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Breeding ecology of the Red-Backed Shrike *Lanius collurio* in the Wielkopolska region (Western Poland)

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The breeding ecology of the Red-backed Shrike was studied in various habitat types of the Leszno region in 1971-1979. The density of the breeding population was 0.8–6.2 pairs per 10 ha. Of the total number of the nest (n = 168), 40% were placed in shrubs with thorn and spines, and 24% in coniferous trees and shrubs. Most nests were built at a hight 0.7–1.8 m, with mean of 1.4 m. The dates of nest initiation were similar in different years thought temperatures showed large year-to-year variation. Two period of eggs laying were distinguished: basic and supplementary. In the basic period 80% of the nests were initiated. Complete clutches consisted of 2 to 7 eggs, with mean 4.97 eggs. The total losses of eggs and nestlings accounted for 40%. Most losses occured during laying and incubation, an they were mainly due to predators and adverse weather. The mean number of nestlings per nest in which at least one nestling hatched was 4.21. The production of young per successful nest, survived by age 8–10 days, was 4.15. The mean number of young per nest declined with the breeding season.

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INTRODUCTION

The Red-backed Shrike *Lanius collurio* occurs throughout Poland as a moderately abundant breeding species (Tomiałojć 1990). In some parts of western Europe this is a threatened species, and in recent years a decrease in numbers was noted (Mois 1973, Poltz 1975, Sonnabend and Poltz 1979). In this situation it is important to know the state of the Red-backed Shrike population in Poland. The main aim of this paper is to present the data on the occurrence and abundance of this species in various habitats of the Wielkopolska region. Also selected aspects of the biology of reproduction and ecology of shrikes are analysed, in particular their breeding success and factors influencing it.

STUDY AREA, MATERIAL, AND METHODS

The study was carried out in 1971-1979 near Leszno (51°51′ N, 16°35′ E) in the Wielkopolska region, in a farmland typical of this region, with relatively intense agriculture. About 56% of the study area was covered with crop fields, 10% was occupied by meadows and pastures, and about 24% was under forests. A detailed description of this area is published elsewhere (Kuźniak 1978).

Numbers of shrikes were estimated from numbers of breeding territories identified during regular visits to the plots. Detailed data on the density of breeding pairs were collected from five plots representing habitats typical of this species in Leszno surroundings.

P l o t 1. Leszno I: suburban ruderal areas occupying 18.5 ha. About half of this plot was earlier used as a dumping area. During the study period it was covered with grass and luxuriant herbs. Woody vegetation consisted of small trees and shrubs such as wild rose *Rosa* sp., blackthorn *Prunus spinosa*, elder *Sambucus nigra*, black locust *Robinia pseudoacacia*, and other species growing singly or in clumps. The remaining area was covered with crop fields separated by wide balks with rows of poplars *Populus* sp., and elders underneath. In this part there were also two small pools surrounded with multi-species thickets. To the east, the plot bordered on a mixed wood, to the south on the storage of a scutching plant, and the remaining sides adjoined suburban orchards and gardens with single buildings.

P l o t 2. Leszno II: pine cultures 15–20 years old, occupying 15 ha. Among pines *Pinus sylvestris* there were single spruces *Picea exelsa*, larches *Larix decidua*, and oaks *Quercus* sp., also birches *Betula* sp. at the edges. Three sides of the plot bordered on an old pine stand, and one side on a six-year old pine culture. The distance to the forest edge was about 1 km.

P l o t 3. Wojnowice I: a forest covering 11.2 ha near the village. Pine stand 50–80 years old with an admixture of birches and oaks. The undergrowth was well developed on almost the whole plot, and it consisted of different species of young deciduous trees, elders, red-berried elder *Sambucus racemosa*, and alder buckthorn *Frangula alnus*. The edges supported clumps of blackberries *Rubus* sp. and blackthorn. In more humid sites, trees were twisted with hop *Humulus lupulus*. The plot bordered on the village, crop fields, and an alder swamp.

P l o t 4. Wojnowice II: tree stand on Wojnowickie Lake, covering 9.4 ha. About half of the plot was occupied by a 40-year old pine stand with a dense undergrowth comprising blackberry and elder. Most trees and shrubs were twisted with hop. The remaining part of the plot supported an alder swamp with rich undergrowth and herbs.

P l o t 5. Świerczyna: shrubby meadows 12 ha in area. The plot covered a part of the meadows near the Świerczyńskie Wielkie Lake. The plot was bordered by a path with willows *Salix* sp. and clumps of wild roses, hawthorn *Crataegus* sp. and bird cherry *Padus avium*, and by drainage ditches with black alders *Alnus glutinosa* and other shrubs along the sides.

