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Changes and breeding ecology in an urban population of the Magpie *Pica pica* in Słupsk, NW Poland

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Abstract. The breeding population of Magpies in Słupsk increased from 98 pairs in 1979 to 214 pairs in 1991, or by an average of 9.8% per year. An 8.9% fall in the population between 1991 and 1992 was related to neither reduced breeding success nor increased winter losses in the preceding season. Losses of Magpies gathering at winter roosts were between 4.0% (in 1989/90) and 19.5% (1986/87) and the average for 6 consecutive winters was 12.2%. Clutches of 3–8 eggs (mean 5.6) were laid between mid-March and the beginning of June. Young Magpies fledged between early May and late July, with the peak in late May/early June. Successful broods had 1–5 fledglings (mean 2.7). 51% of 412 studied pairs were successful at their first breeding attempt and 35% of the 203 pairs failing at their first attempt went on to renest. The 38% of these breeding successfully took the overall proportion of successful breeding pairs in the Słupsk population to 57%.

Key words: Magpie *Pica pica*, population dynamics, breeding success, urban avifauna

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INTRODUCTION

The colonisation of European towns and cities by Magpies and the rapid rise in breeding populations in such environments are an indication of the fact that this species is enjoying ecological success as a result of the process of synurbization. The ecology of urban Magpies has been studied by a number of authors, but the work to date has concentrated on the breeding season (e.g. Jerzak 1995, Kavanagh 1986, Kavanagh *et al.* 1991, Klejnotowski 1974, Tatner 1982a). There has in contrast been a lack of research into the course and results of breeding as well as the population dynamics outside the breeding season. This work therefore augments data on changes in the size of the population of Magpies in the Polish city of Słupsk in the years 1979–1992 with information on the course and results of breeding in 6 seasons and on changes in populations and winter losses in 6 post-breeding seasons.

STUDY AREA AND METHODS

The work was done in Słupsk (54°28'N, 17°01'E) — a city of about 100,000 inhabitants which covers 43km². The research considered both highly urbanised areas of buildings and communication routes (covering about 15km²) and more extensively-developed suburbs (covering about 28km²). In the March to early May periods of 1979, 1984–1985 inclusive and 1987–1992 inclusive, counts were made of the numbers of newly-built nests of Magpies, with a determination of the number of breeding pairs being made in this way. In the six breeding seasons of 1987–1992 inclusive, the course and success of breeding was followed for a total of 412 first-brood nests and 71 nests with repeat breeding (with between 48 and 77 nests being observed in any given year). Observation work was done from the ground, at intervals of 5–7 days, or less in the period when young began to leave the nest. Direct

observation allowed for determination of the contents of a small sample of 30 nests in the period of incubation.

The course of breeding was determined on the basis of the behaviour of breeding pairs. A completed nest in which Magpies were not observed was considered to have been abandoned prior to laying. A nest in which birds were seen to sit but not to feed young was considered to have failed at the laying and incubating stage. A nest in which incubation was seen to be followed by arrivals of adults with food was considered to have failed at the nestling stage if the fledging of young was not observed, or to have succeeded if at least one fledgling did fly from the nest. In most cases, the number of fledglings was determined on the basis of the maximum number of young observed in the period of leaving a given nest. In several cases, poor visibility resulting from dense foliage made it impossible to determine the number of young birds in a nest, although their presence was

the nest began were combined with the times at which fledglings left the nest and the times for incubation and the presence of young in the nest given in the literature (Cramp & Perrins 1994) to estimate the approximate date on which laying had begun in the different nests.

Territories in which the first attempts at breeding were not successful were searched up to the end of July with a view to determining if attempts at re-nesting had been made. In the Decembers and Marches of the 6 winter seasons 1986/87 to 1991/92, counts were made of the numbers of Magpies gathering at roosts within the city. The first four winter seasons saw research done at all the roosting sites found, while work in the last two seasons concentrated on selected roosts only. The results obtained served in presenting the seasonal dynamics of the populations of Magpies in Słupsk and in estimating the level of winter losses (the percentage decrease between the numbers of birds observed at roosts in December of a given year and in March of the following year).

