (20*) villages.

Parameters	1994*	1995*	1996	1997	1994–1997	
	n	n	n	n	n per year	%
Pairs with fledged young						
HPm1	1	4	3	6	3.5	5.3
HPm2	11	15	25	25	19.0	28.9
HPm3	25	26	37	32	30.0	45.6
HPm4	14	10	12	5	10.25	15.6
HPm5	6	3	3	–	3.0	4.6
Fledged young (JZG)	184	167	227	172	–	
Young per pair (JZa)	3.06	2.69	2.73	2.39	2.72	
Young per pair with fledged young (JZm)	3.06	2.88	2.84	2.53	2.83	

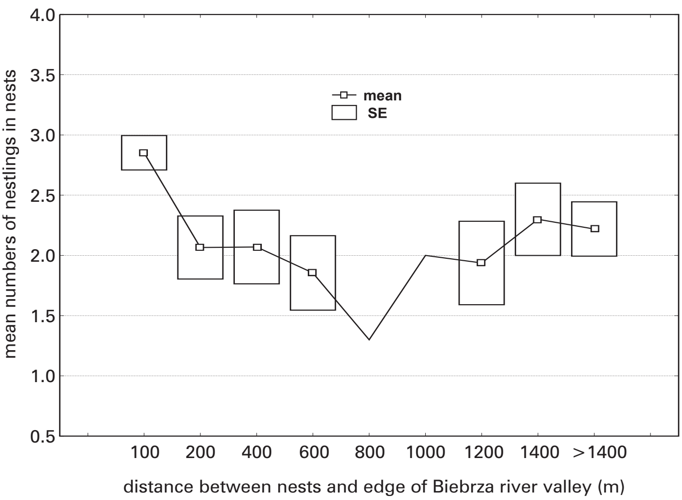

Fig. 1. Relationship between breeding success (average number of fledglings) and distance between the nest sites and the edge of the river valley.

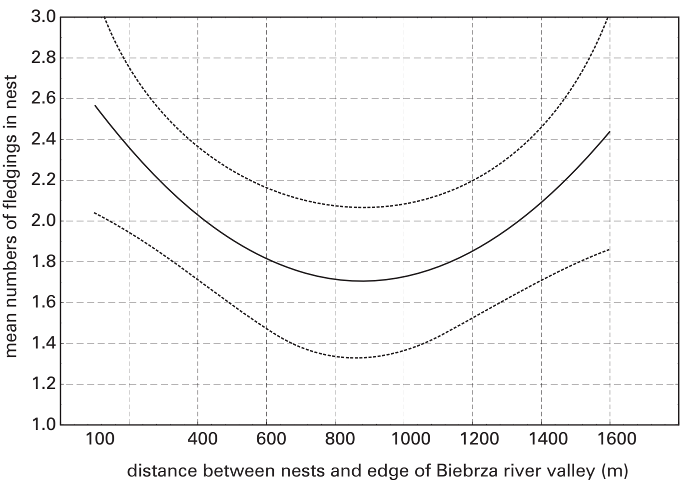

Fig. 2. Regression (solid line) of the breeding success (average number of fledglings per nest) on the distance between the nest site and the edge of the river valley. 95% confidence interval is indicated by dotted lines. The regression equation is: $y = 2.8038 - 0.0025x + 0.000001x^2$

nest close to the edge of the river valley (chi-square test: $\chi^2 = 95.342$, n = 122, df = 8, $p < 0.001$). The average breeding success of pairs correlates significantly with the number of nests located at distances of up to 800 m between nest sites and the edge of the Biebrza valley (r = 0.955, df = 5, p = 0.011) (Fig. 1–2).

Reproduction parameters in relation to the habitat structure

In 1996 and 1997 the greatest proportion of the nesting territories consisted of cereal crop, green crop and wet meadow habitats. Only a small part of the territories consisted of built-up areas and water bodies (Fig. 3). The variation in the percentages of these habitat types in the nesting territories between 1996 and 1997 was not statistically significant (ANOVA). However, the proportions of these habitat types did vary significantly between the nests (ANOVA models, F = 7.935 to 392.525, $p < 0.001$).

