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Authors: Kuźniak, Stanisław, Bednorz, Jan, and Tryjanowski, Piotr

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Spatial and temporal relations between the Barred Warbler *Sylvia nisoria* and the Red-backed Shrike *Lanius collurio* in the Wielkopolska region (W Poland)

Stanisław KUŹNIAK, Jan BEDNORZ & Piotr TRYJANOWSKI*

Department of Avian Biology & Ecology, Adam Mickiewicz University, Fredry 10, 61-701 Poznań, POLAND

*Corresponding author: e-mail: ptasiek@main.amu.edu.pl

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Abstract. The Red-backed Shrike and the Barred Warbler are a pair of species engaged in breeding association. Whilst the arrival time of both species from their wintering grounds was not correlated, they differed in median arrival time by only one day. The majority of the Barred Warbler territories were located within those of the Red-backed Shrike, in both forest and farmland plots. Both species differed significantly in their selection of nest sites, at least in farmland. Unlike to the Red-backed Shrike ($n = 297$), the Barred Warbler ($n = 60$) preferred blackberry bushes and small deciduous thornless shrubs, and avoided elder, coniferous and hawthorn. The Barred Warbler nests were placed significantly lower than those of the Red-backed Shrike. The results show that no special ecological relationships exist as was suggested in earlier papers for other areas.

Key words: Barred Warbler, *Sylvia nisoria*, Red-backed Shrike, *Lanius collurio*, phenology, nest sites

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INTRODUCTION

It has been well documented that many small Passeriformes avoid nesting in the territories of the Red-backed Shrike *Lanius collurio* (Gotzman 1965, Cramp 1992) and any attempts of nesting near this species are considered exceptional (Holań 1992). The most probable reasons for this behaviour include: 1) the Red-backed Shrike can hunt small passerine birds (Mansfeld 1958, Lefranc & Norfolk 1997); 2) it can be a nest predator (Mansfeld 1958, Mielewczyk 1967); 3) the species is aggressive towards representatives of other bird species (Gotzman 1967, Żolner 1983, Holań 1992).

However, at least one species of passerine, the Barred Warbler *Sylvia nisoria*, regularly breeds near Red-backed Shrike nests. It is possible that this association has the advantage of mutual and more reliable warning against threats (Gotzman 1965, Nankinov & Darakchiev 1979, Cramp 1992). There is some evidence that it also increases the Barred Warbler's productivity (Neuschulz 1988, see also Isenmann & Fradet 1995). If the choice of

a nesting site by the Barred Warbler is determined or influenced by the presence of the Red-backed Shrike, this would mean that:

- 1) the Barred Warbler should arrive to the breeding area after the arrival and establishment of Red-backed Shrike territories;
- 2) the spatial distribution of the Barred Warbler territories would be correlated with those of the Red-backed Shrike territories.

In this paper we test both hypotheses. Besides this, we add some information on the breeding biology of this species in Western Poland because the breeding biology of the Barred Warbler in comparison to other *Sylvia* warbler species is relatively poorly known (e.g. Bairlein et al. 1980, Bocheński 1985, Payewski 1999).

STUDY AREA, MATERIAL AND METHODS

The study was conducted on two experimental plots in Western Poland:

1) WPN plot (61 ha) was located in the Poznań province within the Wielkopolski National Park (16°50'E, 52°16'N). The area was covered with a pine forest degraded by heavy fluorine pollution from a nearby chemical plant. Therefore, the tree stand was thin, and the forest floor was covered with clumps of reed grass *Calamagrostis* sp. and blackberry shrubs *Rubus* sp. (Bednorz 1997). The number of birds was estimated by using the spot mapping technique. The number of birds for both species and the size of their territories were determined in the years 1984–1987 and 1992–1995 during 6 to 8 extensive censuses from the beginning of May till the beginning of July.

2) The plot Leszno (10 km²) was located in intensively used farmland near the town Leszno (51°51'N, 16°35'E). This study area has been described by Kuźniak (1991) and Kuźniak & Tryjanowski (2000). In years 1995–2000 the area was searched using the spot mapping method too, as in WPN. Based on the field observations, the number and size of occupied territories were estimated. In almost all territories active nests were found (Kuźniak & Tryjanowski 2000).

