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Brief report

Does breeding performance of Red-backed Shrike *Lanius collurio* depend on nest site selection?

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1. Introduction

The Red-backed Shrike *Lanius collurio* has been declining over large parts of its range, especially in western Europe (Lefranc 1997). For its protection and conservation it is important to identify factors and processes influencing population dynamics. Among them, the loss of breeding habitat is considered as a major cause of decline (Jakober & Stauber 1987, Lefranc 1997). These birds occupy open habitats such as meadows and pastures interspersed with shrubs in which they build open-cup nests.

One of the most important components of the habitat is a safe nest site. It is commonly argued that high nest losses in open-cup nesting passerine birds, with nest predation as the primary source of nesting mortality, should strongly select less vulnerable nest sites. Many authors have found that the incidence of predation may depend on the species of nest shrub (Evans 1978, Gawlik & Bildstein 1990, Tuomenpuro 1991).

The Red-backed Shrike uses a broad spectrum of shrub species as nest sites (Havlin 1959, Lefranc 1979, Jakober & Stauber 1981), but the proportion of nests in thorny or spiny shrubs is particularly high (47–75%). Some authors have suggested that shrike nests placed in thorny shrubs are better protected from predators than in other shrubs (Havlin 1959, Gorban & Bokotej 1995). However, Jakober and Stauber (1981, 1987) found that the Red-backed Shrike nests placed in spruces were particularly successful, but there was no difference in the breeding output between thorny and thornless nest shrubs. Similarly Farkas et al. (1997) found no difference in breeding success of the Red-backed Shrike between thorny and thornless shrubs.

Nest success of the Red-backed Shrike can also vary with respect to the height of nest placement in a given shrub or tree species. For example, Jakober and Stauber (1981) found that nests placed higher than 2.5 m were less successful than lower nests because of their higher vulnerability to predators and harsh weather. Fornasari and Massa (2000) found a higher breeding success for nests built between 0.25 and 1.5 m as compared with nests placed higher than 1.5 m.

The present paper analyses the relation of various types of nest sites to the timing of egg laying, clutch size, hatching success, fledging success, and nest failure from various sources, including predation. Also the effect of the height of nest placement on nesting performance is examined.

2. Study area and methods

The study was conducted during 1971–1979 and most intensively in 1992–1996, in the agricultural landscape of south-western Poland near Leszno (51°51′N, 16°35′E), where crop fields were interspersed with meadows, pastures, and woodlots. Among shrubs scattered in this area singly or in groups, the most common were the Dogrose *Rosa canina*, the Blackthorn *Prunus spinosa*, the Elder *Sambucus nigra*, the Hawthorn *Crataegus* sp., and low (to 4 m) deciduous and coniferous trees. A detailed description of the study area is given by Kuźniak (1991).

The area of 10 km^2 was searched for nests of shrikes. The nests were visited at several day intervals, at least once a week, from mid-May through July. Only the nests found in the laying and incubation stages are analysed in this paper (cf. Tryjanowski & Kuźniak 1999). The date of the first egg was back-calculated from the hatching date. As the accuracy of this estimate largely varied (1–3 days), we used 5-day intervals.

Nests were placed among rather thick branches, deep inside shrubs, or at tree trunks, and in rare cases on forked branches away from the trunk (Kuźniak 1991). The main predators of the Red-backed Shrike nests were magpies *Pica pica* and jays *Garrulus glandarius* (Kuźniak 1991).

Nesting success was calculated as the 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, which is the ringing age. Nestling shrikes typically remain in the nest about 14–16 days. Nonetheless many authors give nesting success at the ringing age (Kuźniak 1991, Olsson 1995) because no data exist for the last few days before fledging. The difference in nest success between the ringing age and fledging age may be high because of spells of harsh weather. It may be less pronounced in case of predation because during the last few days before fledging young shrikes can leave the nest if distributed, and remain motionless deep in tall grass or herbs until the adult birds signal that the danger is over (Olsson 1995).

Nests were classified as lost to predation if all eggs disappeared, some eggs disappeared and adult birds no longer attended the nest, egg shells were in the nest or in the vicinity of the nest, all nestlings disappeared, founded dead nestlings were present in the nest, or the nest was damaged. Nests were considered abandoned where there was no indication of predation and the nest was no longer attended by adults. They were classified as lost due to weather because if they contained dead nestlings after a spell of cold and rainy weather. A nest fall was assumed when the nest was slipping down when attended by adults so that its content (eggs or nestlings) landed on the ground.

All nest sites were grouped into four categories: the Elder, deciduous thornless other than the Elder, thorny, and conifers. The Elder was considered as a separate category because it has more fragile branches than other shrubs. In addition, the Elder abundance has increased in the study area in recent years because of habitat nitrification made environmental conditions favourable to its growth, which, at the same time, inhibited the growth of other shrubs (Wojterska 1990).