The mean breeding success of stork pairs was significantly related to the distance from the nearest occupied nest (Fig. 4). Where the distances between two HPa nests were short (to 600 m), the mean numbers of fledglings were significantly lower than in the nests located at longer distances ($y = 2.26 + 0.018x$; $R^2 = 0.03$, df = 144, F = 4.93, p = 0.028). Where the distances of between 600 and 1100 m separated the nests, mean numbers of nestlings were smallest, and the dependence of breeding success on inter-nest distance was not significant. In that part of the population where the distances between pairs were greater than

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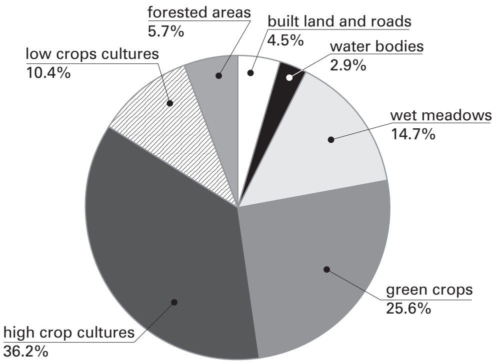

Fig. 3. Average proportions of habitat types distinguished in nesting territories.

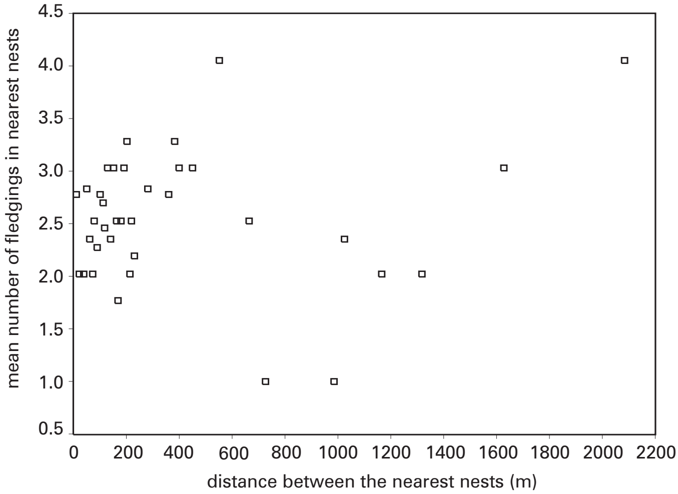

Fig. 4. Relationship between the average breeding success in two adjacent nests and the distances between nests.

1100m there was a significant positive correlation between the inter-nest distance and the number of fledglings ($y = -0.873 + 0.0024x$, $R^2 = 0.98$, df = 3, F = 114.94, p = 0.002). These relations demonstrate the effect of competition between pairs, probably in two different environments: 1) birds whose nests were located at short distances from one another inhabited the river; 2) the birds inhabiting the upland, where the river valley did not strongly influence the breeding success of pairs.

The correlation between breeding success and the habitat structure of the nesting territories was poor, as most nests were located in an optimal habitat. Generally, however, a significant positive correlation was found between the number of nestlings raised and the proportion of wet meadows and peat bogs in the nesting territories (Table 3).

The breeding success of pairs with more than two nestlings was related to the area of water bodies in the nesting territories (Table 4). In territories

Table 3. Variability in the number of nestlings in nests explained by the best subset of multiple regression calculated using Mallow's Cp value.

Effect	Parameter	SE	t	p
Log (proportion of wet meadows)	0.24722	0.09836	2.513	0.0129
Log (proportion of low crops)	-0.45736	0.20199	-2.264	0.0248
Proportion of meadows ^2	-0.00051	0.00020	-2.584	0.0106
Proportion of high crops ^2	-0.00049	0.00018	-2.766	0.0063
constant	5.65558	1.20486	4.694	0.0001

Table 4. Breeding success in relation to habitat structure of nesting territories.

Effect	b	SE of b	t	p
Model: pairs with >2 fledglings				
proportion of water bodies	0.07880	0.02336	3.374	0.0011
constant	3.04137	0.08327	36.521	0.0001
Model: pairs with < 3 fledglings				
proportion of water bodies	0.03137	0.03252	0.966	0.3382
constant	1.45158	0.13748	10.559	0.0001
Model: pairs with < 3 fledglings				
proportion of wetlands	0.01568	0.00736	2.131	0.0368
constant	1.31117	0.14358	9.145	0.0001

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Table 5. Results of logistic analysis explaining the relationship between the breeding success and the habitat structure in nest territories; model: 0 (pairs without nestlings HPo), 1 (nests with nestlings HPm1–5). One-tailed test.