Territories of both species were depicted on maps and their locations over the study plots were compared. As the Barred Warbler territories located near to those of the Red-backed Shrikes, we recognised only these territories, when the distance between their centres, or between the nests of the two species was above than 50 m. The real distributions of these territories were compared with a random distribution using χ^2 test. All yearly data were pooled together, separately for both plots.

The nests following variables were recorded for each nest: nest-site location, i.e. tree species, the height of nest placement in shrubs, and breeding success. A nest was considered to be successful if at least one nestling survived till fledging. For details on nest visiting methods and of the analysis of the nest-site selection see Tryjanowski & Kuźniak (1999) and Tryjanowski et al. (2000).

Additionally, we analysed data on the arrival time for the years 1983–2000 (for details on study area and methods, see Tryjanowski et al. in press).

All the basic statistics were performed according to Sokal & Rohlf (1995).

RESULTS

Arrival in breeding grounds

In the years 1983–2000 the median first arrival time of the Barred Warbler was 7 May (range 3–14

May), and that for the Red-backed Shrike was the 6 May (range 2–14 May). The difference between the arrival times of both species was not statistically significant (median test, $\chi^2 = 1.05$, ns), and the arrival times of the two species was uncorrelated ($r = 0.368$, ns, Fig. 1).

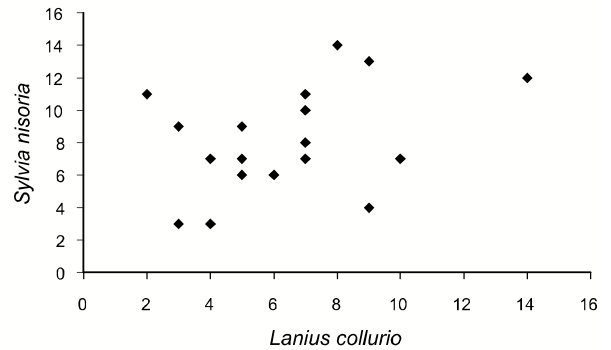


Fig. 1. The spring arrival time (1–16 May) of the Red-backed Shrike and the Barred Warbler. $n = 18$ years (1983–2000).

Density

In the WPN study plot, 6–14 pairs (average density 1.7 ± 0.5 p./10ha) the Barred Warbler and 5–20 pairs (1.9 ± 0.9 p./10ha) of the Red-backed Shrike were found breeding yearly (Fig. 2). The number of breeding pairs of the Barred Warbler and the Red-backed Shrike significantly decreased during the study period ($r = -0.91$ and $r = -0.88$, respectively, $p < 0.005$ in both cases). Changes in the numbers of birds representing both species were significantly positively correlated ($r = 0.75$, $p = 0.033$).

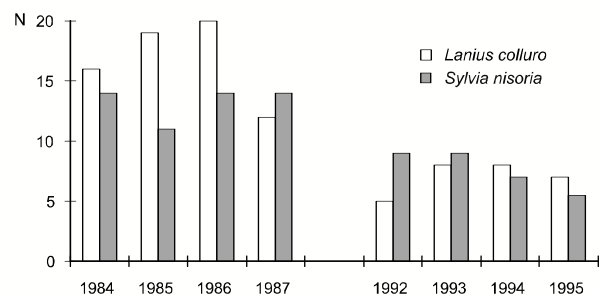


Fig. 2. Number of breeding pairs of both species in the WPN plot during the study period.

In the Leszno plot in the years 1995–2000, the average number of breeding pairs of the Barred Warbler was 7.0 ± 1.7 and the Red-backed Shrike

47.3 ± 6.1 pairs. The population numbers of both species were uncorrelated ($r = -0.023$, ns).

Spatial relations

In the forest study plot (WPN), 69 of 84 (82%) Barred Warbler territories were located within the Red-backed Shrike territories. The Barred Warbler did not nest close (closer than 50 m) to the Red-backed Shrike, as follows from the random distribution ($\chi^2 = 2.17$, ns). In the farmland study plot (Leszno), all of the 52 warbler territories were located near the Red-backed Shrike ones, and the territory distribution differed significant from random ($\chi^2 = 16.94$, $p < 0.0001$).