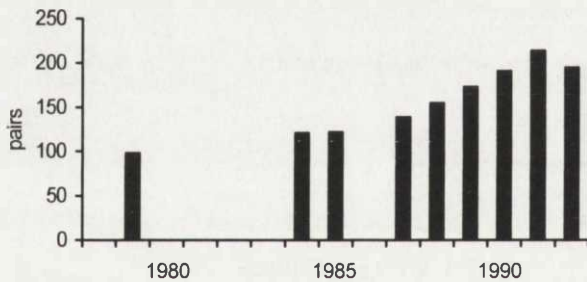


Fig. 1. Population dynamics expressed as changes in the number of breeding pairs in 1979–1992.

[Ryc. 1. Dynamika liczebności wyrażona zmianami liczby par łęgowych w latach 1979–1992.]

indicated by the arrival of adults with food and the calls of alerted young birds from the crown of the tree. In addition, there were 5 nests at which feeding of young continued for long enough (over 4 weeks) to allow it to be expected that development to the flying stage had occurred, and at which adults behaved in such a way as to indicate that fledglings were present (showing alarm at the sight of the observer and giving alarm calls for the whole time while being observed), even though the feeding of these young outside the nest was not actually witnessed. Such cases were included among nests with probable breeding success. The observed times at which the feeding of young in

Table 1. Nest density in some urban and suburban habitats.

[Tabela 1. Zagęszczenie gniazd w niektórych biotopach miejskich i podmiejskich.]

Habitat	Study area (ha)	Nest density (nests/10ha)	
		1987–91	±
City centre	356.0	0.3	0.4–0.2
Residential quarter I	46.5	2.7	3.7–2.1
Residential quarter II	44.0	4.5	5.0–3.9
City park	18.7	2.5	3.7–1.6
Urban allotments	20.0	0.8	1.5–0.5
Suburban allotments	54.0	3.8	6.5–2.6

RESULTS

Population dynamics

The 12-year period 1979–1991 saw the breeding population of Magpies in Słupsk increase 118% from 98 to 214 pairs (Fig. 1). This represented a mean annual increase in the population of 9.8%. The most dynamic increase in the density of nests to be seen in the years 1987–1991 involved suburban allotments and villa districts, while the density in central areas, the city park and urban allotments varied around a relatively constant level (Tab. 1).

In comparison with the situation in 1978 (Górski 1982), the most dynamic increases in densities were noted in suburban allotment gardens (398% over the 13 years or an average of 31% a year) and in residential

quarter I (respective figures of 307% and 24%). The Magpie also expanded its range into the city centre, which it reached in 1983 and thereafter stabilised in numbers after a few years at a relatively low density (Tab. 1). The results of other studies carried out in different European cities (e.g. Harmata 1985, Jerzak 1989, Kavanagh 1987, Klejnotowski 1974, Tatner 1982b, Witt 1985, 1989) also point to continued increases in the populations of this species in the urban environment, to which it seems ever better adapted.

In 1992 there was an 8.9% fall in the breeding population in relation to the previous year. It is not known if this was a short break in the increase or whether it represented the entry of the population into a phase of fluctuating numbers.

Table 2. Seasonal dynamics in numbers and winter losses expressed as differences in numbers of birds gathering in selected urban roosts in December and in March the next year.

[Tabela 2. Sezonowa dynamika liczebności i straty zimowe wyrażone jako zmiany liczby ptaków gromadzących się na wybranych noclegowiskach w grudniu i marcu następnego roku.]

Winter season	Number of birds roosting in:		Winter losses (%)
	December	March	
1986/87	401	323	19.5
1987/88	450	379	15.8
1988/89	525	472	10.1
1989/90	578	555	4.0
1990/91	386	327	15.3
1991/92	183	167	8.7
Mean			12.2 ± 5.6

Winter losses in the years 1986/87–1991/92 varied from between 4% (in winter 1989/90) and 19.5% (in winter 1986/8) of the birds gathering at communal roosts. The mean value was 12.2% (Tab. 2). At 8.7%, losses in the winter preceding the fall in the population in the 1992 breeding season were lower than the mean for the years 1986–1991 (12.9%), which were marked by continued increase in the breeding population. In comparison with those noted among other birds wintering in the centre of Słupsk — like Collared Dove *Streptopelia decaocto* (Górski 1989, 1993, Górski & Górka 1995), winter losses among Magpies were not high in any of the seasons studied. The aforementioned losses in winter 1991/92 could not have been the cause of the population decline noted during the following breeding season because considerably larger winter losses noted previously had not prevented breeding

populations from rising still further in the following year.