Effect	b	SE of b	Wald function value	p
Share of wetlands	0.061	0.032	3.529	0.030
constant	1.884	0.419	20.175	0.0005

of type HPm3-5 nests the proportion of water bodies was significantly higher in comparison with the territories of type HPm2 nests (ts = 2.144, df = 115, p = 0.0017, arc sin data transformation).

In the case of pairs with low breeding success (HPo + HPm1–2), there was no correlation, although the numbers of fledglings did correlate positively with the proportions of wetlands in the territories (Table 4). The territories of pairs without nestlings (HPo) cover a significantly small proportion of wetlands (8.10%) in comparison with the pairs with one nestling (HPm1) — 16.63%. The different proportions of wetlands in the types of nests compared were significant (ts = 2.009, df = 38, p = 0.026; arc sin data transformation). Results of logistic regression explaining the impact of habitat structure in nest territories on the breeding success showed significant relation between share of wetlands and breeding success (Table 5).

DISCUSSION

The White Stork population inhabiting the study area has enjoyed a relatively high breeding success in comparison with other regions of Poland, especially in the last twenty years (e.g. Wojciechowski & Markowski 1992, Bogucki 1994a, Ptaszyk 1994, Indykiewicz et al. 1998). The average breeding success as measured by the JZm index was higher than the average for Central Europe (Profus 1991). The average value of the JZa index was distinctly higher than the expected value for a stable White Stork population (Wojciechowski 1992). In comparison with other regions of Poland (Profus 1991, Wojciechowski 1992, Bogucki 1994b), the population studied here was characterised by a higher and dominant proportion of HPm3-type broods. Exceptionally, the percentage of nests without nestlings (HPo) was lower than in other regions of Poland or Europe (Profus 1991).

The conglomerated distribution of the Biebrza valley population, with its distinct tendency towards nest concentration along the edge of the valley, and the high breeding success parameters of pairs inhabiting the terrain adjoining the edge of the valley, demonstrated that the area provided optimal conditions for reproduction in the White Stork population. The distribution of nests, and their associated territories, were spatially related to the distribution of certain habitat types able to provide abundant food for the storks. The largest concentrations of nests were located in villages lying near vast complexes of wet meadows, green crops, and pastures, and also in villages situated in the valleys of small rivers in the Biebrza catchment area. The habitat types specified above are commonly regarded as the most optimal feeding areas for the White Stork.

Ptaszyk (1994) stated that the density of breeding pairs of White Storks in the Wielkopolska region of Poland varied distinctly and depended, among other factors, upon the proportions of meadows or pastures. In areas with a low proportion of these habitats, densities were very low or storks did not breed at all. The highest densities were noted in valleys of large and medium-size rivers and in lake districts with abundant wet meadows, ponds and low peat bogs (Ptaszyk 1994). Indykiewicz (1998) demonstrated a significant relationship between the percentage of meadows and pastures in farmland and the number of breeding pairs in the Bydgoszcz region. Also Aunins et al. (2001) showed that on Latvian farmland the White Stork exhibits a distinct preference for habitats located close to river valleys.

Based on their observations of feeding White Storks in the Masuria (Mazury) region, Pinowski et al. (1991) showed that the habitats clearly preferred by this species for feeding are wet meadows, pastures and fields of root crops (vegetation height up to 40 cm). In Pomerania, Ożgo & Bogucki (1999) showed that the habitats visited most often in search of food were meadows, grassland and fields; male birds additionally frequented water bodies.

The relationships demonstrated by this study, variously distributed in groups of birds with different levels of breeding success, may be an

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indicator of the non-homogeneity of the population investigated here. The effects of these diverse relationships very probably overlap in the two groups: 1) in the birds inhabiting the area along the edge of the Biebrza valley — the close proximity of the water-filled depressions exerted the greatest influence on breeding success; 2) in the birds whose nests were situated on the Kolno Upland, some considerable distance away from the valley's edge, where the wet meadows lying close by the nests had a similar influence on breeding success.

