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Causes of breeding losses and adult mortality in White Stork *Ciconia ciconia* (L.) in Poland

Przyczyny strat lęgów i śmiertelności bociana białego *Ciconia ciconia* (L.) w Polsce

Abstract

568 causes of nesting failures and 235 instances of the death of fledgelings and old birds from the years 1970-1987 were analysed. The most important reasons for nesting failures were the reduction of broods by parents and throwing away eggs/nestlings during fights for nests. The death of fledgelings and old birds was mostly due to anthropogenic factors: 74.5% of the birds reported were electrocuted after striking overhead electric power lines and 7.2% were herbicide poisoned. The number of fatal accidents is highest at the beginning of the breeding season and after the fledging of young. Some protective measures are proposed.

I. Introduction

When the reasons of White Stork decline occurring in many countries of Western and Central Europe (C r e u t z 1985) were sought, special attention was paid to the factors responsible for the adult mortality and nest losses. Ringing recoveries provided data on adult mortality (R i e g e l , W i n k e l 1971, K a n i a 1985), while causes of nesting losses were analysed in

several population studies (Johansen, Bjerring 1955, Kintzel 1987, and others). Some papers dealing with particular mortality factors were also published. Most attention was given to the problem of overhead electric and telephone lines, which is picturesquely termed "the wiring of a landscape" (Fiedler, Wissner 1980, 1986, Hass 1980, Heijnis 1980, and others). That factor becomes more and more important due to increase of the number of nests placed on electric poles. That phenomenon has been observed in the whole of Central Europe for some time past (Štolmann 1976, 1986, Creutz 1985, Jakubiec et al. 1986, Jakab 1986). Climatic factors as a cause of losses in the White Stork broods were discussed among others by Kuhk and Schüz (1950), Seilkopf (1951), Kuhk (1956). Lack (1966) pointed out the importance of food resources. Numerous data on that subject from Poland are included in the collectively elaborated results of field censuses made in 1974 (Strawiński ed. 1980, Jakubiec ed. 1985).

In Poland the problem of causes inducing the adult mortality and nest losses in White Stork has not been considered hitherto. The present paper is an attempt at filling up this gap. It is aimed at showing main threats to our population of White Stork in the breeding period.

The present report owes much to the work of many persons who participated in the White Stork inventory in 1974 and later on - in similar studies carried out for years in Silesia. Many valuable data were supplied by my collegues: MSc. Tadeusz Krotoski, Dr. Stanisław Kuźniak, and MSc. Jerzy Ptaszyk. Hereby, I would like to express my deepest gratitude to them. I thank also MSc. Wiesława Świętochowska who drew up necessary data from the abundant material of questionnaires from the year 1974.

II. Material and methods

The material analysed in the present paper comes from a number of sources. Data on causes of nesting losses were provided, for the most part, by field controls made in 1974. These data were found in the material obtained from 44 administrative districts. Some records were found in short notes enclosed with the questionnaires responded by village administrators. The results of other field checks carried on for several years in Silesia and in North-Western Poland constituted the last source of information. Altogether

568 records of causes of nesting mortality, coming from the years 1972-1987, were analysed.

The author's own data collected during the field work in the years 1974-1987 afforded the bulk of the material on causes of adult mortality. Some data were given by ornithologists conducting similar studies for many years. A small number of records was obtained from persons who helped in the 1974 inventory and from village administrators responding the questionnaires. 68 recoveries on ringed birds from the Ornithological Station of the Institute of Zoology of the Polish Academy of Sciences were also analysed. Altogether 235 records from 1970-1987 were examined.

The records obtained can be regarded as realiable. However, it sometimes happened that notes given by informants were rather vague, so it was difficult to determine the real cause of a nest loss or bird's death precisely. In many cases it was impossible. Certain weak point of the material collected is its incompletness and for that reason many interesting problems have not been statistically worked out. It is scarcely possible to assume that the author has obtained full information on all incidents or that these were distributed proportionally to some factors, eg. to the population density.

An analysis of data has been made for different stages of the breeding period; their duration was accepted after M r u g a s i e w i c z (1972), C r e u t z (1985), and P r o f u s (1991). There were distinguished three stages as follows:

- egg laying and incubation; it lasts from 10 April to 10 July; 90% of the nestlings hatch before 15 June,
- raising of dependent young (nestling period); it lasts from 15 May to 10 September; less than a half of the young remain in nests after 10 August,
- post-fledging, from fledging to departure for wintering grounds; it lasts from 10 July to 10 September; over 50% of the birds depart before 1 September.

The data on reasons for the adult mortality during the whole period of their residence on breeding grounds, i.e. from 20 March to 20 September, were analysed separately.

