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Breeding ecology of the Marsh Harrier *Circus aeruginosus* in eastern Poland. Part 2. Causes of brood losses

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Abstract. Research was carried out between the years 1979 and 1990 in two types of habitat: retention reservoirs and low bogs of the carbonate type. Checks of nests made every 5–10 days. Treated as separate categories in this work were the success of an individual nest (72%) and the final success of a pair in a given season (78%). At retention reservoirs, the main cause of losses was predation by birds, while on bogs it was predation by mammals. Clutches at the reservoirs were destroyed at an earlier stage than on the bogs, but the habitats did not differ in relation to the success of pairs. The reaction of birds to the loss of a clutch or brood was dependent upon the date on which the destruction occurred: the probability of renesting decreased with the degree of advancement of a clutch at the time that it was lost. Pairs which began breeding earlier had a significantly greater chance of success than those nesting later in the season.

Key words: birds of prey, Marsh Harrier, *Circus aeruginosus*, breeding ecology, breeding success.

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INTRODUCTION

This paper is the second in a series devoted to the breeding ecology of the Marsh Harrier in eastern Poland. Studies on this species were carried out in the 1980s in two types of habitat: retention reservoirs and low bogs of the carbonate type (Buczek & Keller 1994).

The issue of total breeding losses has been treated as a marginal one in the literature devoted to the breeding ecology of the Marsh Harrier. In most cases, authors have only given the percentage of nests in which young have been raised (nesting success), and have then attempted to determine the causes of losses (Witkowski 1989). Thus, analyses to date have in effect involved the determination of the fate of a nest (the percentage of clutches achieving success), rather than the fate of a given pair in a given year. Among other things, this has resulted from the fact that distinctions have not been drawn between first clutches and renesting following a loss. Rather these two occurrences have been put in the same category. Furthermore, there has been no comparative analysis linking the given type of habitat with the level of losses amongst clutches of this species.

The aim of this paper was to analyze: (1) nest success, (2) the reaction of birds to the loss of a clutch or brood, (3) pair success, and (4) the influence on the fate of broods or clutches and pairs of the kind of habitat, the year and the date of the onset of laying.

STUDY AREA

Research was carried out at the Zahajki and Mosty retention reservoirs (areas Z and M, 1979–1986) and on carbonate bogs near Chełm: Roskosz, Gotówka and Brzeźno (areas R, G and B, 1986–1988 and 1990). These areas have been described in the previous paper (Buczek & Keller 1994).

The total area of the reservoirs studied was 616 ha and the total area of the bogs 1049 ha. At the retention reservoirs, habitat conditions (water level and the area of vegetation available for nesting) were quite stable. This was the case both within particular years and

between years. In the case of bogs, differences were noted in relation to the area of vegetation available for breeding. These resulted from the burning of vegetation by local people. There were also changes in water level occurring in the course of the breeding season.

The following were among the predators occurring in the immediate vicinity of the reservoirs and posing a threat to the clutches or broods of harriers: Red Fox *Vulpes vulpes*, Polecat *Mustela putorius*, Wild Boar *Sus scrofa* (not numerous), Raven *Corvus corax* (2 pairs) and Magpie *Pica pica* (5–8 pairs). Hooded Crows *Corvus corone cornix* were not present. Observed most frequently on and around the bogs were: Fox, Badger *Meles meles*, Raccoon-dog *Nyctereustes procyonoides*, Polecat and Wild Boar. Avian predators included: Hooded Crows (*c.* 10 pairs), Magpies (10–15 pairs) and Ravens (3–5 pairs).

METHODS

Observations of harriers were made in all areas throughout the breeding season (April–July). This work involved the search for nests and regular checks upon them, as well as observations of the adult birds. Adult birds were not marked, but the great variability of the colouration of the species allowed many birds to be recognized as individuals. Nests were located as they were being built and in the majority (90%) of them, checks began at the egg-laying stage. Nests were checked at least once a week until the young left the nest. Such frequent visits made it possible for the fate of a clutch or brood to be determined, along with the date and cause of losses and the rapid identification of possible renesting.