Timing of breeding

In the period 1988–91, Magpies in Słupsk began building their nests in the middle of February, and exceptionally even in the first third of this month. The greatest intensity of the onset of nest building was noted in the first two thirds of March, when more than 53% of the 105 pairs observed began to build. New nests continued to appear in April (12.5% of the total) and also in the first days of May (c. 2%) — Fig. 2. The majority of nests whose building began in the latter two months were those of pairs repeat breeding after having failed at the first attempt. Nests of pairs

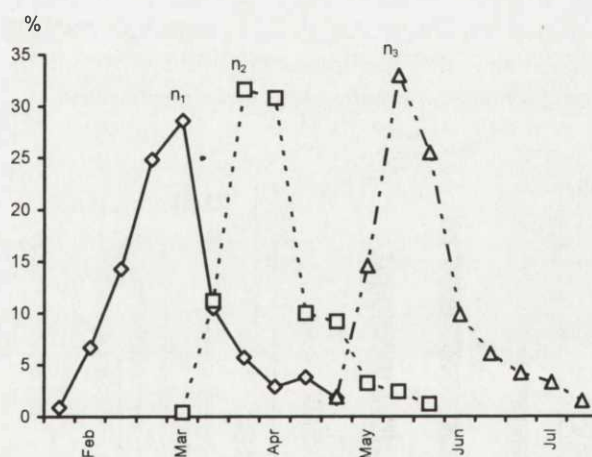


Fig. 2. Timing of: nest building (1988–1991, 105 nests), egg-laying (1987–1992, 250 broods) and fledging (1987–1992, 212 broods). n_1 — number of nests, n_2 , n_3 — number of broods.

[Ryc. 2. Dynamika przystępowania do budowy gniazd (1988–1991, 105 gniazd), znoszenia jaj (1987–1992, 250 lęgów) i opuszczania gniazd przez podloty (1987–1992, 212 lęgów). n_1 — liczba gniazd, n_2 , n_3 — liczba lęgów.]

engaged in repeat breeding were built in close proximity to the first nests. About 92% of all nests in which repeat breeding took place ($n = 36$) were situated within 50m of the first nest, with only 8% of second nests being 51–100m from the nest in which the first attempt had been made.

The times at which Magpies began nest building in Słupsk were similar to those given for other cities in western Poland, namely Poznań (Klejnotowski 1974) and Zielona Góra (Jerzak 1995). Examples of the very early commencement of building in the latter cities

(January 25th in Poznań and November in Zielona Góra) are interpreted by Jerzak (1995) as a method by which birds demonstrate the occupation of territory in conditions of very high population density. In Słupsk too, a nest outside the study area was begun in 1990 as early as in December. However, in the areas where Magpies nested at low densities it would seem that the phenomenon of the early commencement of building may have another foundation, for example one connected with the physiological state of the birds. The onset of building in suburban areas occurred later by around two weeks than that in the built-up parts of the city. In the latter area, the pairs did not winter in suburban roosts, but rather in the city, near their nests from the previous year, in places where illumination from street lamps is present. It is possible that this has the effect of accelerating the physiological reactions stimulating earlier readiness to reproduce, even in the period when the photoperiod is growing shorter.

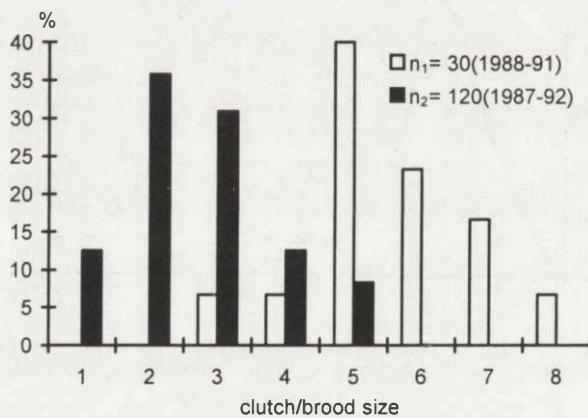


Fig. 3. Percentage distribution of clutch (n_1) and brood (n_2) size.
[Ryc. 3. Procentowy rozkład wielkości zniesień (n_1) i lęgów (n_2).]