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REFERENCES

Afifi A. A., Clark V. 1990. Computer — aided multivariate analysis. Second Ed., VNR New York.

Alonso J. A., Alonso J. C., Carrascal L. M., Munoz-Pulido R. 1994. Flock size and foraging decisions in central place foraging White Storks, *Ciconia ciconia*. Behaviour 129: 279–292.

Aunins A., Petersen B. S., Priednieks J., Prins E. 2001. Relationships between birds and habitats in Latvian farmland. Acta Ornithol. 36: 55–64.

Bogucki Z. 1994a. [Distribution and numbers of the White Stork *Ciconia ciconia* in five Provinces of the Wielkopolska region]. In: Ptaszyk J. (ed.). [The White Stork *Ciconia ciconia* in Wielkopolska region]. Prace Zakładu Biologii i Ekologii Ptaków UAM 3: 43–67.

Bogucki Z. 1994b. [Brood size of the White Stork *Ciconia ciconia* in Wielkopolska in 1971–1992]. In: Ptaszyk J. (ed.). [The White Stork *Ciconia ciconia* in Wielkopolska region]. Prace Zakładu Biologii i Ekologii Ptaków UAM 3: 165–176.

Dallinga J. H., Schoenmakers S. 1989. Population changes of the White Stork since the 1950s in relation to food resources. In: Rheinwald G., Ogden J., Schulz H. (eds). Weiβstorch — White Stork. Proc. 1th Int. Stork Cons. Symp., Schriftenreihe des DDA 10: 231–262.

Dziewiaty K. 1992. Nahrungsökologische Untersuchungen am Weiβstorch *Ciconia ciconia* in der Dannenberger Elbmarch (Niedersachsen). Vogelwelt 113: 133–144.

Górski W., Górska E., Kaczmarek S., Wiśnowska J. 1980. [Number, distribution, brood effectivity and some remarks on phenology of the White Stork, *Ciconia ciconia* (L.), in the middle part of Polish Baltic coast in 1973–1976]. In: Strawiński S. (ed.). [The ecology of coastal birds. White Stork, *Ciconia ciconia* (L.)]. Soc. Sci. Gedanensis, Acta Biol. 6: 25–44.

Indykiewicz P. 1998. [Factors determining distribution of breeding pairs of the White Stork *Ciconia ciconia* (L.) in the Bydgoszcz province in 1994–1995]. In: Indykiewicz P. (ed.). [The White Stork *Ciconia ciconia* (L.) in the Bydgoszcz Province in 1994–1995]. Bydgoszcz, pp. 63–71.

Indykiewicz P., Kucharski R., Wojciechowski A. 1998. [The results of the census of White Stork *Ciocnia ciconia* (L.) nests in the Bydgoszcz Province in 1994–1995]. In: Indykiewicz P. (ed.). [The White Stork *Ciconia ciconia* (L.) in the Bydgoszcz Province in 1994–1995]. Bydgoszcz, pp. 51–62.

Jakubiec Z. 1985. [Methods of studies on White Stork population in Poland organized within the framework of the Third International Census of the White Stork]. In: Jakubiec Z. (ed.). [Population of White Stork *Ciconia ciconia* L. in Poland. Part I. Number and reproduction of the White Stork according to results of field controls and inquiry data]. Studia Naturae A 28: 17–24.

Jakubiec Z., Guziak R. 1998. [White Stork *Ciconia ciconia* in Poland in 1995 — distribution, numbers, conservation problems]. Notatki Ornitol. 39: 195–209.

Löhmer R., Jaster P., Reck F. G. 1980. Untersuchungen zur Ernährung und Nahrungsraumgröβe des Weiβstorches (*Ciconia ciconia*). Beitrage Naturkunde Niedersachsen 33: 117–129.

Mrugasiewicz A. 1972. White Stork, *Ciconia ciconia* (L.) over the district Milicz in the years 1959–1968. Acta Ornithol. 13: 243–278.