In analyzing breeding by the populations studied, a distinction was drawn between **nest success** and **pair success**. Nest success was understood as the percentage of the nests in which eggs were laid from which at least one young bird ultimately flew. Pair success was defined as the percentage of pairs breeding (laying eggs) which went on to rear at least one young bird. The measure of pair success took no account of the number of times that breeding was attempted. In analysis, no account was taken of non-breeding pairs which maintained territories for only part of the season (even though they sometimes went as far as to build nests).

RESULTS

The level and causes of total losses

The fate of 267 of the studied nests was known. Of these, 193 were successful, which means that total loss was noted in 28% of the instances of breeding. There were no significant differences between the retention reservoirs and the bogs in terms of the level of total failures noted (Tab. 1). The main cause of losses was predation by mustelid mammals and foxes, as well as by Ravens and Magpies. A major and significant difference between the habitats lay in the role of predators in accounting for the total pool of losses. Predator pressure was considerably greater on bogs than on retention reservoirs. On bogs, the greatest losses (16%) were caused by mammals, while destruction of harrier broods by birds was far less common. In contrast, the relative role of birds (corvids) was considerably greater on the retention reservoirs. Total losses due to man were similar in both types of environment (at the level of 5%), but the perpetrators were different, being mainly anglers at the reservoirs and local people on the bogs.

Table 1. The incidence and causes of total losses in breeding. * – differences between habitats significant at the 0.05. ** – at the 0.01 level (test of the two percents)

[Tabela 1. Wielkość i przyczyny strat całkowitych w lęgach. * – różnice między środowiskami istotne na poziomie 0.05. ** – na poziomie 0.01 (test dwóch procent).]

	Reservoirs		Bogs	
	N	(%)	N	(%)
Clutches/broods analysed	123	(100)	144	(100)
Clutches/broods destroyed	38	(31)	38	(26)
Causes of losses				
Man	7	(6)	6	(4)
All predators	16	(13)	31	(22)
– predatory mammals+wild boar**	5	(4)	23	(16)
– birds*	11	(9)	2	(1)
Drowned nest	5	(4)	–	–
All eggs crushed	1	(1)	–	–
No eggs hatched	–	–	1	(1)
Abandoned clutch or brood	3	(2)	–	–
Unknown causes	6	(5)	–	–

Total losses and the phase of breeding

The two habitats differed significantly in terms of the degree of advancement of breeding during which total losses occurred (Tab. 2). Losses at the retention reservoirs were mainly noted during the periods in

which the eggs were being laid or incubated, while more than half of the losses on bogs occurred after the young had hatched.

Table 2. Total losses and the phase of breeding. * – differences between habitats significant at the 0.05 level, ** – significant at the level 0.01 (test of the two percents).

[Tabela 2. Straty całkowite a faza lęgu. * – różnice między środowiskami istotne na poziomie 0.05, ** – na poziomie 0.01 (test dwóch procent).]

	Reservoirs		Bogs	
Number of total losses of known date	32	(100)	36	(100)
Phase of breeding:				
egg-laying stage	10	(31)	5	(14)
incubation stage*	18	(57)	9	(25)
chick-rearing stage**	4	(13)	22	(61)

Reactions of breeding pairs

The reaction of adult birds to the loss of a clutch or brood depended on both the degree to which these were advanced and the date of the onset of laying by the given pair. Repeat breeding became less and less probable as the degree of advancement of the breeding attempt at the time of loss increased (Tab. 3). No case of renesting was noted when a loss occurred after chicks had hatched. Otherwise, repeat laying following a loss was more likely (albeit not significantly more likely) amongst "early pairs" than amongst "late pairs", i.e. more likely amongst those pairs which had started breeding prior to the median date determined for the population as a whole.

Renesting occurred in nests at between 70 and 1100 m of the first one. The time interval between the destruction of the first clutch and the onset of renesting varied from 7 to 15 days.

Table 3. Incidence of renesting in relation to the degree of advancement of the first clutch or broods at the moment of loss.

[Tabela 3. Podejmowanie lęgu ponownego w zależności od stopnia zaawansowania pierwszego lęgu w momencie straty.]