Differences in nest-site selection

Both species used a wide spectrum of shrubs as nesting sites (Table 1). The differences in using particular nesting sites by the Barred Warbler and the Red-backed Shrike were statistically significant ($\chi^2 = 56.61$, $df = 7$, $p < 0.0001$). The Barred Warbler preferred blackberry shrubs and thornless shrubs and avoided elder, coniferous trees and hawthorn. Another difference was the height of the nest above the ground: the Red-backed Shrike ($N = 266$) built nests on the average at a height of 141 ± 62 cm (range 40–400), while the Barred Warbler ($N = 58$) at a height of 77 ± 54 cm (range 20–220). The differences were statistically significant (Mann-Whitney U test, $z = -5.37$, $p < 0.0001$).

Table 1. Nest places of the Red-backed Shrike ($n = 297$) and the Barred Warbler ($n = 60$) breeding on the same farmland plot Leszno.

Nest site	R.-b. Shrike		B. Warbler	
	n	%	n	%
Elder <i>Sambucus nigra</i>	100	33.7	4	6.7
Other deciduous thornless	46	15.5	16	26.7
Thorny				
Dogrose <i>Rosa canina</i>	33	11.1	12	20
Hawthorn <i>Crataegus</i> spp.	48	16.2	1	1.7
Berry <i>Rubus</i> spp.	29	9.8	20	33.3
Blackthorn <i>Prunus spinosa</i>	14	4.7	7	11.7
Other thorny	5	1.7	0	0
Coniferous	22	7.4	0	0

Data on breeding biology of the Barred Warbler

Out of 41 clutches 29 (70.7%) were successful. The measurements were performed for 15 nests in total. The average outer diameter was 122 ± 11 mm (range 110–140), inner diameter — 77 ± 7 mm (70–90), height 81 ± 19 mm (60–130) and depth 53 ± 9 mm (40–90).

In total, 97 eggs from 20 clutches were measured. The average values presented were calculated using the mean clutch value. The mean length of an egg was 20.90 ± 0.89 mm (range for the clutch: 19.75–22.72, for individual eggs: 18.9–23.1), and the mean egg width was 15.75 ± 0.39 mm (range: 15.12–16.62, for individual eggs: 14.7–17.7).

The mean clutch size was 4.7 ± 0.7 (range 3–6 eggs, $N = 43$), mean brood size was 4.4 ± 1.0 (range 2–6 nestlings, $N = 41$).

DISCUSSION

Co-occurrence of the Barred Warbler and the Red-backed Shrike has been known at least from the beginning of the 20th century (Dresscher 1910), and noted over the whole areas within the geographical range in which the two species occur together (Schmidt 1981, Cramp 1992, Neuschulz 1998, Schönfeld 1998). Many authors have pointed out that the two species are characterised by a similar spatial distribution because they have similar habitat requirements (Gotzman 1965, Neuschulz 1988, Schönfeld 1998, Payevsky 1999). However, no indication of mutual relationships has been given. In the forest study area the majority and in the farmland area all the Barred Warbler territories were close to those of the Red-backed Shrike, but only in the farmland area their distribution was significantly different from random. This observation could be a result of structural differences in the character of the two study areas — there were many more potential nest sites in the forest. Moreover, outside the Red-backed Shrike territories, the Barred Warbler occupied the area with blackberries without open vegetation, which is an element necessary for the Red-backed Shrike. It has been established that the number of breeding shrikes is depending on the percentage of meadows and wastelands, which are the main foraging places of this species (Kuźniak & Tryjanowski 2000).

A detailed analysis of the ecological niches of the two species shows that they differ in the choice of nesting site, the way the nests are fixed, the zones of foraging and diet composition (Gotzman 1965). In the two study plots an evident difference was found in the nest placement, i.e. the choice of shrub for the nesting site and the height of the nest above the ground. The differences in the choice of shrubs for nesting sites have already been reported by Neuschulz (1988).

