

Breeding biology of the Great Grey Shrike (*Lanius excubitor*): an analysis of nest record cards

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Abstract: The aim of the study was to present variability in nest and breeding parameters of the Great Grey Shrike in Poland. We analyzed 83 nest record cards. Most data were recorded in 1982–2002. The analyzed parameters included: nest location, nest height, nest structure, breeding phenology, clutch size, breeding success and breeding losses. Our results were consistent with those found in the literature. In the paper we also discussed the possibilities and limitations of using data available in the Polish Nest Record Scheme.

Key words: breeding biology, Great Grey Shrike, nest record cards, nest structure

INTRODUCTION

The Great Grey Shrike (*Lanius excubitor*) is relatively flexible in its choice of breeding territories and nesting sites (BAUER et al. 1988). Most nests are centrally located in the territory, with convenient perches that allow monitoring of the entire territory (HÖLKER 1993a). Nest structure of the Great Grey Shrike was previously described by other authors (YOSEF 1992, ŽURAVLEV & PAMCELJUZIN 1974, SOLIS & REBOLLO 1985, PANOV 1996, IVANOVSKY & KUZMENKO 2000). The nest structure depends on substrate availability in the territory; for example in 60–90% of nests located in pines the outer layer is made of pine twigs (ŽURAVLEV & PAMCELJUZIN 1974). However, more detailed research is required into the nest construction process. From a theoretical perspective, features like nest structure, nest size, or nest location are subject to strong natural selection pressures (COLLIAS 1997). The nest is a parameter that may influence sexual selection and, ultimately, the breeding success (SOLER et al. 1995). Research on the Red-backed Shrike (*Lanius collurio*), however, has not supported this theoretical assumption (TRYJANOWSKI 1999). In the case of the Great Grey Shrike the nest is built by both the male and the female, with

the male appearing more frequently around the nest (PANOV 1996). The construction process is relatively long, ranging from 9 to 15 days (YOSEF 1992). Next, it may take up to 6 days between the completion of nest construction and the laying of the first egg (PANOV 1996). The main objective of our study was to present nest structure variability in the Great Grey Shrike. Additionally, we discuss in this paper the possibilities of using data available in Nest Record schemes, as those previously used for the Blackbird (*Turdus merula*; WESOŁOWSKI & CZUCHRA 2000).

MATERIAL AND METHODS

We analyzed 83 nest cards. Most data were recorded between 1982 and 2002, and only a small percentage (9.8%) in 1964–1982. The majority of the data were collected in southwestern and western Poland (68.7%). Parameters like nest height, nest location, and the plant species in which the nest was found, were read from the nest card. However, we assessed from the additional available data also some other variables, such as type of habitat, timing of breeding, clutch size, and breeding success. The timing of breeding was defined as the day of laying the first egg (or the initiation date), and was calculated backwards, basing on available literature (CRAMP & PERRINS 1993). Such a procedure estimated the timing of breeding with an accuracy of ± 3 days (resulting from the variability of the length of the incubation stage). For cards that provided information about the results of the water test or the developmental stage of the nestlings, a similar procedure was applied, basing on MAYER-GROSS' key (1972). If the date of laying the first egg could not be determined (38.5%), only the range of plausible timings of breeding was provided, reaching up to 14 days (as the observation day could fall anywhere between the first and the last day of the incubation period).

Clutch size was defined as the number of eggs in the nest monitored at the incubation stage, or alternatively the sum of the number of nestlings and the number of unhatched eggs in nests observed after hatching. The analyses excluded nests (60%, $n=83$) where only the presence of eggs or nestlings was indicated, without providing exact numbers.

Breeding success was defined as the percentage of nests in which at least one nestling fledged. The loss rate was calculated as the percentage of damaged/undamaged nests in the sample. Hatching success (i.e. the percentage of nests with at least one nestling) and fledging success were calculated with the following formulas:

Hatching success = number of hatchlings/number of eggs * 100%

Fledging success = number of fledglings/number of nestlings * 100%

All calculations and statistical analyses were performed in SPSS/PC+ (NORUSIS 1994).

RESULTS

Habitat

The most preferred habitat were field hedges (61%), while coniferous and mixed forests constituted the remaining 39%. Nests were found in at least 18 different plant species, with 72.1% located in deciduous trees and shrubs. Nests found in conifer-

ous trees and shrubs made up 27.8% of the sample. The largest number of nests was located in pines (20.2%; Table 1).