These plots and neighbouring areas were searched for nests of shrikes. The nests were visited at several-day intervals, not longer than one week, from mid-May through July. When clutches were completed, nests and eggs were measured. Eggs were measured with a slide calliper to the nearest 0.1 mm. Some eggs were also weighed to the nearest 0.5 g, using a Pesola spring balance. Only newly laid eggs were weighed, no more than two days after laying. Five-day-periods were used as a time unit for phenological analyses (Berthold 1973).

Data on temperatures during the egg laying period were taken from the weather station at Leszno. Mean temperatures of 5-day-periods were calculated from mean daily temperatures.

Nesting success was calculated as a proportion of successful nests in the total number of nests. A nest was considered to be successful if at least one nestling survived 8–10 days (Poltz 1975). The 8–10-day old nestlings were ringed. Adult birds were not captured at nests.

A total of 168 nests were analysed.

RESULTS

Nesting habitat and density of breeding pairs

Data on numbers and densities of breeding pairs in 1971-1979 are shown in Table 1. The lowest densities were noted on the shrubby meadows and in the tree stand on the lake. The highest densities occurred in the pine forest near the village. One could expect the highest densities in suburban ruderal areas which, according to Durango (1956), seems to be the best habitat to shrikes. This was an open area with rich and diverse herbaceous vegetation, insolated for most of the day, with dense shrubs scattered throughout, and adequate number of perching sites. It should be noted, however, that the number of pairs was rather stable on this plot, whereas on plot 3, the number of pairs drastically declined after 1976, though no important changes occurred in the habitat.

During earlier studies near Leszno in 1968-1972 (Kuźniak 1978), the following densities of shrikes were recorded: 0.1–0.2 pairs/10 ha in villages, 1.3 pairs/10ha in a rural park, and 2.1–2.9 pairs/10 ha in tree stands.

Large year-to-year fluctuations in numbers of shrikes were observed on the study plots. In 1972, 1975, and 1977 densities were high in all the habitats, whereas in 1973, 1976, and 1978 they were low (Table 1).

Nest

Nests were placed in the verticil of rather thick branches, deep inside shrubs, or at tree trunks, and in rare cases on forked branches away from the trunk. Occasionally they were built in herbaceous vegetation or in a pile of dry twigs. Typically they were well sheltered from above and on sides by the hop climbing the trees and shrubs, and also by herbs.

Table 1. Density of breeding pairs of the Red-backed Shrike in 1971-1979 (n – number of pairs, d – pairs/10 ha, x – no data)

Tabela 1. Zagęszczenie par lęgowych *Lanius collurio* w latach 1971-1979 (n – liczba par, d – par/10 ha, x – brak danych)

No and name of plot Nr i nazwa powierzchni	Area (ha) Wielkość (ha)	Year – rok																			
		1971		1972		1973		1974		1975		1976		1977		1978		1979		$\bar{x}$	
		n	d	n	d	n	d	n	d	n	d	n	d	n	d	n	d	n	d	n	d
1. Leszno I	18.5	4	2.2	7	3.8	3	1.6	4	2.2	7.5	4.1	2	1.1	6	3.2	5	2.9	4	2.2	4.7	2.6
2. Leszno II	15.0	x	x	x	x	4	2.7	3	2.0	5	3.3	4	2.7	4	2.7	5	3.3	4	2.7	4.1	2.7
3. Wojnowice I	11.2	7	6.2	5	4.5	5	4.5	6	5.4	6	5.4	1	0.9	3	2.7	1	0.9	x	x	4.2	3.7
4. Wojnowice II	9.4	3	3.2	3	3.2	2	2.1	2	2.1	3	3.2	2	2.1	4	4.3	1	1.1	1	1.1	2.3	2.4
5. Świerczyna	12.0	3	2.5	4	3.3	1	0.8	2	1.7	x	x	x	x	x	x	x	x	x	x	2.5	2.1

Some 40% of the nests were built in thorny and spiny shrubs such as wild rose (31 nests), blackberry (18 nests), Duke of Argyll's *Lycium halimifolium* (6 nests), and hawthorn (2 nests). 24% of the nests were built in coniferous trees and shrubs such as pines (20 nests), spruces (16), larches and junipers *Juniperus communis* (2 nests on each). 30% of the nests were built in other trees such as elder – 19 nests, dogwood *Cornus sanguinea* –4, meadowsweet *Spirea* sp., willow, birch, alder, lilac *Syringa vulgaris*, and snow-berry *Symphoricarpus albus* –two nests in each, beech *Fagus silvatica*, bird cherry, and maple *Acer* sp. – one nest in each. The remaining nests were placed in herbaceous vegetation (2 nests) and in a pile of dry twigs (1 nest).