Ożgo M., Bogucki Z. 1999. Home range and intersexual differences in the foraging habitat use of a White Stork (*Ciconia ciconia*) breeding pair. In: Schulz H. (ed.). Weiβstorch im Aufwind? — White Storks on the up? Proc. Int. Symp. White Stork, Hamburg, 1996, NABU, (Naturschutzbund Deutchland e. V.), Bonn. pp. 481–492.

Peterson U., Jakubiec Z., Okulewicz J., Profus P., Haecks J. 1999. Der Weiβstorchbestand im Kreis Ketrzyn (Rastenburg), Masuren/Polen. In: Schulz H. (ed.). Weiβstorch im Aufwind? — White Storks on the up? Proc. Int. Symp. White Stork, Hamburg 1996, NABU, Naturschutzbund Deutchland e. V.), Bonn. pp. 395–412.

Pfeiffer R. 1989. Zu Nahrungssituation und Bruterfolg des Weiβstorchs *Ciconia ciconia* an zwei Brutplätzen im Rotmaingebiet. Anzeiger der Ornitchologischen Gesellschaft in Bayern 28: 117–130.

Pinowska B., Pinowski J. 1989. Feeding ecology and diet of the White Stork *Ciconia ciconia* in Poland. In: Rheinwald G., Ogden J., Schulz H. (eds). Weiβstorch — White Stork. Proc. 1th Int. Stork Cons. Symp., Schriftenreihe des DDA 10: 381–396.

Pinowski J., Pinowska B., De Graff R., Visser J., Dziurdzik B. 1991. Influence of feeding habitat on prey capture rate and diet composition of White Stork *Ciconia ciconia* (L.). In: Jakubiec Z. (ed.). Population of White Stork *Ciconia ciconia* L. in Poland. Part II. Some aspects of the biology and ecology of White Stork. Studia Naturae A 37: 59–85.

Profus P. 1986. Zur Brutbiologie und Bioenergetik des Weiβstorchs in Polen. Beiheft Veröffentlichunguen Naturschutz. Landschaftspflege Baden-Württemberg 43: 205–220.

Profus P. 1991. The breeding biology of White Stork *Ciconia ciconia* (L.) in the selected area of Southern Poland. In: Jakubiec Z. (ed). Population of White Stork *Ciconia ciconia* L. in Poland. Part II. Some aspects of the biology and ecology of White Stork. Studia Naturae A 37: 59–85.

Profus P. 1993. [Changes in the breeding population of the White Stork *Ciconia ciconia* in Europe and its endangerment. I. Status of the stork population in Poland]. Chrońmy Przyr. Ojczystą 49: 51–66.

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Profus P. 1994. [Changes in the breeding population of the White Stork *Ciconia ciconia* in Europe and its endangerment. II. Status of the stork population in Poland (cont.) and in the neighbouring countries]. Chrońmy Przyr. Ojczysta, 50: 5–16.
Ptaszyk J. 1994. [Results of the inventory investigation of nests of the White Stork *Ciconia ciconia* in Wielkopolska in 1984–1985]. In: Ptaszyk J. (ed.). [The White Stork *Ciconia ciconia* in Wielkopolska region]. Prace Zakładu Biologii i Ekologii Ptaków UAM 3: 21–41.
Schneider-Jacoby M. 1993. Nahrungsplatzwahl des Weiβstorchs (*Ciconia ciconia*) unter optimalen Bedingungen in den Save-Auen. Schriftenreihe für Umwelt und Naturschutz im Kreis Minden-Lübbecke 2: 17–20.
Schüz E. 1952. Zur Methode der Storchforschung. Beuträge zur Vogelkunde 2: 287–298.
Sokal R. R., Rohlf F. J. 1995. Biometry. 3rd ed., W. H. Freeman and Co., New York.
Struwe B., Thomsen K. M. 1991. Untersuchungen zur Nahrungsőkologie des Weiβstorches (*Ciconia ciconia*, L., 1758) in Bergenhusen 1989. Corax 14: 210–238.
Tryjanowski P., Kuźniak S. 2002. Population size and productivity of the White Stork *Ciconia ciconia* in relation to Common Vole *Microtus arvalis* density. Ardea 90: 213–217.
Wojciechowski Z. 1992. [White Stork (*Ciconia ciconia*) in the Łowicz District]. In: Tranda E. (ed.). [Results of investigating the White Stork *Ciconia ciconia (L.)* population in Central Poland]. Acta Universitatis Lodzensis, Folia Zool. 1: 5–28.
Wojciechowski Z., Markowski J. 1992. [Characterization of the selected population parameters of the White Stork (*Ciconia ciconia*) in Central Poland]. In: Tranda E. (ed.). [Results of investigating the White Stork *Ciconia ciconia* (L.) population in Central Poland]. Acta Universitatis Lodzensis, Folia Zool. 1: 97–108.
Wojciechowski Z., Ogrodowczyk E. 1978. [Distribution and effectivity of White Stork broods in Łódź city province in comparison to the materials from former district of Łowicz and Łęczyca]. Notatki Ornitol. 19: 27–38.