When the causes inducing losses in broods were analysed, only a number of incidents was taken into account, a number of eggs or nestlings lost were ignored. Partial losses of broods were also left out of account. In that case the brood was considered as completed successfully though only in part. An analysis of reasons for the adult mortality was based on number of dead individuals.

Two categories of mortality factors, i.e. anthropogenic and natural ones, were distinguished.

III. Results

1. Causes of clutch losses

That period lasts from 10 April to 10 July, i.e. for 2.5 months on the average. The results illustrating the influence of the particular factors are shown in table I, and their relative importance - in fig. 1.

TABLE I

Causes of clutch losses in White Stork

Przyczyny strat lęgów bocianich w okresie składania i wysiadywania jaj

Category Kategoria	Causes of clutch losses Przyczyny straty lęgu	Number of clutches Liczba lęgów	%
Natural Naturalne	Eggs thrown out of nest by parents Wyrzucenie jaj z gniazda przez rodziców	108	44.1
	Eggs thrown out by intruding birds during fight for nest Wyrzucenie jaj przez ptaki obce w trakcie walki o gniazdo	92	37.6
	Destruction - nest fallen down Zniszczenie - runięcie gniazda	22	9.0
	Predation Drapieżnictwo	3	1.2
	Clutch abandoned Porzucenie lęgu	1	0.4
Anthropogenic Antropogeniczne	Destruction of nest and clutch by man Zniszczenie gniazda i lęgu przez człowieka	14	5.7
	Fire of nest Pożar gniazda	2	0.8
	Clutch abandoned due to disturbing birds Porzucenie lęgu w wyniku niepokojenia	1	0.4
	Total Razem	245	100.0

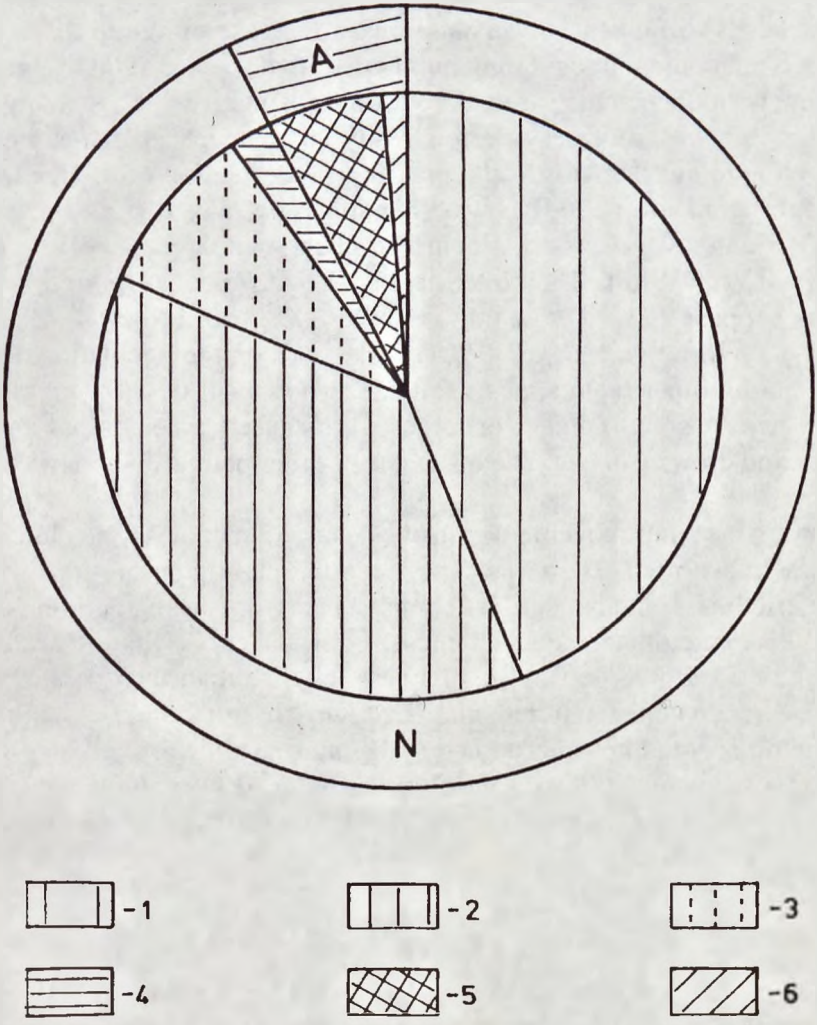

Fig. 1. Influence of different factors on clutch losses in White Stork. A - anthropogenic factors, N - natural factors. 1 - throwing out of eggs by parents, 2 - throwing out of eggs during fights for nests, 3 - destruction or downfall of the nest, 4 - other natural factors, 5 - destruction of the clutch by man, 6 - other anthropogenic factors