The majority of nests (73.2%) were built at a height of 0.7 to 1.8 m (Table 2). Two nests were placed on the ground one in nettles *Urtica dioica* and one under a low blackberry shrub in grass on the meadow. The highest nests were built in pines at heights of 3.5 and 4 m. A mean height of 168 nests was 1.4 m.

Table 2. Height of nest location (N = 168)

Tabela 2. Wysokość umieszczenia gniazd (N = 168)

Height (m) Wysokość (m)	<0.4	0.4–0.6	0.7–0.9	1.0–1.2	1.3–1.5	1.6–1.8	1.9–2.1	2.1<
N	5	15	20	41	32	30	10	15
%	3	9	12	24	19	18	6	9

The results of measurements of 92 nests are set in Table 3. The outer diameter was 100–160 mm. Most of the nests were in classes 111–120 mm (24%) and 131–140 mm (also 24%). The inner diameter was less variable, ranging from 62 to 90 mm. 38% of the nests were in class 71–75 mm, and 32% in class 76–80 mm. The height of nests largely varied from 80 to 160 mm. 19% of the nests were in class 111–120 mm and also in class 121–130 mm. Like in the case of the inner diameter, also differences in the depth of nests were lower. They ranged from 40 to 60 mm. The depth of 51–55 mm was noted for 29% of the nests, and 56–60 mm for 23%.

Table 3. Measurements and statistical characteristics of nests in mm (N = 92)

Tabela 3. Wymiary i charakterystyka statystyczna gniazd w mm (N = 92)

Dimension – Wymiar	$\bar{x}$	S.D.	S.E.	V (%)
Outer diameter – Średnica zewnętrzna	132.7	22.1	2.3	16.6
Inner diameter – Średnica wewnętrzna	75.8	5.6	0.6	7.3
Height – Wysokość	109.1	20.4	2.1	18.7
Depth – Głębokość	54.0	6.7	0.7	12.4

Table 4. Timing of the initiation of egg laying and seasonal changes in clutch size in 1971-1979

Tabela 4. Przebieg rozpoczynania lęgów i sezonowe zmiany wielkości zniesienia w latach 1971-1979

		Basic period Okres podstawowy						Supplementary period Okres dodatkowy							Total Ogółem
		16–20 May	21–25 May	26–30 May	31 May – 4 June	5–9 June	10–14 June	15–19 June	20–24 June	25–29 June	30 June – 4 July	5–9 July	10–14 July	15–19 July	
Clutches initiated – Rozpoczętych lęgów	N	10	30	21	23	20	15	4	6	6	6	3	2	2	148
	%	6.8	20.3	14.2	15.5	13.5	10.1	2.7	4.1	4.1	4.1	2.0	1.3	1.3	100.0
Mean clutch size – Średnio jaj w zniesieniu		5.40	5.40	5.05	4.96	5.05	4.80	4.50	4.33	4.67	4.83	3.33	4.00	3.50	4.97

Egg laying

The date of the first egg laying was considered as the date of the initiation of breeding by individual pairs. The earliest clutch was initiated on May 16 and the latest on July 19. Thus, the laying period was very long, taking 65 days. Based on the cumulative distribution of the dates of clutch initiation in 1971-1979, the laying period was divided into two parts, named after Gromadzki (1980) the basic period and the supplementary period. The basic laying period extended from May 16 to June 14. In this period, 80% of the clutches were initiated, and 83% of the eggs were laid (Table 4). In the supplementary period, delayed and repeated clutches were laid.

The relation of mean air temperatures in May to the timing of the initiation of egg laying was analysed in details. It was become evident that temperatures in May were not univocally related with the timing of laying. In different years, laying was initiated at about the same time, in the period from May 16 to May 20 when a mean air temperature in 5-day-periods were above 10° C. Only in 1978, when temperatures were extremely low early in May (10–12° C) and then even lower between May 10 and 16 (5–6° C), laying was delayed by several days. The first pair initiated laying on May 22, and next pairs on May 24 and 25.

Clutch size

The size of 148 complete clutches with known date of the first egg ranged from 2 to 7 eggs, with a mean of 4.97. In the basic period, the clutch size varied from 4 to 7 eggs, with a mean of 5.17 eggs. Most clutches contained 5 and 6 eggs. In the supplementary period, the clutch size varied from 2 to 7 eggs, with a mean of 4.09. Most clutches contained 4 and 5 eggs (Table 5). Clutches containing 5 and 6 eggs accounted for 70% of all the clutches in both periods jointly.