Phase of breeding	All pairs			Early pairs			Late pairs		
	losses	pairs repeating		losses	pairs repeating		losses	pairs repeating	
	N	N	(%)	N	N	(%)	N	N	(%)
Egg-laying	11	7	(64)	3	2	(67)	8	5	(63)
1st half of incubation	12	6	(50)	6	5	(83)	6	1	(17)
2nd half of incubation	12	3	(25)	7	2	(29)	5	1	(20)
Chick-rearing	26	–	–	12	–	–	14	–	–

Pair success in different habitats

Of the 246 pairs which commenced breeding, 179 (73%) achieved success at the first attempt (Tab. 4). The success of repeat breeding was very similar, being at the level of 74% (N=19). A total of 78% of the breeding pairs reared young at either the first or second attempt. The representation of successful pairs did not differ significantly in the two habitats, with the only differences being that pairs from bogs were characterized by a greater tendency to make no further attempt to breed following the first loss (Tab. 4). This was a consequence of the fact that the peak predation pressure was experienced later on the bogs than at the retention reservoirs (Fig. 1.).

Table 4. Breeding success of pairs.

[Tabela 4. Sukces lęgowy par.]

	Bogs		Reservoirs		Total	
	N	(%)	N	(%)	N	(%)
Number of pairs with known fates	138	(100)	108	(100)	246	(100)
Number of pairs successful at 1st attempt	101	(73)	78	(72)	179	(73)
Number of pairs giving up after loss	31	(23)	17	(16)	48	(20)
Number of pairs successful at 2nd attempt	5	(4)	9	(8)	14	(6)
Number of pairs with losses occuring twice	1	(1)	4	(5)	5	(2)
Total number of successful pairs	106	(77)	87	(79)	193	(78)

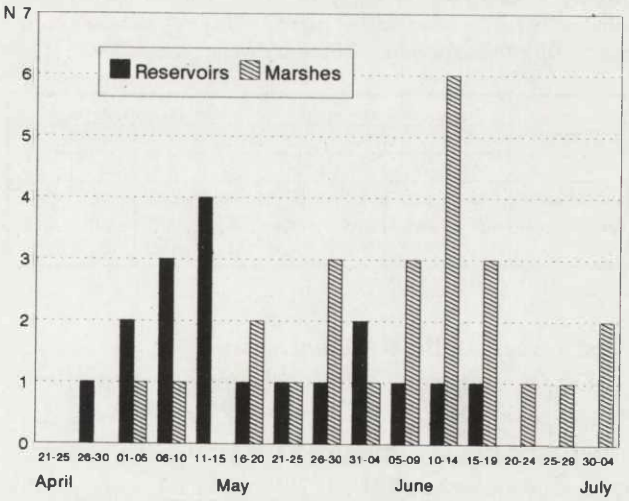

Fig. 1. Dates of the destruction of nests at retention reservoirs and on bogs.

[Ryc. 1. Terminy zniszczeń gniazd na zbiornikach retencyjnych i torfowiskach.]

Pair success ranged from 75% to 82% in the different areas studied. These differences were not significant (Tab. 5).

Table 5. Breeding success of pairs in the areas studied (N) and % of successful pairs.

[Tabela 5. Sukces lęgowy par na badanych powierzchniach: liczba badanych par (N) i % par z sukcesem lęgowym.]

Plot	N	%
Reservoirs:		
Zahajki	45	78
Mosty	63	82
Bogs:		
Gotówka	39	79
Roskosz	85	75
Brzeźno	14	79

Pair success and the date of laying

The ultimate success of "early pairs" was significantly greater than that of "late pairs" (Tab. 6). This relationship was noted in both of the habitats studied. In addition, the success of first breeding attempts by "early pairs" were significantly greater than those by "late pairs" (Tab. 6).

Table 6. Success of (A) "early" and (B) "late" pairs - difference between "early" and "late" pairs significant at * - the 0.05 level, ** - at the level 0.01 (test of the two percents)

[Tabela 6. Sukces par "wczesnych" (A) i "późnych" (B) - różnica między "parami wczesnymi" a "parami późnymi" istotna na poziomie * - 0.05, ** - na poziomie 0,01 (test dwóch procent).]

Habitat	Success of first breeding				Final success of pairs			
	A		B		A		B	
	%	(n)	%	(n)	%	(n)	%	(n)
Reservoirs	84	(51)	61	(57)	88	(51)	74	(57)
Bogs	78	(65)	68	(73)	82	(65)	71	(73)
Total	81	(116)	**65	(130)	84	(116)	*73	(130)

Nest success in the different years

On retention reservoirs, nest success was similar in "vole peak" years and "non-vole" years (vole data after Romankow-Żmudowska & Grala 1990, Romankow-Żmudowska 1991), at 72% and 74% respectively (Tab. 7). Predators reduced 15% of nests in "vole peak" years and 12% in "non-vole" years. Nest success on bogs was greater in "non-vole" years than in "vole peak" years (with the respective figures being 89% and 68%). "Vole" years saw a predator pressure of 22% in this type of habitat, as compared to 10% in the remaining years. However, it should be noted that none of these differences achieved statistical significance.