The laying of clutches began from the end of March (exceptionally in the middle third of that month). The greatest intensity of the commencement of laying is however noted in the first and middle thirds of April (accounting for 62% of all nests, $n = 250$). New laying was initiated up to the first days of June (Fig. 2), albeit with clutches produced after mid-May being those of pairs engaging in repeat breeding.

Times of the commencement of laying given for Zielona Góra by Jerzak (1995) are close to those seen for Słupsk. However, data for Dublin (Kavanagh 1986) and Amsterdam (Walters 1988) show that the phenomenon begins as early as at the beginning of

March in these places. Young left the nest between the first days of May and the end of July. The greatest intensity of flights from the nest was however noted in late May and early June, when nestlings from about 59% of successful nests left ($n = 212$) — Fig. 2. The first young left at the end of the first third of May (1990 and 1991) or in the second half of this month (1987–1989, 1992). Compared to those given by Harmata (1985) for Kraków and Mizera (1988) for Poznań, these are rather earlier dates (in the case of 1990–1991), or similar ones (other years).

Clutch and brood sizes

Incubated clutches had 3–8 eggs, although those with 5 eggs were noted most frequently (accounting for 40% of the total) — Fig. 3. The mean size of clutches varied from 5.5 eggs (in 1989) to 5.8 (in 1990). The overall mean for the years 1988–91 was 5.6 ± 1.2 , $n = 30$.

1–5 fledglings were observed to leave successful nests, although by far the most frequent figures were 2 (in 36% of broods) or 3 (in c. 31%) — Fig. 3. The mean number of fledglings per successful brood varied from 2.3 in 1988 to 3.0 in 1990, while the overall mean for the years 1987–1992 was 2.7 ± 1.1 , $n = 120$. In relation to the mean size of clutches, the reduction in the sizes of broods in successful nests at the stage of the presence of eggs and nestlings was on average 2.9 eggs and nestlings (almost 52% of the mean size of clutches).

Most young (more than 1/3) came from broods containing 3 fledglings, and broods with 3 or 2 fledglings reared accounted together for almost 2/3 of all fledglings.

Mean clutch size and the mean number of fledglings per successful nest showed a high level of variability (according to the scale from Bogucki 1979) in the years under study. The index of variability C_v had respective values of 22% and 41% for the two variables. However, the data for Słupsk lay within the limits given for other urban populations of Magpies in Europe (e.g. by Husby 1986, Jerzak 1995, Kavanagh *et al.* 1991, Tatner 1982b).

Breeding success and nesting failures

Each year, a certain proportion of nests were abandoned after construction and before the laying of eggs (Tab. 3). It seems possible that these were attempts at breeding made by birds from the previous year. In the first breeding the proportion of such nests varied

from 6% (in 1992) to 16% (in 1988). For the whole study period the figure was over 11%. Among the nests in which incubating Magpies were observed, the proportion failing at the laying or incubating stages was 27% for the period as a whole, with maxima and minima being 15% in 1992 and 37% in 1991 (Tab. 3). The proportions of nests with clutches failing at the nestling stage ranged between a further 8% (in 1990) and 26% (1988), with an overall value for the period of 16%. The completion of breeding with success occurred in between 47 and 71% of nests containing clutches (in 1987 and 1992 respectively) and the figure for the period was 57%. The proportion was lower (at 51% of successful nests) when set against all first-breeding nests constructed (i.e. including those which never contained clutches) — Tab. 3. The mean number of young per nest with a clutch varied from 1.3 (in 1988) to 1.9 (in 1992), while the figure for the entire period was 1.5 fledgling/nest with clutch.

Table 3. Breeding success and nesting failures.
[Tabela 3. Sukces lęgowy i straty gniazdowe.]