Hence, the fact that representatives of the two species breed close together follows only from similar habitat preferences with differences in the microhabitat character of the nesting sites. Other species of *Sylvia* warblers sometimes have similar habitat requirements (Schubert 1978, Bocheński 1985), but in contrast to the Barred Warbler they avoid the Red-backed Shrike (Žolner 1983). In contrast, the Barred Warbler sometimes attacks the Red-backed Shrike near the nest (Lindström & Lindström 1999, our unpubl. data). Therefore, it is believed that the Barred Warbler makes a free choice of its nesting sites close to the Red-backed Shrike territories.

The habitat mediated character of the Barred Warbler and the Red-backed Shrike association is also supported by the arrival dates. The Red-backed Shrike arrives at the study area on average only one day before the Barred Warbler, so the Barred Warbler cannot choose the nesting site within the Red-backed Shrike territory because the territories of the latter are still being established (Kuźniak 1991).

It is interesting to note that over 70% of the Barred Warbler clutches were successful. This observation was similar to the reports from Sweden (75.3 %, Hedenström & Åkesson 1991), and higher than the value reported from Germany (53.3%, Neuschulz 1981), although the differences have not been statistically significant (χ^2 test, ns in both comparisons). Unfortunately, it is impossible to correlate these differences with the presence of the Red-backed Shrike since in the areas studied in Poland, no the Barred Warbler nests have been found outside the Red-backed Shrike territories.

The results of nest and egg measurements for the Barred Warbler are very similar to data reported from other European areas (Bocheński 1985, Neuschulz 1981, Schmidt 1981).

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STRESZCZENIE

[Zależności czasowe i przestrzenne pomiędzy jarzębatką i gąsiorkiem w Wielkopolsce]

Według autorów wielu prac jarzębatka i gąsiorek, stanowią parę gatunków silnie powiązanych przestrzennie. Podkreślano, że wybór miejsca gniazdowego przez jarzębatkę warunkowany jest obecnością terytorium gąsiorka.

Jeśli tak było, to powinny znaleźć potwierdzenie następujące założenia: 1) jarzębatka pojawia się na terenie badań po przylocie gąsiorka i za-

jęciu terytoriów przez ten gatunek; 2) rozmieszczenie przestrzenne terytoriów jarzębatki powinno zależeć od przestrzennego rozmieszczenia terytoriów gąsiorka. Hipotezy te weryfikowano opierając się na danych zebranych w latach 1984–2000 na dwóch powierzchniach (krajobraz rolniczy i zdegradowany bór sosnowy) w Wielkopolsce.

Jarzębatka przylatywała na teren badań zaledwie 1 dzień po gąsiorku, a terminy przylotu obu gatunków nie były z sobą skorelowane w kolejnych latach badań (Fig. 1).

Na powierzchni leśnej większość, a na powierzchni polnej wszystkie terytoria jarzębatki znajdowały się w pobliżu gniazd gąsiorka. Jednak, oba gatunki znacząco różniły się w wyborze miejsc gniazdowych (Tab. 1) i wysokości umieszczenia gniazda nad ziemią. Jarzębatki najchętniej gniazdowały w jeżynach, unikając zakładania gniazd na bzie czarnym i drzewach iglastych. Ich gniazda były umieszczone przeciętnie 60–70 cm niżej niż gniazda gąsiorka.

Wszystkie odnalezione gniazda jarzębatki znajdowały się w terytoriach gąsiorka. Rozmiary gniazd i jaj, wielkość lęgu oraz sukces gniazdowy jarzębatki były podobne do stwierdzanych na innych terenach występowania tego gatunku.

Nasze badania nie potwierdziły, sugerowanego wcześniej, mutualistycznego związku między tymi dwoma gatunkami. Jarzębatki gniazdują w terytoriach gąsiorka prawdopodobnie z racji podobnych wymagań środowiskowych. Zależność ta jest szczególnie silna w krajobrazie rolniczym, gdzie czynnikiem limitującym występowanie i wpływającym na obraz rozmieszczenia przestrzennego jest obecność terenów zadrzewionych otoczonych polami i łąkami. Jarzębatka, w przeciwieństwie do wielu innych niewielkich wróblowych, nie boi się gąsiorka (a nawet aktywnie go atakuje) i w ten sposób może wykorzystywać pojawiającą się wolną niszę ekologiczną.