Table 7. Breeding success of nests (S) and percentage of nests destroyed by predators (P) in "vole peak" years an in the remaining years. (N) – numbers in sample.

[Tabela 7. Sukces lęgowy gniazd (S) oraz procent gniazd niszczonych przez drapieżniki (P) w latach "mysich" i pozostałych. (N) – liczebności próby.]

	Reservoirs			Bogs		
	S		P	S		P
	%	(N)	%	%	(N)	%
Vole peaks years:						
1981	77	(13)	15			
1984	66	(21)	14			
1987				72	(32)	16
1990				62	(52)	27
Mean	72		14.5	68		22
Other years:						
1979	67	(6)	0			
1980	67	(6)	33			
1982	57	(7)	0			
1983	82	(17)	18			
1985	56	(32)	18			
1986	90	(20)	5	95	(32)	5
1988				82	(39)	14
Mean	74		12	89		10

DISCUSSION

Methodological issues

Comparison between the above results and those in other published material is in many cases difficult on account of the fact that other authors have not chosen to differentiate between "nest success" and "pair success", as has been the case in this paper. The values for these two measures will only be identical in cases in which birds do not proceed to repeat lay following losses, and the combining of all nests into a single pool results in a lowering of the estimation of "pair success". In our research, "pair success" was found to be 1/12 greater than "nest success" (the figures being 79% and 73% respectively). It is appropriate to employ the two different measures for different purposes. For example, analysis of the influence of the habitat on breeding losses is better served by the use of "nest success", whilst data on "pair success" is indispensable for population or demographic studies.

Furthermore, the adoption of the aforementioned assumptions is only possible in cases in which Marsh Harriers have monogamous pairings. Our research did not uncover any cases of polygamy by this species, but it has been noted on a number of occasions elsewhere (Altenburg *et al.* 1982, D. Bukacinski, P. Nicolau-Guillaumet – inf.).

Total losses in breeding

Comparisons with results obtained in different regions of Europe must perforce make use of the "nest success" measure only. This value ranges in the literature from 60 to 97%, with the highest levels of success being enjoyed by harriers in Sweden – 91% and 93% (Odsjo & Sondell 1977, Arvidson 1980), Denmark – 93% (Jorgensen 1985) and The Netherlands – 97% (Schipper 1977). The lowest levels of "nest success" have been reported for south-west France – 60% (Bavoux *et al.* 1989), Finland – 63% (Hilden & Kalinainen 1966) and Germany – 66% (Bock 1979). The figure obtained in this work (72%) is most comparable with those given for western Poland – 81% (Witkowski 1989), the Czech Republic and Slovakia – 82% (Divis 1984) and 84% (Danko 1986, 1987, 1988, 1989, 1990) and England – 76% (Underhill-Day 1984).

Predation

The main cause of total losses on the retention reservoirs and bogs was predation, which was reported for respectively 13% and 22% of harrier breeding attempts. A similar situation was described by Witkowski (1989) at ponds in the Barycz Valley, where predators destroyed 10% of the nests of this species in the years 1982–1984. However, in the opinion of Witkowski, predation was in some cases preceded by the abandonment of the nest by the female. It would seem that, on the retention reservoirs, the relatively great role played by corvids in the overall pool of total breeding losses may have been linked to the threats posed to incubating females by anglers, and thus to the advantage taken of the female's absence from the nest by Ravens and Magpies. Such incidents were observed on two occasions. Human penetration was less intensive on the bogs, and the influence of Hooded Crows and Magpies was considerably less marked. Predation and abandonment of nests were also given as the main factors influencing breeding success by Underhill-Day (1984) and by Bavoux *et al.* (1989). The predators of harrier's nests mentioned most frequently in the literature are various mustelid mammals and corvids, as well as – on a more local scale – Foxes, Wild Boar and Bitterns *Botaurus stellaris*, as well as members of the harriers' own species (Bengtson 1967, Creutz 1968, Thiollay 1970, Bock 1979, Underhill-Day 1984, Bavoux *et al* 1989, Witkowski 1989). In addition, on the bogs studied in this work, a Lesser Spotted Eagle, *Aquila pomarina*, was observed in the process of robbing a brood of Marsh Harriers.