The height of nest placement in shrubs was measured with a metre stick to the nearest 10 cm. Only the first (non-repeated) nesting attempts were analysed.

We used one-way ANOVA and Tukey's post hoc test to identify differences in the date of first egg, clutch size, number of young hatched per nest, and in the number of young fledged per nest among different categories of shrubs, also to compare nest heights among different shrub species. A chi-square test was used to compare numbers of nests lost in different shrub species (Sokal & Rohlf 1995).

3. Results

Of the 204 Red-backed Shrike nests found, 95 (46.6%) were placed in thorny shrubs, 17 (8.3%) in coniferous, 54 (26.5%) in elder and 38 (18.6%)

in other deciduous thornless shrubs (Table 1). As the proportion of different shrubs in the study area was not estimated, we cannot comment on nest site preference.

The mean height (± SD) of nest placement for all categories of nests was 139 ± 62 cm. Differences in nest heights between nest sites were significant (Table 2; ANOVA, $F_{3,198} = 8.673$, $P < 0.001$), but only nests in thorny shrubs were placed significantly lower than nests in other shrub species (Tukey test, $P < 0.05$). This was due to a high number of nests placed in low berries (Table 1).

For all the nest sites combined and all four categories of nest substrate (elder, deciduous thornless other than elder, thorny and conifers) no significant relationship was found between the height of nest placement and the clutch size, or the number of young hatched per nest, or the number of young fledged per nest ($P > 0.09$ in all cases).

The compared nest sites did not differ in the date of the first egg laid, as calculated over 5-day periods (Table 2; ANOVA, $F_{3,200} = 1.338$, $P = 0.26$).

No significant differences were found in clutch size and number of young hatched per nest among four categories of nest sites (ANOVA, $F_{3,200} = 0.451$, $P > 0.71$ and $F_{3,200} = 0.808$, $P > 0.49$, respectively), nor was there a significant difference in the number of fledglings per nest (ANOVA, $F_{3,200} = 1.168$, $P > 0.32$; Table 2). However, when the conifers were excluded and the remaining nest shrubs grouped in two categories: thorny and thornless (including elder), the number of young fledged per nest was significantly higher in the former (Mann-Whitney U-test, $U = 3617.5$, $df = 1$, $P = 0.03$). Nests in thorny shrubs fledged on average 2.42 young whereas those in thornless shrubs on average 1.87 young. In successful nests, all the compared parameters were similar for all nest sites (ANOVA, $F_{3,105} = 0.769$, $F_{3,105} = 0.489$, and $F_{3,105} = 0.908$ for the clutch size, number of nestlings per nest and number of fledglings per nest respectively; in all cases $P > 0.5$).

Nest losses, calculated as the proportion of nest lost in the total number of nests, were 50.0% in elder, 52.6% in other thornless shrubs, 42.1% in thorny shrubs, and 35.3% in conifers. These differences are not significant ($\chi^2 = 2.37$, $df = 3$, $P = 0.49$). Causes of nest losses (categories: predation, weather, nest fall, nest abandonment and not identified) were similar for all categories of nest sites ($\chi^2 = 8.57$, $df = 12$, $P = 0.74$), predation be-

Table 1. Nest sites of the Red-backed Shrike

Nest site	n	%
Elder *Sambucus nigra*	54	26.5
Other deciduous thornless	38	18.6
Lilac *Syringa vulgaris*	3	1.5
Birch *Betula* spp.	5	2.5
Oak *Quercus* spp.	7	3.4
Aspen *Populus* spp.	3	1.5
Willow *Salix* spp.	3	1.5
Others	17	8.3
Thorny	95	46.6
Dogrose *Rosa canina*	22	10.8
Hawthorn *Crataegus* spp.	36	17.6
Berry *Rubus* spp.	22	10.8
Blackthorn *Prunus spinosa*	12	5.9
False acacia *Robinia pseudoacacia*	3	1.5
Coniferous	17	8.3
Pine *Pinus silvestris*	9	4.4
Spruce *Picea abies*	8	3.9
Total	204	100.0

Table 2. Data on nest parameters and reproductive success of Red-backed Shrike in different nest sites; mean ± SD.

Nest site (N)	Nest height (cm)	Timing of egg laying (penthad)	Clutch size	No. of nestlings	No. of fledglings
Elder (54)	156.6 ± 7.7	32.2 ± 2.7	5.09 ± 0.81	2.70 ± 2.25	1.87 ± 2.10
Other thornless (38)	161.3 ± 10.1	32.7 ± 2.7	5.00 ± 0.87	2.58 ± 2.25	1.87 ± 2.23
Thorny (95)	59.5 ± 6.1	31.7 ± 2.7	5.15 ± 0.87	3.16 ± 2.25	2.42 ± 2.37
Coniferous (17)	159.8 ± 14.5	31.5 ± 2.1	4.94 ± 0.90	2.94 ± 2.28	2.64 ± 2.32

ing the major mortality factor (45.2% of all cases).