STRESZCZENIE

[Struktura środowiskowa terytoriów gniazdowych i parametry rozrodu bociana białego — przykład z Wysoczyzny Kolneńskiej i doliny Biebrzy]

Badania prowadzono w latach 1994–1997 na części Wysoczyzny Kolneńskiej (powiat Jedwabne) przylegającej do doliny Biebrzy oraz na obszarze tej doliny w pasie ok. 2 km szerokości. Kontrolowano od 62 do 95 gniazd rocznie. Największe skupienia gniazd znajdowały się w miejscowościach: Klimaszewnica (12–15), Mocarze (12–13), Łoje-Awissa (11). Stwierdzono wysoki udział zajętych gniazd (Tab. 1) i niski udział gniazd bez sukcesu lęgowego (HPo: 0%–5.7%). Średnie wielkości lęgów w latach 1994–1996 były stosunkowo wysokie w porównaniu do innych regionów Polski i wyższe niż przeciętny sukces dla Środkowej Europy (Profus 1991). W roku 1997 sukces lęgowy był istotnie mniejszy niż w pozostałych badanych sezonach lęgowych, brak było gniazd z pięcioma młodymi, a wzrósł udział gniazd z jednym młodym (Tab. 2).

Pary ptaków, których gniazda ulokowane były blisko krawędzi doliny Biebrzy (do 100 m) lub w samej dolinie miały istotnie wyższy sukces lęgowy niż pary ptaków zakładających gniazda w dalszych odległościach od krawędzi doliny Biebrzy (Fig. 1 i 2). Badana populacja wykazywała wyraźną tendencje do lokalizowania gniazd w pobliżu krawędzi doliny.

W wyznaczonych rewirach gniazdowych bociana białego o promieniu 1 km wyróżniono siedem typów środowisk, wśród których największy udział miały uprawy wysokie, użytki zielone oraz łąki podmokłe (Fig. 3). Zróżnicowanie udziałów wyróżnionych typów środowisk między rewirami gniazdowymi było wyraźne.

W obu sezonach lęgowych, przeciętna liczba odchowanych młodych w sąsiadujących gniazdach, umieszczonych w odległości do 600 m od siebie, korelowała ujemnie z odległością między tymi gniazdami (Fig. 4). Wskazuje to na nasilenie konkurencji miedzy parami ptaków, których gniazda umieszczone są blisko siebie.

W badanej populacji wykazano istotne zależności sukcesu lęgowego a udziałem powierzchni podmokłych łąk i powierzchni zbiorników i cieków wodnych (Tab. 3 i 4). Związki te odmiennie układające się w różnych grupach ptaków wyróżnianych z uwagi na wielkość sukcesu lęgowego mogą wskazywać na niejednorodność badanej populacji. Wyróżniają się w niej dwie grupy — ptaki zasiedlające obszar krawędziowy doliny Biebrzy i te których gniazda położone były na terenie wyżyny w znacznej odległości od krawędzi doliny.

Związek między przeciętną liczbą odchowanych młodych a udziałem powierzchni zbiorników i cieków wodnych w rewirach bociana był wyraźnie zaznaczony jedynie w grupie ptaków o wysokim sukcesie rozrodczym (HPm3–5). W całości populacji jak również u par z mniejszą liczbą odchowanych młodych zależności takiej nie stwierdzono (Tab. 4). Terytoria par bez sukcesu lęgowego (HPo), miały w rewirach istotnie mniejszy udział terenów podmokłych.

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