This work has shown that different predators were responsible for the destruction of the clutches or broods in the different habitats. The bogs had perennially low water tables, and these decreased in the course of each season. As a consequence, the bogs were considerably more accessible to mammalian predators than the retention reservoirs. An additional element favouring penetration of this habitat by predatory mammals was the burning of extensive areas of vegetation in some years. A further consequence of these differences between habitats was the different times (and thus the different stages of breeding) at which the most intensive predation pressure was experienced. Birds are certainly effective in destroying the nests of harriers at an earlier stage in the season than are mammals. This in turn influences the possibility for harriers to engage in renesting. Nevertheless, in the case of the two habitats studied, there were no ultimate differences in "pair success" at the end of the season.

Other factors

A significant group of factors influencing "nest success" and "pair success" is that connected with human activity and including direct destruction of nests and collection of nests as well as indirect effects through the presence of organochlorine and organophosphate chemicals and heavy metals (Witkowski 1989). The second factor had a significant role as recently as ten to twenty years ago. Witkowski also showed that, in the period 1972–1975, c. 10% of the harrier clutches studied were totally unproductive as a consequence of either the crushing of eggs or the failure of nestlings to hatch. However, in none of the habitats studied in Poland does the current level of total losses due to the crushing of eggs or the death of embryos exceed 0.8% of the total number of nests founded (Witkowski 1989, Buczek & Keller – unpubl.

data). This value is slightly lower than the c. 3% reported from south-west France by Bavoux *et al.* (1989). Moreover, in the habitats studied in the present paper the destruction of broods or clutches of harriers by people was only of a sporadic nature, whilst the collection of eggs did not occur at all.

An issue which has been discussed frequently in the literature is the influence of mass occurrences of the Common Vole on the breeding of various species of birds of prey (Newton 1979). This issue has usually been considered from the point of view of the number of voles and the breeding productivity of birds of prey. However, in this paper, an attempt was made to determine the pressure of the community of predators using this kind of prey on the nest success of Marsh Harriers. It was anticipated that "vole peak" years would see the broods or clutches of Marsh Harriers destroyed to a lesser extent than would be the case in "non-vole" years. However, the data obtained did not offer support for this hypothesis. In the case of the retention reservoirs it was probably the greater pressure due to corvids than to mammals which resulted in the lack of differences in nest success in the different years. Corvids do not have such strong trophic links with voles as do predatory mammals (like Martens, Polecats and Foxes). However, it might have been expected that the predominant role of mammals in the observed losses of clutches or broods on bogs would have ensured that predator pressure would have been greater in "non-vole" years than in "vole peak" years. Unexpectedly, such a result was not noted on bogs either, and it can only be suggested that this was the result of the chance coincidence between "vole peak" years and years in which extensive patches of vegetation were burnt. Burnt areas enabled predatory mammals to penetrate the area more easily.

Pairs starting to breed earlier rather than later in the season had greater success in both types of habitats – a feature which is not easy to explain. However, on the basis of the monograph by Newton (1986) on Sparrowhawks, it is possible to put forward two hypotheses which are not mutually exclusive. The first of these relates to the age of birds, and considers that females which are older, more experienced and coupled with males that are on average older are able to select a safer nest site and to defend it more effectively.

The second hypothesis relates to the quality of the males providing the females with the majority of the food in the periods prior to laying and during incubation. The quality of a male may thus determine: (1) the lapse of time between the return of the female from the wintering grounds and the onset of laying, (2) the frequency with which the incubating female must leave the nest, and (3) the tendency of the female to abandon the clutch or brood indefinitely. However, it will be necessary for further studies to be carried out if confirmation of these factors is to be obtained.

Translated from Polish by dr. James Richards.

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STRESZCZENIE

[Ekologia rozrodu błotniaka stawowego *Circus aeruginosus* we wschodniej Polsce. Część 2. Przyczyny strat całkowitych w lęgach.]