Ryc. 1. Wpływ różnych czynników na straty lęgów bocianich w okresie składania i wysiadywania jaj. A - czynniki antropogenne, N - czynniki naturalne. 1 - wyrzucenie jaj przez rodziców, 2 - wyrzucenie jaj w trakcie bitwy o gniazdo, 3 - zniszczenie lub runięcie gniazda, 4 - pozostałe czynniki naturalne, 5 - zniszczenie gniazda i lęgu przez człowieka, 6 - pozostałe czynniki antropogenne

The main causes of egg losses was throwing eggs out of nests by parents and throwing them out during fights for nests - altogether 81.2% of the cases. The throwing out of eggs by parents, and thereby a total or partial reduction of clutches is difficult to understand but in the case of White Stork it is a common phenomenon regulating numbers of that species at that stage of its breeding period when the parental investments are fairly low. In many cases the eggs thrown out of nests were already incubated, so perhaps there are involved here mechanisms of the preliminary evaluation of food resources in a given breeding period, as was mentioned by Mrugasiewicz (1972). Fights over nests are a common phenomenon characteristic of the biology of White Stork. Their intensity varies in different years, and, as some authors suppose (Wojciechowski, Ogrodowczyk 1978, Profus, Mielczarek 1981), it depends on the population density. From among other factors, nests fallen down or bent down were of some importance. A small number of losses were caused by predators, martens *Martes* and crows *Corvus*. The influence of other natural factors was insignificant.

Among the anthropogenic factors the destruction of nests and clutches by man was most often. These incidents occurred mainly during repair works on electric lines, but also in other circumstances, eg. during building operations. Five incidents, such as these, took place in State Farms (see Okulewicz 1985). The fire of a nest and disturbance by passing trains were indirectly connected with man's activity. In this last case, it appeared that the birds could get accustomed to the unusual situation.

The percentages of losses in clutches induced by natural and factors anthropogenic were extremely unequal, 93.1 and 6.9% respectively.

2. Causes of brood losses

That period lasts from 15 May to 10 September, i.e. for 3 months on the average. The results referring to that stage of the breeding period are shown in table II.

From among the causes of losses in broods most important were: young thrown out by parents, heavy rain and cold, and death of nestlings from unknown reasons. These constituted altogether 72.5% of all the factors inducing losses in broods. Only the influence of rain and cold was precisely determined, while the records of remaining causes are general statements which may be variously interpreted. In 1974 many cases of the young thrown out or dead were due to heavy rains which that year induced a catastrophic

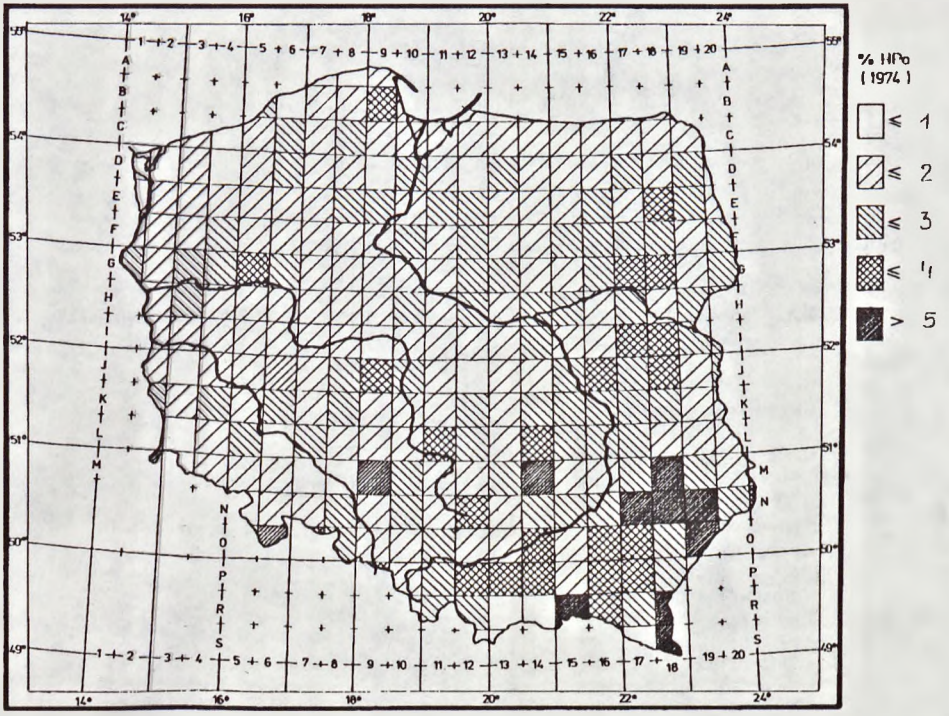

Fig. 2. Percentage of pairs without brood (%HPo) in Poland in 1974: 1 - 9,9%, 2 - 10,0 - 19,9%, 3 - 20,0 - 29,9%, 4 - 30,0 - 39,9%, 5 - 40,0%