First breeding attempt	1987–92
Total nests (1)	412
Nests abandoned prior to laying	47
% of (1)	(11)
Nests with clutch (2)	365
Nests failing before hatching	97
% of (1)	(23)
% of (2)	(27)
Nests failing at nestling stage	59
% of (1)	(14)
% of (2)	(16)
Successful and probably successful nests	209
% of (1)	(51)
% of (2)	(57)
Fledglings/nest with clutch	1.5
Fledglings/nest	1.3
Renesting	
Nests failing at first breeding attempt	203
Attempts at renesting	71
%	(35)
Nests with known results of breeding	52
Successful and probably successful nests	20
%	(38)

35% of the 203 pairs whose first attempt at breeding ended in failure went on to repeat breed. On account of the considerable development of foliage on trees in the repeat-breeding period, the results of breeding were only established for 73% of nests. Success was obtained in the case of 38% of repeat broods whose results were

established. However, the number of fledglings was only determined for a small proportion (5) of the above, with a figure of 1.6 fledglings per nest obtained. In consequence, the overall proportion of pairs in Słupsk breeding successfully was 57%. Tatner (1982a) and Kavanagh *et al.* (1991) underlined that renesting was particularly prevalent in those towns and cities where percentage losses of first broods were high.

Repeat-nesting was also noted in the cases of 11 pairs whose first attempts ended in success. Magpies were removing the roofs of their nests even before the departure of the young and had begun to build new nests in the vicinity of the old ones. The new nest was most often built by only one member of the pair. In 10 cases, the nests were abandoned while they were still being built, but in the one remaining nest young were born to a pair (though there can be no certainty that it was the same pair which had earlier bred in the territory). Young flew from the first nest on May 9th 1990, while the second breeding began on May 23rd, with young flying on July 5th.

Table 4. Nesting failures — combined data from 1987–1992 for first breeding attempt.

[Tabela 4. Straty gniazdowe.]

No. of failed nests:	n=203	(100%)
— at prelaying stage	47	(23.1)
— at laying and incubating stage	97	(47.8)
— at nestling stage	59	(29.1)

In the years 1989–91, the breeding success of nests founded in the urban zone of Słupsk amounted to 57% ($n = 178$), and was thus considerably higher than in the suburban zone, where the corresponding figure was 34% ($n = 32$). This difference was significant at $p < 0.001$ (U test).

Breeding success also differed in territories of varying degrees of attractiveness to Magpies. The result of breeding in the years 1989–91 show that the greatest success (69% of nests, $n = 90$) was enjoyed by Magpies in territories occupied for all three years. Success was lower in those occupied for 2 years, at 47% ($n = 76$), and lowest of all in areas occupied for only one year — 26% ($n = 27$). These differences between different categories of territory were significant at $p < 0.001$ (U test). It is possible that the influence of the quality of territories on breeding success was augmented by the age-related breeding experience of

different pairs. Among territories occupied for three successive years ($n = 30$), breeding success in all years was noted for 30% of pairs, success in 2 seasons for 50% and success in one year for 17%. A lack of success three years running was noted in only one territory (i.e. 3% of those studied). Nesting failures were divided into three categories in relation to the stage of nesting during which abandonment or the loss of broods occurred (Tab. 4). Among 203 unsuccessful first attempts at breeding, 23% involved nests abandoned prior to laying, nearly 48% were abandoned in the course of laying or incubation and 29% at the stage of rearing nestlings in the nest.

CONCLUSIONS

1. After a period of increase in the years 1979–1991, the year 1992 saw a fall in the numbers of breeding pairs of Magpies in Słupsk. This resulted from neither smaller numbers of young in the preceding year, nor from winter losses that were greater than in previous seasons. It is possible that the population has now entered a phase of fluctuating numbers in relation to available food resources.

2. More than half (51%) of pairs founding nests had breeding success at the first attempt, and the figure rose to about 57% when repeat breeding was taken into account. However, losses in successful nests extended to about 52% of mean clutch size. Of the greatest significance to the production of young in the population were cases of breeding in which 3 and 2 young were reared. Together these accounted for 2/3 of young flying from nests.

3. Breeding success was higher in the urban zone than in the suburban zone, a phenomenon associated with differences in pressure from nest predators in the two zones. Breeding success also differed in relation to the length of occupation of a breeding territory by Magpies, with success being clearly greater in those occupied for a greater number of seasons. The factors involved in this may well have been differences in the quality of territories and the age and experience of the pairs holding them.

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STRESZCZENIE

[Zmiany liczebności i ekologia lęgów miejskiej populacji sroki w Słupsku]

Badania przeprowadzono w Słupsku na obszarze 43km², obejmującym zarówno strefę miejską (ok. 15km²), jak i podmiejską (ok. 28km²). Zbadano zmiany liczebności miejskiej populacji lęgowej w okresie 14 lat (1979–1992), przebieg i wydajność lęgów w latach 1987–1992 oraz liczebność i straty zimowe w 6 sezonach połęgowych (1986/87–1991/92).