W literaturze poświęconej rozrodowi błotniaków stawowych autorzy najczęściej ograniczają się do podania procentu gniazd, w których zostały odchowane młode i do określenia przyczyn strat. Celem niniejszej pracy była analiza:

(1) sukcesu gniazd, (2) reakcji ptaków na utratę lęgu, (3) sukcesu par lęgowych oraz (4) wpływu rodzaju siedliska, roku i terminu przystępowania do rozrodu na los lęgów oraz par. Badania prowadzono na zbiornikach retencyjnych Zahajki i Mosty (powierzchnie Z i M, 1979–1986) oraz na torfowiskach węglanowych w okolicach Chełma: Roskoszy, Gotówce i Brzeźnie (powierzchnie R, G i B, 1986–1988 oraz 1990). Warunki środowiskowe na zbiornikach retencyjnych (poziom wody i powierzchnia roślinności dostępna do lęgów) były dość stabilne, zarówno w poszczególnych latach jak i pomiędzy latami. W przypadku torfowisk różnice między latami dotyczyły powierzchni roślinności dostępnej do lęgów (z powodu wypalania roślinności przez okoliczną ludność) oraz zmian poziomu wody (następujących również w obrębie sezonu lęgowego). Spośród drapieżników zagrażających lęgom błotniaków na zbiornikach i w ich bezpośrednim sąsiedztwie występowały: lis, tchórz, dzik (nielicznie), kruk oraz sroka, brak było natomiast wrony siwej. Na torfowiskach oraz w ich okolicach obserwowano często lisa, borsuka, jenota, tchórza i dzika a z ptaków wronę siwą, srokę, kruka.

Obserwacje polegały zarówno na wyszukiwaniu i regularnych kontrolach gniazd jak i na obserwacjach dorosłych ptaków. Kontrole gniazd były dokonywane przynajmniej jeden raz w tygodniu aż do wylotu młodych. Taka częstotliwość kontroli pozwalała na ustalenie losu lęgu, terminu i przyczyny straty oraz szybkie odszukanie ewentualnego lęgu powtarzanego. Przy analizie rozrodu badanych populacji odrębnie traktowano sukces gniazd (procent gniazd, z których wyleciało choć jedno młode w stosunku do wszystkich gniazd w których zostały zniesione jaja) i sukcesu par (procentowy udział par odchowujących przynajmniej jedno młode w stosunku do ogółu par podejmujących lęgi (składających jaja).

Spośród 267 badanych gniazd o znanym losie sukcesem zakończyło się 193 (72%). Różnice pomiędzy zbiornikami retencyjnymi a torfowiskami w poziomie strat całkowitych były nieistotne (tab. 1). Główną przyczyną strat było drapieżnictwo ze strony ssaków łasicowatych i lisa oraz kruka i sroki.

W porównywanych siedliskach straty całkowite następowały w różnych fazach zaawansowania lęgu (tab. 2).

Reakcja ptaków dorosłych na utratę lęgu była zależna zarówno od stopnia jego zaawansowania, jak i od terminu przystąpienia danej pary do rozrodu (tab. 3) – im bardziej zaawansowany był lęg w momencie straty tym mniejsze było prawdopodobieństwo podjęcia lęgu ponownego. "Pary wczesne" tzn. przystępujące do lęgów przed medianą określoną dla całej populacji w danym roku, wykazywały większą tendencję do ponawiania lęgów po stracie niż "pary późne".

Spośród 246 par przystępujących do lęgów 179 par (73%) osiągnęło sukces przy pierwszej próbie (tab. 4).

Sukces lęgów ponownych był bardzo podobny i wynosił 74% (N=19). Ogółem 78% par lęgowych wyprowadziło młode (po 1 lub 2 próbach). Nie stwierdzono różnic między środowiskami w udziale par z sukcesem. Jedyna różnica polegała na większym udziale ptaków rezygnujących z dalszych prób po pierwszej stracie na torfowiskach (tab. 4). Największe nasilenie presji drapieżników obserwowano tam bowiem później niż na zbiornikach retencyjnych (ryc. 1). Różnice w sukcesie par między badanymi powierzchniami wahały się od 75% do 82% i były nieistotne (tab. 5). Ostateczny sukces "par wczesnych" był istotnie większy niż "par późnych" (tab. 6). Zależność ta była stwierdzona w obydwu badanych środowiskach. Sukces pierwszych lęgów par "wczesnych" był istotnie większy niż par "późnych" (tab. 6).