Ryc. 2. Udział par bez potomstwa (%HPo) w Polsce w roku 1974: 1 - 9,9%, 2 - 10,0 - 19,9%, 3 - 20,0 - 29,9%, 4 - 30,0 - 39,9%, 5 - 40,0%

decline in a brood success in South-Eastern Poland (fig. 2). That fact was established by many authors (Domaszewicz, Lewartowski 1985, Głowaciński 1985, and many others). The situation described should by considered as unusual in many respects, though a negative influence of weather conditions in submontane areas was mentioned by Profus and Mielczarek (1981).

The influence of other natural factors was negligible, their percentage did not exceed 10% in any case. In that period fights for nests ceased and the nestlings killed by intruding Storks constituted only 6% of all the incidents. The effect of predation, mainly on the part of the marten *Martes* or polecat *Putorius*, and in one case - of the crow *Corvus* was surprisingly small. The stinging of young to death by swarming bees should be considered as a natural factor, however this is undoubtedly an effect of the synantropization

TABLE II

Causes of brood losses in White Stork

Przyczyny strat lęgów bocianich w okresie wychowu młodych, przed osiągnięciem przez nie zdolności lotu

Category Kategoria	Causes of brood losses Przyczyny strat lęgów	Number of broods Liczba lęgów	%
Natural Naturalne	Young thrown out by parents Wyrzucenie młodych przez rodziców	110	34.1
	Heavy rain and cold Ulewny deszcz i ochłodzenie	86	26.6
	Death of nestlings for unknown reason Śmierć piskląt z nieustalonych przyczyn	38	11.8
	Destruction - nest fallen down Zniszczenie - runięcie gniazda	26	8.0
	Killing by intruding Storks Zabicie przez obce bociany	19	5.9
	Thunder strike Uderzenie pioruna	10	3.1
	Stinging to death by bees Zażądlenie przez pszczoły	9	2.8
	Predation Drapieżnictwo	7	2.2
	Death of parents Śmierć rodziców	2	0.6
	Cronism Kronizm	2	0.6
Anthropogenic Antropogenne	Destruction of nest - young killed by man Zniszczenie gniazda i zabicie młodych przez ludzi	6	1.9
	Poisoning of nestlings Zatrucie piskląt	4	1.2
	Strangulation with string Omotanie sznurkiem	2	0.6
	Fire of nest Pożar gniazda	1	0.3
	Clutch abandoned due to disturbance Porzucenie lęgu w wyniku niepokojenia	1	0.3
	Total Razem	323	100.0

of White Stork. In general, the natural causes of losses in broods constituted as much as 95.7% in that period.

Among the anthropogenic factors the direct destruction of nests with young by man was most important. Incidents such as these took place in State farms (O k u l e w i c z 1985) and they were also caused by intervence of electric utility workers. Other factors were rather unimportant though the poisoning of young by chemicals, used for spraying fields in the vicinity of nests, could be difficult to detect and might be reckoned to the natural factors such as the throwing out by parents. In two cases the death of nestlings happened in consequence of the strangulation with nylon strings brought by parents as a nest material. The presence of a material such as this in the environment was reckoned to the anthropogenic factors. One case of the brood left by parents was caused by a helicopter that flied too low. The anthropogenic factors responsible for losses in broods constituted mere 2.8%.

The significance (in per cent) of different causes at that stage of the breeding period is shown in fig. 3.

3. Causes of independent bird mortality

The analysis of causes was based on the data compiled in table III. The natural factors are clearly divided into these that threaten adult birds and those which threaten juvenile ones. The percentage of losses caused by natural factors was small, in the case of adult birds it was 27.8% and in the case of juvenile ones - 11.5%. Injuries received during fights for nests were the most frequent cause of the adult mortality - 13.3%. The influence of other factors was negligible.