W latach 1979–1991 lęgowa populacja sroki w Słupsku wzrosła z 98 do 214 par (ryc. 1) — wzrost o 118% w ciągu 12 lat. Średnie roczne tempo wzrostu wyniosło 9,8%. Najwyższy przyrost zagęszczenia stwierdzono w podmiejskich ogródkach działkowych i dzielnicach willowych (tab. 1). W roku 1992 liczebność spadła o 8,9% w stosunku do stanu z poprzedniego roku. Straty zimowe wahały się od 4 do 19,5%, średnio 12,2%, liczby ptaków gromadzących się na wspólnych noclegowiskach na peryferiach miasta (tab. 2). Straty w zimie 1991/92, poprzedzającej sezon lęgowy 1992, w którym nastąpił spadek liczebności populacji lęgowej były niższe (8,7%) od średniej dla okresu 1986–1991 (12,9%), w którym obserwowano wzrost liczebności par lęgowych.

Sroki rozpoczynały budowę gniazd w lutym (zazwyczaj w połowie miesiąca, wyjątkowo — już w pierwszej dekadzie). Największe nasilenie rozpoczynania budowy gniazd notowano w dwóch pierwszych dekadach marca, nowe gniazda pojawiały się do pierwszych dni maja (ryc. 2). Składanie jaj rozpoczynało się pod koniec (wyjątkowo — już w drugiej dekadzie) marca, największe nasilenie inicjowania zniesień przypadało na pierwszą i drugą dekadę kwietnia, a nowe zniesienia rozpoczynane były do pierwszych dni czerwca, przy czym te rozpoczynane po połowie maja należały do par powtarzających lęgi. Młode opuszczały gniazda od pierwszej dekady maja do końca lipca, a największe nasilenie wylotów przypadało na przełom maja i czerwca.

Wysiadywane zniesienia liczyły 3–8 jaj, najliczniej występowały zniesienia zawierające 5 jaj. Średnia wielkość zniesienia wahała się od 5,5 do 5,8, łącznie w atach 1988–91 wynosiła 5,6 jaj.

Udane lęgi liczyły 1–5 podlotów, najczęściej 2 i 3 młode. Redukcja wielkości lęgu w gniazdach z sukcesem wylotu wynosiła średnio 2,9 jaj i piskląt (ok. 52% średniej wielkości zniesienia). Średnia liczba podlotów w pomyślnym lęgu wynosiła 2,7.

W 11% terytoriów, w którym sroki podjęły próby lęgów gniazda zostały porzucone jeszcze przed złożeniem jaj. Spośród gniazd, w których obserwowano wysiadujące sroki 27% zostało porzuconych jeszcze przed wykluciem się młodych a dalsze 16% — na etapie karmienia młodych w gnieździe. Sukcesem wylotu zakończyły się lęgi w 57% gniazd zawierających zniesienia (tab. 3). Spośród par, których pierwsza próba lęgu zakończyła się niepowodzeniem 35% przystąpiło do powtórnego lęgu. Ze względu na trudności w obserwacji tych gniazd (silny rozwój liści w czerwcu), rezultat lęgu ustalono tylko dla 73% gniazd. Sukces wylotu odnotowano dla 38% gniazd. Dokładną liczbę podlotów ustalono tylko dla 5 powtarzanych lęgów (średnio — 1,6 podlotów udany lęg). Całkowita proporcja pomyślnie gniazdujących par sroki w Słupsku wynosiła 57% rozpoczynających lęgi.

Spośród 203 nieudanych pierwszych prób lęgów 23% stanowiły porzucenia gniazda przed złożeniem zniesienia, ok. 48% strat — utrata zniesienia w trakcie składania bądź wysiadywania jaj i 29% — utrata lęgu na etapie wychowywania piskląt w gnieździe (tab. 4).

Zarówno wielkość produkcji młodych, jak i straty zimowe nie tłumaczą przyczyn spadku liczebności populacji lęgowej w roku 1992. Niewykluczone, że po okresie stałego wzrostu populacja sroki w Słupsku wkroczyła już w fazę fluktuacji liczebności.

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