Sukces gniazd na zbiornikach retencyjnych w latach "mysich" (lata masowego pojawu nornika zwyczajnego) i "nie mysich" był zbliżony i wynosił odpowiednio: 72 i 74% (tab. 7).

Porównanie wyników niniejszych badań z innymi materiałami dotyczącymi całkowitych strat w lęgach błotniaka stawowego oraz sukcesu lęgowego jest w wielu przypadkach trudne z powodu rozróżnienia przez nas "sukcesu gniazd" i "sukcesu par", czego nie czynili inni autorzy. Wartości te są identyczne jedynie w sytuacji, gdy ptaki nie powtarzają lęgów po stratach. Niewyodrębnianie kategorii lęgów powtarzanych i łączenie wszystkich gniazd w jedną pulę prowadzi do zaniżenia oceny "sukcesu par". W naszych badaniach "sukces par" był o 1/12 wyższy niż "sukces gniazd" (odpowiednio 79 i 73%). Dla różnych celów stosowne jest używanie jednej lub drugiej kategorii. Przy analizie np. wpływu środowiska na straty w lęgach celowe jest korzystanie z "sukcesu gniazd", w innych sytuacjach, np. przy badaniach populacyjnych, demograficznych niezbędne jest posiadanie danych o "sukcesie par".

W Europie "sukces gniazd" błotniaków stawowych waha się od 60 do 97%. Największy sukces miały gniazda błotniaków w Szwecji – 91 i 93%, Danii – 93% i Holandii – 97%. Najmniejszy "sukces gniazd" notowano w południowo-zachodniej Francji – 60%, Finlandii – 63% oraz Niemczech – 66%. Dane uzyskane w niniejszej pracy (72%) są najbardziej zbliżone do podanych dla zachodniej Polski – 81%, Czech i Słowacji – 82–84% a także Anglii – 76%.

Głównym powodem strat całkowitych w lęgach wszystkich badanych w Europie populacji błotniaków stawowych było drapieżnictwo. Najczęściej jako drapieżniki gniazd błotniaków podawane są różne ssaki łasicowate oraz ptaki krukowate a lokalnie również: lis, dzik i bąk a także własny gatunek i orlik krzykliwy. W niniejszej pracy wykazano, że w odmiennych typach środowisk lęgi błotniaków były niszczone przez różne drapieżniki. Torfowiska, na których poziom wody był niski i zmniejszał się w trakcie sezonu były znacznie bardziej dostępne dla ssaków drapieżnych niż zbiorniki retencyjne. Dodatkowym elementem sprzyjającym penetracji tego środowiska przez ssaki drapieżne było wypalanie znacznych połaci roślinności w niektórych latach. Skutkiem tego presja drapieżnicza na torfowiskach i na zbiornikach retencyjnych występowała w największym nasileniu w odmiennych terminach i w związku z tym – w odmiennych fazach lęgów błotniaków.

We wszystkich środowiskach badanych w Polsce aktualny poziom strat całkowitych w lęgach powodowanych przez zgniatanie jaj lub zamieranie wszystkich zarodków nie przekracza 0,8% ogółu gniazd. Zagrożenie lęgów ze strony pestycydów jest obecnie znacznie mniejsze niż w latach 70.

W obydwu typach środowisk znacznie większy sukces odnosiły pary przystępujące do lęgów wcześniej w sezonie. Tłumacząc tą sytuację wysunięto dwie nawzajem niewykluczające się hipotezy.

Pierwsza z nich wiąże się z wiekiem ptaków. Samice starsze, bardziej doświadczone i skojarzone z przeciętnie starszymi samcami potrafią wybrać bardziej bezpieczne miejsce na gniazdo jak również skuteczniej je bronić. Druga hipoteza wiąże się z jakością samców, dostarczających samicom większości pokarmu przed zniesieniem jaj i podczas inkubacji. Jakość samca może decydować o: (1) odstępie czasu między powrotem samicy z zimowiska a jej przystąpieniem do lęgu, (2) częstością opuszczania gniazda przez wysiadującą samicę, (3) jej skłonnością do definitywnego porzucenia lęgu. Czynniki te wymagają jednak potwierdzenia w dalszych badaniach.

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