The anthropogenic factors induced 72.2% of the fatal accidents among adults, and as much as 88.5% - among juveniles. Among these factors collisions with overhead electric power lines and electrocution were most important. These factors caused 58.7% of the fatal accidents among adults, and 77.0% - among the juvenile birds. The latter are exposed to a danger of collisions only for two months, while the former - for 6 months, thus it appears that an individual experience is very important. Sometimes it comes to mass accidents, eg. on the turn of August 1983, about 200 Storks perching upon posts near Skupno (Konin province) were observed, the day after 6 dead birds (both old and young) were found under the wires (Antoni K r z y ż a n o w s k i - pers. inf.). In 1987 in Lower Silesia a similar catastrophe occurred, then 20 specimens were killed. In these two cases, the

TABLE III

Influence of different factors on the mortality among adult Storks and juvenile ones after fledging

Wpływ różnych czynników na śmiertelność bocianów dorosłych i młodych po osiągnięciu zdolności lotu

Category Kategoria	Cause of death Przyczyna śmierci	Age of bird Wiek ptaka			Total Razem	%
		adult dorosły	juvenile młodociany	unknown nieznany		
		Number of individuals Liczba osobników				
Natural Naturalne	Fight for nest Walka o gniazdo	12	-	-	12	5.1
	Illness Choroba	6	2	1	9	3.8
	Wing or leg broken Złamanie skrzydła lub nogi	4	2	-	6	2.6
	Thunder strike Uderzenie pioruna	3	-	-	3	1.3
	Accident during training in flying Wypadek przy nauce latania	-	2	-	2	0.9
	Crushing to death by a broken branch Przywalenie złamanym konarem	-	2	-	2	0.9
	Killing by other Storks, not during fight for nest Zabicie przez inne bociany, ale nie w trakcie walki o gniazdo	-	1	-	1	0.4
	Predation Drapieżnictwo	-	1	-	1	0.4
Anthropogenic Antropogenne	Collision with overhead cables or electrocution Uderzenie w przewody linii napowietrznych lub porażenie prądem	52	67	56	175	74.5
	Poisoning Zatrucie	9	8	-	17	7.2
	Collision with a motor vehicle Kolizja z pojazdem mechanicznym	2	2	1	5	2.1
	Killing by man Zabicie przez człowieka	2	-	-	2	0.9
	Total Razem	90	87	58	235	100.0

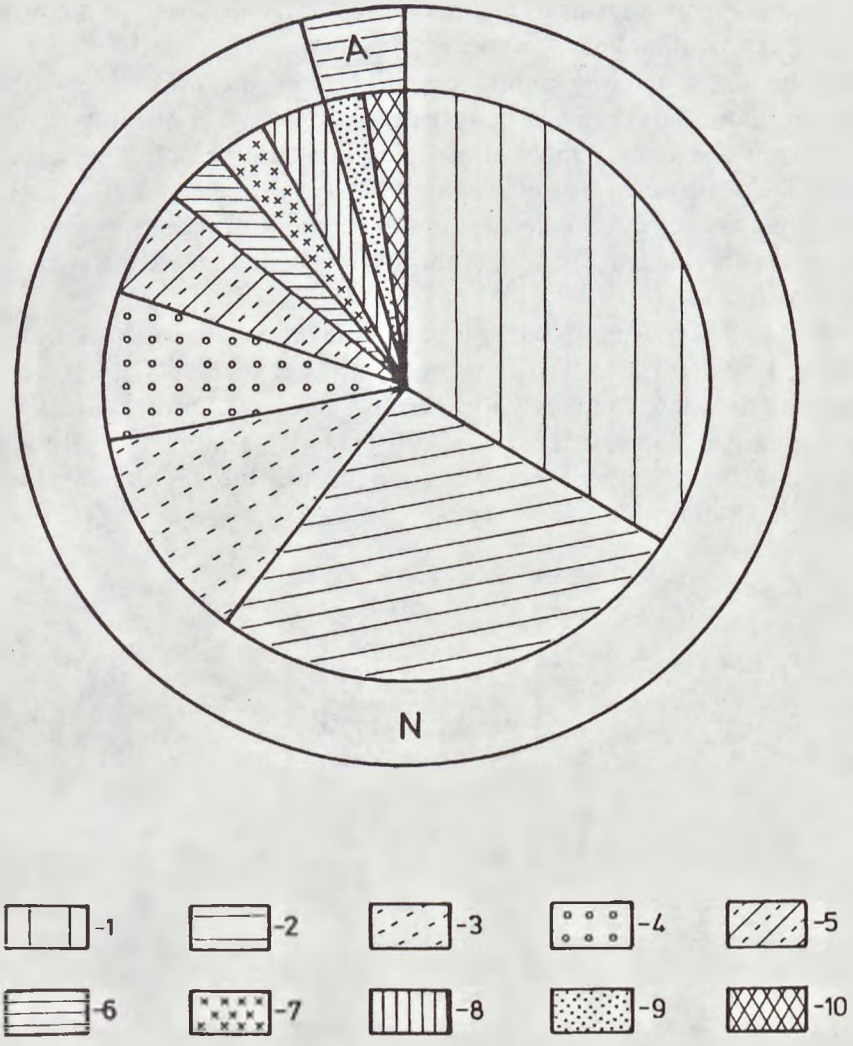

Fig. 3. Influence of different factors on brood losses in White Stork. A - anthropogenic factors, N - natural factors. 1 - young thrown out by parents, 2 - heavy rain and cold, 3 - death of nestlings, 4 - destruction or down fall of the nest, 5 - killing by intruding Storks, 6 - thunder strike, 7 - stinging to death by bees, 8 - other natural factors, 9 - destruction of the nest by man, 10 - other anthropogenic factors