Table 1. Frequency of Great Grey Shrike nests in deciduous trees and shrubs

Tree/shrub species	No. of nests	% of all nests
Hawthorn (<i>Crataegus</i> sp.)	11	14.0
Poplar (<i>Populus</i> sp.)	8	10.1
Oak (<i>Quercus</i> sp.)	8	10.1
Willow (<i>Salix</i> sp.)	6	7.6
Blackthorn (<i>Prunus spinosa</i>)	5	6.3
Alder (<i>Alnus</i> sp.)	4	5.1
Pear tree (<i>Pyrus</i> sp.)	3	3.8
Birch (<i>Betula</i> sp.)	2	2.5
Other deciduous	10	12.6
<i>DECIDUOUS subtotal</i>	<i>57</i>	<i>72.1</i>
Pine (<i>Pinus sylvestris</i>)	16	20.2
Spruce (<i>Picea excelsa</i>)	6	7.6
<i>CONIFEROUS subtotal</i>	<i>22</i>	<i>27.8</i>
TOTAL	79	100

Nest location

Most nests were found on side branches (37.6%) or in branch bifurcations (34.8%), while 14.5% by the trunk and 13.1% close to the top of the tree (n=83). Depending on plant type – deciduous versus coniferous trees and shrubs – nest locations differed primarily in the percentage of nests found by the trunk: 31.8% in coniferous trees and 5.2% in deciduous trees. Numbers of nests positioned in branch bifurcations and close to the top were similar for both types of plants.

Nest height

The Great Grey Shrike's nest height ranged from 0.2 to 25.0 m (mean±SD = 7.6±4.5 m). Most frequently the nests were built 3.5 to 5.0 m above ground, with 27% of the nests within this range. In field hedges, nest height ranged from 2.0 to 15.0 m (mean±SD = 6.5±3.5 m). In coniferous forests the mean nest height was 11.9±8.6 m; in wet habitats 9.3±4.7 m; whereas in mixed forests 8±2 m.

Nest structure

On top of standard elements of the nest structure, the birds used grass blades (92.4% of nests), feathers (63.3%), nylon string (24.4%), and paper (6.1%). Paper

was first identified in the nest structure in 1995, whereas nylon string was first noted in 1982. The frequency of string use for nest construction increased in subsequent years (logistic regression: $y = -45.49 + 0.023x$, $R^2 = 0.123$, $F = 8.98$, $df = 64$, $P = 0.004$).

Breeding phenology

Nest construction was first reported on 28th March. The largest number of nests at the construction stage were found between 6th and 13th April. Egg laying started in late March or in April, as 30th March was the earliest recorded initiation date. The timing of breeding peaked in late April. The last clutches were laid in late May, 30th May being the latest recorded initiation date.

Clutch size

Clutch size ranged from 1 to 8 eggs, with most clutches comprising 6–7 eggs (56.4%); mean \pm SD = 5.6 ± 1.6 eggs (Fig. 1).

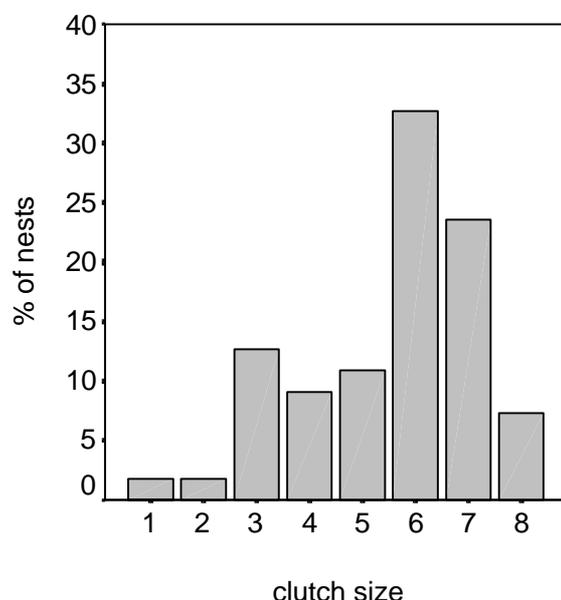


Fig. 1. Distribution of clutch size of the Great Grey Shrike (n=55)

Breeding success

In 71.7% of the nests, at least one nestling hatched. The survival rate of hatched clutches was 68.1%. The final breeding success could not be calculated directly, as different nest samples were used to determine hatching success and fledging success. Therefore the following formula was applied to calculate the breeding success: breeding success = hatching success \times fledging success / 100%

Thus calculated, breeding success was 48%, which means that in every second nest of the Great Grey Shrike in Poland, one or more nestlings fledged.