Table 5. Percentage distribution of different clutch sizes in the basic and supplementary periods of 1971-1979

Tabela 5. Rozkład procentowy i różnice w wielkości zniesień w okresie podstawowym i dodatkowym w latach 1971-1979

Clutch size Wielkość zniesienia	Basic period Okres podstawy (N = 116)	Supplementary period Okres dodatkowy (N = 32)	Total Łącznie (N = 148)
2	–	6.2	1.4
3	–	12.5	2.7
4	18.1	43.7	23.6
5	49.1	31.2	45.3
6	30.2	3.1	24.3
7	2.6	3.1	2.7
Average ($\bar{x}$ + S.E.) Średnio ($\bar{x}$ + S.E.)	5.17 + 0.08	4.09 + 0.24	4.97 + 0.04

Differences in the mean clutch sizes between the basic and supplementary periods were highly statistically significant ($p < 0.001$). But year-to-year differences in the mean clutch sizes were not significant.

Clutch size in the Red-backed Shrike clearly declined throughout the season (Table 4), and this decline was highly significant (Spearman rank correlation coefficient $r_s = -0.896$, $p < 0.001$).

Egg size and weight

Mean egg length and width and their variation are shown in Table 6. The length of eggs was normally distributed ($\chi^2 = 1981.98$, $k = 7$, $p < 0.001$), and it did not depend on the clutch size ($r = -0.056$, $p < 0.05$). Also the width of eggs was normally distributed ($\chi^2 = 2075.05$, $k = 7$, $p < 0.05$). It showed a weak but statistically significant correlation with the clutch size. Eggs from smaller clutches were not so wide on average as eggs from large clutches were ($r = 0.275$, $p < 0.05$).

The mean weight of 48 fresh eggs was 3.25 g. The distribution of egg weights fitted the normal distribution ($\chi^2 = 14.1$, $k = 7$, $p < 0.001$). Variation in egg weight was high ($V = 17.8\%$).

Nest losses

Of 168 nests, 60 (36%) were totally destroyed at various stages. Of this number, 13 nests were destroyed or abandoned during construction, 35 during egg laying and incubation, and 12 during the nestling stage.

In some nests, single eggs and nestlings were lost. The total losses of eggs and nestlings accounted for 40.4% of the total number of eggs laid ($n = 752$). During laying and incubation, 242 eggs were lost, that is, 32.2%. From the hatching of nestlings until days 8–10, 62 nestlings were lost, that is, 12.2% of their total number. No relationship was found between the size of losses and clutch size.

The causes of nest losses in different years are shown in Table 7. Predators accounted for 34% of nest losses on average, which is 13.7% of the total number of eggs laid. Nests were robbed mainly by magpies *Pica pica* and jays *Garrulus glandarius*. No other predators were directly recorded. Weather conditions directly accounted for 14% of nest losses (5.6% of the eggs laid). Prolonged rainfalls often in conjunction with low temperatures cause death of nestlings from cold and hunger. In two cases, nests with nestlings were flooded.

Some nest losses, 26% on average (10.7% of the eggs laid), were due to the abandoning of the nest as a result of frequent visits by the observer. This was particularly the case in the first two study years. Few nests were parasitized by the cuckoo *Cuculus canorus*, which accounted for 5% of the losses on average. Three such cases were noted and this reduced the number of eggs laid by 2.1%. 5.1% of the eggs were unfertile, and this accounted for 13% of the losses on average.

Table 6. Egg length and width in relation to the clutch size (N = 97 clutches)

Tabela 6. Zależność wymiarów jaj od wielkości zniesienia (N = 97 zniesień)

Clutch size Wielkość zniesienia	Number of eggs Liczba jaj	Length (mm) – Długość (mm)						Width (mm) – Szerokość (mm)					
		$\bar{x}$	S.D.	S.E.	V%	max.	min.	$\bar{x}$	S.D.	S.E.	V%	max.	min.
2	2	20.90	–	–	–	20.9	20.9	16.25	–	–	–	16.3	16.2
3	9	22.80	–	–	–	24.5	21.8	16.23	–	–	–	16.8	15.7
4	80	22.17	0.73	0.08	3.3	24.3	20.0	16.68	0.58	0.07	3.5	18.2	15.6
5	245	22.18	0.95	0.06	4.3	25.0	19.9	16.66	0.61	0.04	3.7	17.8	15.0
6	132	22.40	0.82	0.07	3.7	24.8	20.8	16.80	0.41	0.04	2.4	18.1	15.9
7	14	22.28	–	–	–	23.3	21.2	16.78	–	–	–	17.5	16.0
Total Ogółem	482	22.25	0.89	0.04	4.0	25.0	19.9	16.70	0.47	0.02	2.8	18.2	15.0