Ryc. 3. Wpływ różnych czynników na straty lęgów bocianich w okresie wychowu młodych. A - czynniki antropogenne, N - czynniki naturalne. 1 - wyrzucenie młodych przez rodziców, 2 - ulewne deszcze i ochłodzenie, 3 - śmierć piskląt, 4 - zniszczenie bądź upadek gniazda, 5 - zabicie przez obce bociany, 6 - uderzenie pioruna, 7 - zażądlenie przez pszczoły, 8 - pozostałe czynniki naturalne, 9 - zniszczenie gniazda przez człowieka, 10 - pozostałe czynniki antropogenne

death of birds was a result of electrocution, which occurred at the moment when Storks set their beaks to wires or insulators.

Among the remaining anthropogenic factors the poisoning with herbicides used for the spraying of cultivated fields was of some importance. In the relevant reports, the facts of spraying and death of birds were closely related; the death occurred always in a few days after the spraying, preceded by an illness. Collisions with motor vehicles concerned trains and cars, 2 incidents each. Some cases of the Storks killed by man were the evident acts of vandalism.

The number of the analysed cases of death among adults was 90, and that referring to juveniles - 87. If the records of fatal accidents are assumed to come with the same frequency for these two groups of birds, the respective accident indices, calculated per 1 month of activity, amount to 15.0 and 43.5. Hence, it is clear that the mortality among juvenile birds is almost 3 times as high as that among adult individuals.

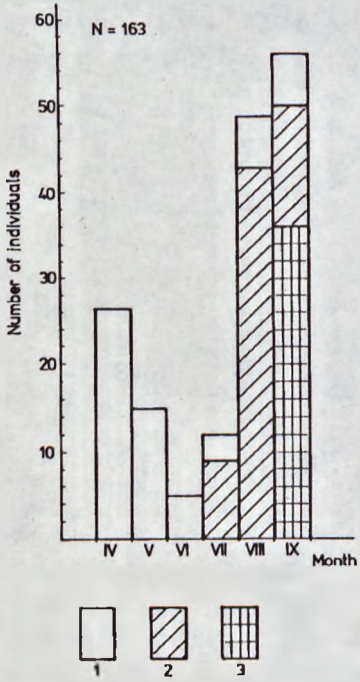

Fig. 4. Independent birds mortality in the period April-September: 1 - adult birds, 2 - juvenile individuals after their departure from nests, 3 - individuals of an unknown age

Ryc. 4. Porównanie śmiertelności lotnych bocianów białych w okresie kwiecień - wrzesień: 1 - ptaki dorosłe, 2 - osobniki młodociane po wylocie z gniazd, 3 - osobniki o nieznanym wieku

The distribution of 100 fatal accidents during the whole period spent by the Storks in Poland is shown in fig. 4. The number of accidents among adult birds was highest immediately after their return from wintering grounds. This was induced by the frequent, at that time, fights for nests and lack of experience in moving around the nests situated on electric poles. A number of records referred to the birds electrocuted during the fight because the live wires often are only some tens of centimeters below the nest. In the following months a number of accidents diminishes, increasing sharply when the young fledge.

The significance of particular factors throughout the breeding period is shown in fig. 5.

IV. Discussion

The above results show clearly that the anthropogenic factors are of little importance for the nesting success of White Stork. A similar situation has been found in Eastern Slovakia; a list of causes of nesting failures, established for that area, agrees with that given for the area of Poland (Fulin 1984). The data from Germany (Schildmacher 1960, 1975, Meybohm, Dahms 1975, Kintzel 1987) reveal an almost identical importance of the particular factors, and especially of the eggs and nestlings thrown out of nests by parents or as a result of fights for nests with intruding Storks. The prevailing influence of weather conditions has been found only in Denmark (Johansen, Bjerring 1955).

The analyses of causes inducing the adult mortality based on ringing recoveries revealed considerable local differences (Zink 1967, Riegel, Winkel 1971, Kania 1985). In Europe the greatest number of accidents, usually above 50%, result from collisions with electric lines or electrocution. In Asia Minor and in Africa the shooting is of decisive importance.