4. Discussion

The results of this study show that nest site selection has an effect on the breeding performance of Red-backed Shrike, but the evidence concerns only some indices. No significant differences were found in the clutch size and number of young hatched per nest among various categories of shrubs. However, the number of young fledged per nest was significantly higher in thorny as compared with deciduous thornless (including elder) shrubs. It was even higher in spruces but the difference was not significant because of the small number of nests in this nest substrate. Jakober and Stauber (1981, 1987) who also found a high nesting success in spruces argue that spruces provide a firm support for the nest due to the rough texture of the bark on branches; spruces also provide a good nest concealment as they are evergreen plants.

As the advantage conferred by thorny shrubs concerns the nestling stage and not the egg stage, and predation was the main source of nest failure, the difference in nest success between these two stages might arise from the change in antipredator behaviour of the parents. During the egg stage, Red-backed Shrikes rely on secretive behaviour rather than on active defence against predators, although sometimes they may attack predators as noted by Panow (1983). However, during the nestling stage they actively deter predators, with intensity increasing towards the end of the nestling stage (Gotzman 1967, Lefranc 1979). It is possible that nests in thorny shrubs are easier to defend than nests in other shrubs. The reason may be that nests in thorny shrubs are often accessible from one side only, the other sides being protected by dense and stiff branches. Moreover, there are individual differences in the intensity of nest defence during the nestling stage, ranging from avoidance to violent attacks, the most aggressive parents being the most successful ones (Diehl unpubl.). If the most aggressive birds nested in thorny shrubs in a higher proportion than did less aggressive birds, nest site quality and parent quality might have cumulative effect on the reproductive output. This might have been the case if thorny shrubs conferring advantage for breeding success were in short supply, and there was competition for territories with such shrubs, in which more aggressive males were likely to be winners. Nest height may also affect the nesting outcome of different bird species (Best & Stauffer 1980), but it seems to be of little importance to the breeding success of Red-backed Shrike in the study area. Only in conifers, lower nests were marginally more successful than higher nests.

As a large number of factors influences breeding performance, more detailed analyses are needed to evaluate the importance of nest site selection.

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Selostus: **Vaikuttaako pikkulepinkäisen pesäpaikan valinta pesimämenestykseen?**

Pikkulepinkäiskannat ovat taantuneet viime vuosina etenkin Länsi-Euroopassa. Yksi tärkeimmistä syistä kantojen koon pienenemiseen on ollut sopivien pesimäympäristöjen väheneminen. Linnuilla pesimähabitaatin oleellinen osa on hyvä ja turvallinen pesäpaikka. Kirjoittajat tutkivat erilaisten pesäpaikkojen (selja, muu piikitön lehtipensas kuin selja, piikkipensas ja havupensas/puu) ja pesän sijainti korkeuden vaikutusta pikkulepinkäisen pesintämenestykseen Puolassa vuosina 1971–1979 ja 1992–1996. Valtaosa (47%) löydetyistä 204 pesästä sijaitsi piikkipensaissa. Piikkipensaissa sijainneet pesät olivat alempana kuin muissa pensaissa sijainneet pesät. Pesän sijaintikorkeus ei kuitenkaan vaikuttanut pikkulepinkäisten pesimämenestykseen. Myöskään pesän sijaintipaikka ei näyttänyt vaikuttavan pesimämenestykseen. Jatkoanalyysissä, jossa pesäpaikka luokiteltiin kuuluvaksi joko piikkipensaisiin tai piikittömiin pensaisiin, oli lentopoikasten määrä suurempi piikkipensaspesissä. Piikkipensaissa sijaitsevat pesät lienevät paremmin turvassa pedoilta kuin muissa pensaissa sijaitsevat pesät. Pesien tuhoutumisessa ei kuitenkaan havaittu eroja erilaisten pesäpaikkojen välillä. Pesien tuhoutumisen tärkeimpänä syynä oli predaatio, mikä aiheutti 45% havaituista tuhoista. Pesäpaikan lisäksi pesimämenestykseen vaikuttaa myös emojen laatu. Kirjoittajien mukaan esimerkiksi pikkulepinkäisemojen välillä on eroja pesän puolustusintensiteetissä. Agressiivisesti pesäänsä puolustuvat emot menestyvän pesinnässään muita paremmin. Lintujen pesäpaikan valintaa tutkittaessa olisikin pyrittävä huomioimaan useita eri tekijöitä elinympäristön yleisestä rakenteesta emojen laatuun asti.

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