Table 7. Nest losses and their causes

Tabela 7. Wielkość i przyczyny strat

	Years – Lata									Average Średnio
	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Number of eggs laid – Liczba złożonych jaj	53	91	68	108	135	84	76	80	57	
Number of eggs and nestlings lost – Liczba zniszczonych piskląt i jaj	35	38	29	53	34	38	20	30	27	
Total loses (in percent) – Straty ogółem (%)	66	42	42	49	25	45	26	37	47	40.4
including: – w tym:										
Predation – Drapieżnictwo	11	6	25	18	14	17	3	18	11	13.7
Adverse weather – Warunki atmosferyczne	11	8	–	3	2	5	–	9	23	5.6
Abandonet – Opuszczone	30	19	7	15	2	12	7	7	5	10.7
Cuculus canorus	–	–	–	–	–	6	14	–	–	2.1
Unterfeirtile eggs – Jaja niezalężone	6	8	10	7	5	2	–	2	3	5.1
Others – Inne	8	1	–	6	2	3	2	1	5	3.2

Among other factors contributing to nesting failure, which acccounted for 8% of nest losses (3.2% of the eggs laid) one nest fell down, and single eggs or nestlings fell from tilted nests. This category also includes all unknown reasons of nest failure.

Breeding success

In 1971-1979, red-backed shrikes under study laid 759 eggs which produced 510 nestlings, which means that 67.8% of the eggs hatched. At least one nestling hatched in 121 nests. On average, 4.21 nestlings were produced per succcessful nest, and 3.04 nestlings per all nests. Year-to-year differences in the mean number of nestlings per nest were small (Table 8). Statistically significant differences ($p < 0.05$) occurred between 1971 and 1975. A low mean number of nestlings in 1971 could have been due to nest abandoning as a result of frequent visits to the nests by the observer in the first year of the study.

In 108 nests, 448 nestlings survived until 8–10 days of age therefore the average breeding success was 4.15 nestlings per nest. Table 8 shows the mean production of nestlings 8–10-days old from all the nests. In 1971-1979, it was 2.67 young per nest. Significant differences ($p < 0.05$) occurred only between 1971 and 1975 for reasons already mentioned. The actual number of young birds leaving the nest could have been lower than this figure because according to Poltz (1975), losses between the ages of 8–10 days and fledging can account for 20% of the number of eggs laid.

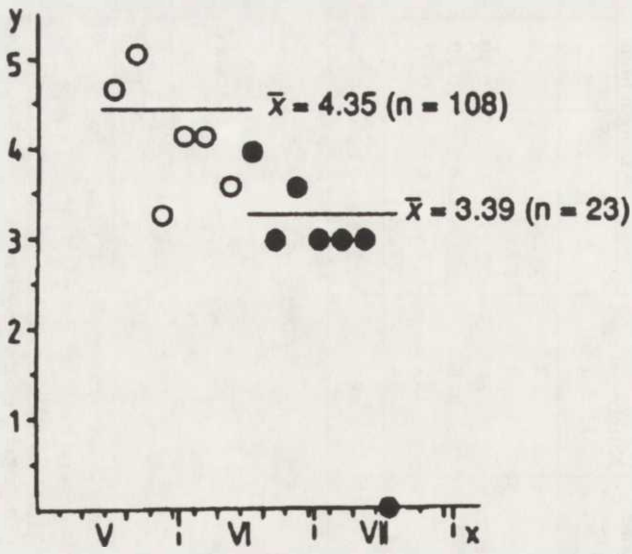

Fig. 1. Seasonal changes in the number of nestlings 8–10 days old per nest (mean values for 1971-1979). x – 5-days periods, y – number of nestlings; O – basic period, ● – supplementary period.

Rys. 1. Sezonowe zmmiany liczby młodych w wieku 8–10 dni na gniazdo. x – okresy 5-dniowe, y – liczba piskląt; O – lęgi okresu podstawowego, ● – lęgi okresu dodatkowego.

The mean production of 8–10-day old nestlings per nest declined over the breeding season (Fig. 1). The relationship between their number and the date of the first egg was significant (Spearman rank correlation coefficient $r_s = -0.852$ i.e. $r^2=73\%$, $p < 0.01$). Eggs laid in the basic period produced 4.45 nestlings 8–10 days old per successful nest, on average, whereas eggs laid in the supplementary period produced 3.39 nestlings, the difference being significant ($p < 0.001$).

The decrease in the number of young per nest over the breeding season resulted from a seasonal decrease in the mean clutch size (Table 4). Both these variables were correlated with each other ($r = 0.81$, $p < 0.001$).