The comparison of causes inducing adult mortality in Poland with the data from other countries shows that the identical or very similar factors are involved there. In all the compared regions of Germany (Schildmacher 1960, 1975, Meybohm, Dahms 1975) and of Slovakia (Fulin 1984) the threats due to anthropogenic factors decidedly prevailed over those created by natural ones.

The threat of electric lines has been given a good deal of attention, for nowadays the percentage of birds dying for that reason predominates over

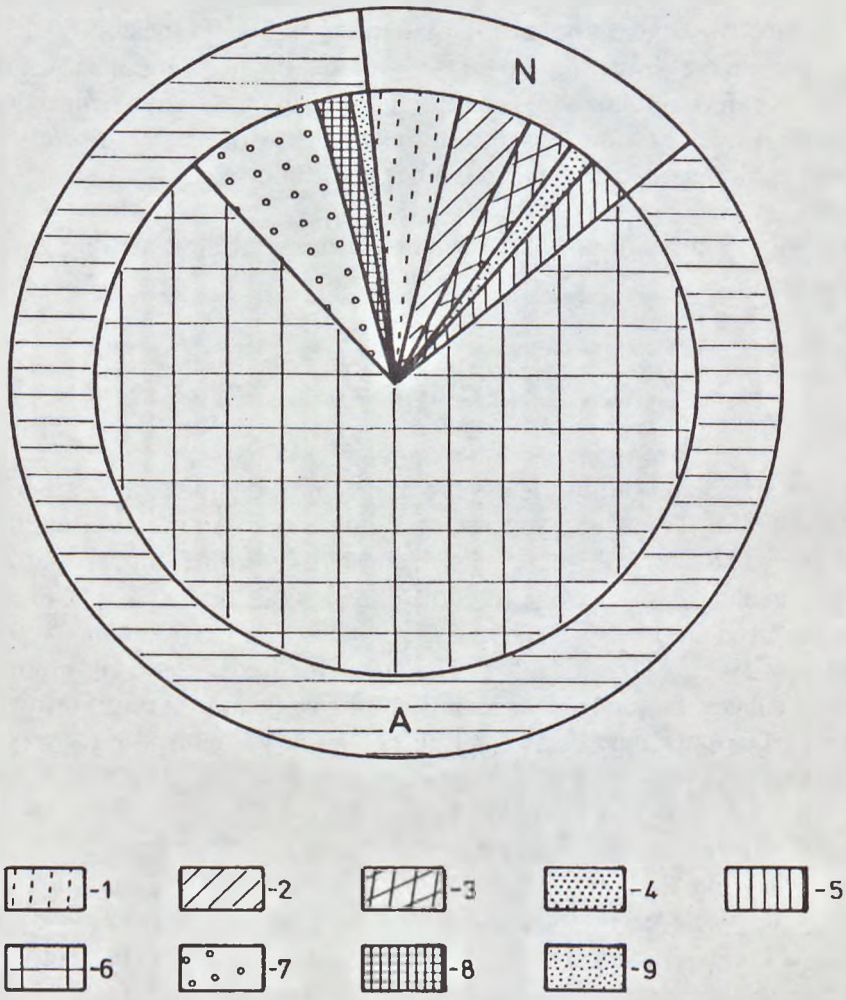

Fig. 5. Influence of different factors on the adult mortality and on the mortality among young Storks after fledging. A - anthropogenic factors, N - natural factors. 1 - fight for the nest, 2 - illness, 3 - wing or leg broken, 4 - thunder strike, 5 - other natural factors, 6 - collision with live wires or electrocution, 7 - poisoning, 8 - collisions with motor vehicles, 9 - killing by men

Ryc. 5. Wpływ różnych czynników na śmiertelność bocianów dorosłych i młodych po osiągnięciu zdolności lotu. A - czynniki antropogenne, N - czynniki naturalne. 1 - walka o gniazdo, 2 - choroba, 3 - złamanie skrzydła lub nogi, 4 - uderzenie pioruna, 5 - pozostałe czynniki naturalne, 6 - uderzenie o przewody linii napowietrznych lub porażenia prądem, 7 - zatrucia, 8 - kolizje z pojazdami mechanicznymi, 9 - zabicie przez człowieka