Six-egg clutches produced the highest number of young (3.8 per nest). Differences in the mean number of young produced from 4- and 5-egg clutches were highly significant ($p < 0.001$).

DISCUSSION

The density of breeding pairs observed in the Leszno region did not differ much from that recorded in other regions. Tomiałojć (1970, 1974) and Tomiałojć and Profus (1977) found densities ranging from 0.2 pairs/10 ha in villages to 2.4 pairs/10 ha in rural parks of Upper Silesia. In eastern Germany, the density ranged from 0.04 pairs/10 ha on meadows to 4.3 pairs/10 ha in small woods (Klafs and Stübs 1977). In Slovakia it ranged from 0.1 to 7.3 pairs/10 ha, depending on the habitat type (Randik 1971). The highest densities were recorded there in habitats of the forest-steppe type, and the lowest in a cultural landscape largely transformed by man. According to Durango (1956) one could expect the highest densities in suburban ruderal areas which seem to be the favourable habitat to shrike but it was not so in the study. Unusually high densities were observed in the Wielkopolska region, where Czarnecki (1956) recorded 14.9 pairs/10 ha on average over a three-year study period in a small cemetery, and Gromadzki (1970) found 18.0–20.2 pairs/10 ha in small woods near the village of Turew.

Thus, the density of breeding pairs is clearly related to the habitat type. It largely fluctuates from year to year (Czarnecki 1956, Münster 1958, Randik 1971, author's observations). The fact that changes in numbers went parallel in different habitats suggests that they reflected general changes in the Red-backed Shrike population, presumably caused by factors acting outside their breeding areas. The possible reasons include weather during migration, predation, and available food supply. Also the breeding success in earlier years can account for yearly fluctuations in the breeding population, which indirectly involves such factors as weather during the breeding season, predation on nests, and brood parasitism by cuckoos (Münster 1958, Randik 1971, Stein 1972, Poltz 1975). In recent years, in some countries especially of western Europe, the Red-backed Shrike population is declining. This is due to unfavourable changes in the landscape (Randik 1971, Jakober und Stauber

Table 8. Breeding success in 1971-1979

Tabela 8. Efekty lęgów w latach 1971-1979

Year Rok	Nests Gniazda	Eggs laid Jaja	Nestlings hatched – Pisklęta n	 (%)	Young 8–10 days old Piskląt 8–10-dniowych n	 (%)	Average per nest – Średnio na gniazdo Eggs laid Jaj	 Nestlings hatched Piskląt	 Young 8–10 days old Piskląt 8–10-dniowych
1971	12	53	24	(45)	18	(34)	4.4	2.0	1.5
1972	19	91	56	(62)	53	(58)	4.8	2.9	2.8
1973	16	68	42	(62)	39	(57)	4.3	2.6	2.4
1974	24	108	63	(58)	55	(51)	4.5	2.6	2.3
1975	32	135	117	(87)	101	(75)	4.2	3.7	3.2
1976	18	84	57	(68)	46	(55)	4.7	3.2	2.6
1977	18	76	57	(75)	56	(74)	4.2	3.2	3.1
1978	17	80	60	(75)	50	(62)	4.7	3.5	2.9
1979	12	57	34	(60)	30	(52)	4.8	2.8	2.5
Total/Average ± SE Razem/Średnio ± SE	168	752	510	(68)	448	(60)	4.48 ± 0.24	3.04 ± 0.34	2.67 ± 0.36

1981) and to the use of pesticides and other chemicals in agriculture and forestry (Mols 1974, Poltz 1975). Also in the study area near Leszno, the number of breeding pairs decreased (Table 1), but based on the 9-years study period, it is difficult to tell if this was a persistent trend.

Many authors (Czarnecki 1956, Münster 1958, von Haartman 1966, Mols 1973) have shown that shrikes show preference for thorny and spiny shrubs and for coniferous trees and shrubs as nest sites. Sonnabend and Poltz (1979) have found that at high population densities the proportion of nests on other trees and shrubs such as willows, alder buckthorn, and alders was higher. The selection of nest site largely depends on habitat conditions. On dry wastelands typically covered with different species of spiny and thorny shrubs, they are preferred nest sites. On clearings and along forest edges, nests are placed in clumps of blackberries, in spruces, or in piles of dry twigs and branches.

A high plasticity of shrikes in nest site selection was noted by Jakober and Stauber (1981), who emphasized that nest site selection is influenced by local habitat conditions.