all other causes of death (F i e d l e r , W i s s n e r 1980). There are strong indications that the influence of that factor steadily increases. This may be induced by the development of electric power systems as well as by the moving of White Stork from traditional nesting places (trees, roofs) to electric poles (Š t o l l m a n 1976, 1986, C r e u t z 1985, J a k u b i e c et al. 1986, J a k a b 1986) , or at last by laying on the most dangerous types of installations (H a a s 1955, F i e d l e r , W i s s n e r 1980, 1986). The investigations carried on in Germany demonstrate the increasing role of collisions with live wires and of electrocutions in the adult mortality. In the years 1950-1959 35.8% of the ringed White Storks died for that reason, whereas in the years 1960-1976 - even 51.9% (B a i r l e i n , Z i n k 1979). The data from the Ringing Station (Vogelvarte Helgoland) showed that in the years 1937-1967 (30 years) 251 Storks were killed due to collisions with electric lines and electrocutions, while in the years 1971-1979 (9 years) - as much as 335 birds (F i e d l e r , W i s s n e r 1980). The highest mortality was estabilished for young birds, immediately after their departure from nests. According to B a i r l e i n and Z i n k (1979), out of 280 victims of those accidents, 44% die in the neighbourhood of the nest, and the further 41% somewhere in the area of Germany.

All the results of the research from Central Europe, discussed above, agree with those from Poland. According to the unanimous opinion, the reduction of a number of fatal accidents connected with "the wiring of a landscape" is of fundamental importance for the survival of White Stork in its breeding grounds in Eastern and Central Europe.

V. Protective measures proposed

When F i e d l e r and W i s s n e r (1980) examined the cases of White Stork death due to collisions with overhead cables and electric poles, they found that 83% of the birds were killed owing to a short circuit caused by these birds perching on poles, and only 16% died in consequence of collisions with wires in flight. The results from Poland appear to confirm these findings. Out of 129 individuals which died on wires and electric poles, over 50 were killed in two mass accidents. This indicates that in our country this percentage is also high. It is necessary to take into account that in many reports on fatal accidents, their authors did not clearly stated whether the birds where electrocuted while flying or while perching upon electric poles.

After the detailed analysis of the particular records it has been found that most electrocutions happen on transition poles of a medium-tension system, supplied with standing insulators (Haas 1955, Fiedler, Wissner 1980, 1986). Beside the White Stork, this danger concerns also other bird species, many birds of prey included (Haas 1955). The birds perching upon cross bars placed between insulators examine their surroundings and they often set their beaks to wires. Then it comes to electrocution. The author's suggestions in this matter are as follows:

- to stop the installation of standing insulators which are most dangerous,
- to install the constructions on cross-bars, which enable the birds to perch on them, eg. high vertical bars,
- to install an additional bar for perching birds over a cross-bar with insulators.

These last two methods of safeguarding the existing electric lines should by applied as quickly as possible, at first - on the routes of concentration of the migrating Storks, i.e. in Southern Poland, in the Sudetic Foreland and in the Carpathian Foothill.

The reduction of a number of fatal accidents occurring due to collisions with live wires may by achieved through the installation of supports for nests placed on electric poles. These supports raising the nest over 1 m above the wires make the access to the nest easier and conditions in which the young are trained in flying safer (Jakubiec 1989).

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Streszczenie

Przeanalizowano 245 przypadków strat lęgów bocianich w okresie składania i wysiadywania jaj, 323 przypadki strat lęgów w okresie wychowu młodych oraz 235 wypadków śmierci ptaków lotnych, z czego 87 stanowiły ptaki młode po wylocie z gniazd, a 90 ptaki dorosłe.

Głównymi przyczynami strat lęgów w okresie wysiadywania jaj i wychowu młodych były czynniki naturalne, które wynosiły odpowiednio: 93.1% i 95.7%. Największe znaczenie miała redukcja lęgów - 44.1% w przypadku lęgów z jajami i 34.1% lęgów z młodymi. Na te ostatnie duży wpływ wywierały warunki atmosferyczne - 26.6% strat. Udział czynników antropogennych był minimalny.

Wypadki śmiertelne ptaków lotnych były w ogromnej większości (84.7%) następstwem oddziaływania czynników antropogennych, głównie uderzeń w przewody linii napowietrznych i porażeń prądem - 57.8% w przypadku ptaków dorosłych i 77.0% w przypadku ptaków młodocianych. Śmiertelność ptaków lotnych, w okresie od kwietnia do września, miała przebieg nierównomierny i swe maksimum osiągała wiosną, bezpośrednio po przylocie ptaków, oraz po wylocie młodych z gniazd. Śmiertelność ptaków młodych była prawie trzykrotnie wyższa od śmiertelności starych, a jej wskaźnik na 1 miesiąc wynosił odpowiednio: 15.0 i 43.5. Udział czynników naturalnych w śmiertelności ptaków lotnych był niewielki i wynosił 15.4%, przy czym był on wyższy u ptaków dorosłych, gdzie najczęstsze były wypadki śmiertelne w trakcie wiosennych walk o gniazda.

Porównując sytuację z Polski z wynikami z innych krajów środkowoeuropejskich stwierdzono, że zagrożenia i znaczenie poszczególnych czynników są typowe dla całego tego obszaru.

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