The height of nests in the study area did not differ from that reported by other authors. According to Münster (1958), typically nests are built 1–2 m above the ground. Few nests are built lower or higher, and the highest nest was at a height of 25 m. Jakober and Stauber (1981) have found that most nests were built between 80 and 169 cm. Moreover, they found an interesting, statistically significant tendency to place the nests higher up with time in the season. Mean heights calculated for a large number of nests range from 0.9 m (v. Haartman 1966) to 1.2 m (Ullrich 1971, Sonnabend and Poltz 1979). Nests placed on the ground were observed by Münster (1958), Havlin (1959), and v. Haartman (1966).

The effect of weather in spring, especially temperature and rainfall, on the onset of breeding is documented for many species (e.g. Dyrcz 1963, Kuźniak 1967, Ullrich 1971). Stein (1962) argued that the initiationn of breeding in the Red-backed Shrike depends on temperatures in April, whereas temperatures in May neither delay nor speed up the timing of laying. The correlation between high temperatures in April and early onset of breeding is due to an earlier arrival of birds to the breeding area. When weather conditions in April are favourable, first individuals arrive at the end of this month or early in May. Shortly after the arrival of females, which occurs 1–3 days later, the birds start courtship display and nest construction. Egg laying is initiated immediately after the nest is completed. Under optimal conditions, the first egg may be laid seven days after the arrival of females (Schreurs 1941, Münster 1958).

As shrikes come back from their winter quarters rather late in the season, they have time for raising only one brood a year. They need 60–65 days from laying the first egg to raising the young to independence. They can successfully raise two broods in western Europe, but even there this is a rare phenomenon (Mois 1973).

Similar clutch sizes and their distributions as in the Leszno region were also observed in central Poland. The mean size of 412 clutches from the Kampinos National Park in 1964-1977 was 4.90 eggs (unpublished data of B. Diehl from the Nest Record Scheme developed at the Department of Avian Ecology, University of Wrocław). The size of first clutches ranged from 2 to 7 eggs, with a mean of 5.20. Replacement clutches consisted of 1 to 6 eggs, with a mean of 4.45. First clutches typically contained 5 and 6 eggs, and replacement clutches 4 and 5 eggs. In the region of Warsaw, J. Desselberger and J. Gotzman (pers. comm.) found that a mean size of 61 clutches was 5.20 eggs, and it ranged from 3 to 7 eggs. Most clutches contained 5 and 6 eggs. As compared with the Wielkopolska region, 6-egg clutches were more frequent in central Poland.

The data of many authors (e.g. Schreurs 1941, Münster 1958, Havlin 1959, Poltz 1975) show that also in central and western Europe most clutches contain 5 and 6 eggs, and 7-egg clutches are rare. Also in Finland, the clutch size varies from 3 to 7 eggs and most clutches consists of 5 and 6 eggs, but a mean clutch size of 5.4 (v. Haartman 1966) is slightly higher.

A decrease in the mean clutch size with the season is known for many bird species. It was analysed in detail by Berndt and Winkel (1967) and v. Haartman (1967), who have found that clutch size is closely related to the date of laying. The earlier a female initiates laying, the larger is the clutch size. This pattern has been named a calendar effect. A highly significant relationship of the same type (Spearman rank correlation, $p < 0.001$) was found by Ullrich (1971) and Sonnabend and Poltz (1979).

Eggs of Red-backed Shrike breeding in the vicinity of Leszno are bigger than those in central Poland where the mean length is 21.82 mm and width 16.50 mm (P. Profus and J. Gotzman –per. comm.). Further east-southward, namely in Slovakia (Makatsch 1976, Ferianc 1979) and in the Ukraine (Knysz et al. 1977) the eggs are also smaller (21.70–21.87 x 16.40–16.57 mm) than in Wielkopolska, whereas the Shrike eggs in Sweden (Rosenius in Makatsch 1976) and in Britain (Jourdain in Makatsch 1976) are distinctly bigger (22.49–22.90 x 16.75–17.11 mm) in size.

Most nest losses occurred during egg laying and incubation. Differences in nest losses between different stages of the nesting cycle are due to the behaviour of parents at the nest. As shown by Gotzman (1967), shrikes exhibit two kinds of response to disturbance at the nest –they abandon the nest or defend it. At the stage of nest construction and egg laying, the abandoning of the nest predominates. This response attenuates over the incubation stage and totally disappears when the nestlings hatch, giving way to the defence response.

The present results and the literature data show that the breeding success of the Red-backed Shrike depends on weather conditions and on the density of breeding pairs. Favourable weather during migration and after arrival to breeding grounds stimulate the earlier initiation of breeding, and there is a relationship between the date of the first egg and the clutch size, known as the calendar effect. The relationship between the clutch size and the population density is still a controversial issue in ecology (Pianka 1981). However, such a mechanism of intrapopulation regulation was identified in populations of different bird species (Kluijver 1951, Perrins 1965, Berndt and Winkel 1967). It was also found for the Red-backed Shrike by Sonnabend and Poltz (1979) in their 26-year study on the population of this species: the higher the density of breeding pairs, the lower was the mean clutch size ($p < 0.01$, Spearman rank correlation). The clutch size, in turn, determines the number of nestlings and fledglings per nest.

Weather conditions during the breeding season influence the mortality of embryos and nestlings (Table 7, Ullrich 1971, Poltz 1975). They can also influence the abundance and presumably most of all the availability of food (Havlin 1959).

The rate of predation on nests and brood parasitism by cuckoos are also influenced by the population density (Münster 1968, Ullrich 1971, Poltz 1975).

Weather conditions and the density of breeding pairs can also affect breeding success in such a way that the pairs initiating breeding earlier have more chance to select a better habitat and nest site (Havlin 1959, Sonnabend and Poltz 1979). Better concealed nests are not so easily predated or parasitized by cuckoos, and nestlings in such nests are better protected from adverse weather (Jakober and Stauber 1981).

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STRESZCZENIE

[Ekologia rozrodu gąsiorka *Lanius collurio* w Wielkopolsce]

W latach 1971-1979 w okolicach Leszna na 5 wybranych powierzchniach (podmiejskie tereny ruderalne, zadrzewienie, zakrzewiona łąka, las i młodniki sosnowe) przprowadzono badania wybranych aspektów ekologii okresu lęgowego gąsiorka. Ogółem kontrolowano 168 gniazd.

W okolicach Leszna gąsiorek jest ptakiem pospolitym i średnio licznym, zajmującym różnorodne siedliska. Nie gnieździ się tylko w głębi większych lasów i nie wnika do większych osiedli. Zagęszczenie populacji lęgowej było największe na powierzchniach leśnych, a najmniejsze na łąkach. Na tych samych powierzchniach zagęszczenie wahało się znacznie z roku na rok (tab. 1). Fluktuacje liczebności były prawdopodobnie niezależne od lokalnych warunków siedliskowych, które w okresie badań nie ulegały istotnym zmianom.

Gniazda były budowane na różnych gatunkach drzew i krzewów, najczęściej na dzikiej róży, sośnie, bzie czarnym i w kępach jeżyn. Łącznie na drzewach i krzewach z kolcami i cierniami było 40% gniazd, na drzewach i krzewach iglastych – 24%. Większość gniazd została umieszczona na wysokości od 0,7 do 1,8 m, średnio na wysokości 1,4 m (tab. 2). Średnie wymiary gniazd zestawiono w tabeli 3.

Termin rozpoczynania lęgów w poszczególnych latach, mimo różnic w przebiegu zmian temperatury, był zbieżny, z wyjątkiem roku 1978. Wyróżniono dwa okresy składania jaj: podstawowy i dodatkowy. W okresie podstawowym rozpoczęło się 80% lęgów zawierających 82% jaj (tab. 4). W okresie dodatkowym składane były jaja ze zniesień opóźnionych i powtarzanych.

Pełne zniesienia liczyły od 2 do 7, przeciętnie 4,97 jaj. Wielkość zniesień malała z upływem pory lęgowej. W okresie podstawowym zniesienia liczyły 4–7, przeciętnie 5,17 jaj, a w okresie dodatkowym – 2–7, przeciętnie 4,09 jaj. Najczęstsze były zniesienia 5–6 jajowe (tabela 5). Wymiary jaj zestawiono w tabeli 6.

W badanej populacji zniszczeniu w różnych stadiach zaawansowania lęgu ulegało 36% gniazd. Łączne straty jaj i piskląt wyniosły 40,4%. Większość strat przypadała na okres składania i inkubacji jaj, a ich najczęstszymi przyczynami było drapieżnictwo i niekorzystne warunki atmosferyczne (tab. 7).

Przeciętna liczba piskląt w gniazdach, w których wylęgło się co najmniej jedno pisklę wyniosła 4,21. Efektywność lęgów wyniosła 4,15 piskląt w przeliczeniu na gniazdo, w którym wychowało się co najmniej jedno pisklę do wieku 8–10 dni. Produkcja piskląt w przeliczeniu na wszystkie gniazda wyniosła 2,67 (tab. 8). Przeciętna liczba piskląt na gniazdo zmniejszała się wraz z upływem pory lęgowej (rys. 1). Najwięcej piskląt do wieku 8–10 dni wychowało się ze zniesień 5 i 6 jajowych.