Partial losses

The comparison of the initial average clutch size (5.6 eggs) with the mean number of nestlings observed in the nests (5.3 ± 1.4 range 2–8, $n=29$), suggests that partial losses were relatively small in the study species.

Complete losses

Nearly 18% of nests with known fate ($n=39$) were destroyed. Nests with eggs were damaged more frequently (4 of 7) than nests with nestlings (1 of 7). From two nests, eggs were removed. In the remaining cases, only empty nests were destroyed.

DISCUSSION

The use of data from the Nest Record Scheme to correctly describe and interpret parameters of birds' breeding is complicated. Data provided in nest cards are prone to distortions resulting from both the observer's and the analyst's biased evaluations (CRICK et al. 2003). Information recorded in nest cards may be incomplete for several reasons: nests are frequently found after the initiation date, and nest checks may be unsystematic (CRICK et al. 2003). Considering the heterogeneity of the material, information concerning the date of laying the first egg, number of eggs, number of nestlings, and the final breeding success should be regarded as mere estimates. Some records need to be ignored due to their unreliability. Further, not all nest cards provide information about each of the aspects of the breeding biology. The main advantage of using data collected by volunteers in the Nest Records is the low cost of the procedure. Moreover, the observers work all over the country, which makes it possible to compare aspects of the breeding biology of a species in different regions. The many years of efforts of the participants have resulted in large numbers of cards compiled through the years, enabling the monitoring of changes in aspects of the breeding biology of many bird species. This paper is based on 83 nest record cards. Such a number is sufficient for a relatively accurate description of those aspects of the breeding biology which may be identified through a single nest check (such as the type of habitat or nest height). However, this method of collecting data enables only an approximate assessment of those breeding parameters which require repeated nest checks (WESOŁOWSKI & CZAPULAK 1986). The Great Grey Shrike's habitat preferences, determined through nest record card analyses, are consistent with the findings of faunistic studies. Great Grey Shrikes nest in coniferous and deciduous trees, various types of hedges (61% of 82 nests) and in orchards (HÖLKER 1993a, SCHÖN 1994, PANOV 1996, TRYJANOWSKI et al. 1999). They are also likely to nest in wet habitats. IVANOVSKY & KUZMENKO (2000) found from 0.3 to 0.8 couples per km^2 in the marshes of Belarus. Their preferred breeding territories comprise semi-open space with numerous vertical structures (shrubs, single trees, fences, etc.), used as perches (HÖLKER 1993a). Nests of this species were most often found in pines (*Pinus sylvestris*) and hawthorns (*Crataegus* sp.; see Table 1). They were also relatively frequent in poplars (*Populus* sp.) and oaks (*Quercus* sp.): 19.2% jointly ($n=83$). Among the 27 nests found in Wielkopolska, 7 were located in poplars and 6 in pines (TRYJANOWSKI et al. 1999).

PANOV (1996) noted that in some regions Great Grey Shrikes preferred deciduous plants while in others they favored coniferous species. For example in Belarus 10 out of 14 nests were found in pines, 2 in spruces, and the remaining 2 in an oak and a poplar. In Spain, oaks (*Quercus rotundifolia*) and hawthorns (*Crataegus monogyna*) were the most popular nesting sites (SOLIS & REBOLLO 1985), whereas in Germany 22 out of 30 nests were found in spruces (*Picea abies*) and only 2 in hawthorns (*Crataegus* sp.) (HÖLKER 1993b).

Great Grey Shrikes nest at the average height of 7.6 ± 4.5 m, which is consistent with the mean value for the entire Palearctic, i.e. 7 meters (PANOV 1996). However, mean values reported from several countries are very different from our results: 13.2 m (n=30) in Germany (HÖLKER 1993b), 12.8 m (n=36) in Switzerland (BASSIN 1982), and 3 m (n=21) in Spain (SOLIS & REBOLLO 1985). This shows that nest height in this species is variable and probably depends on the height of trees and shrubs in the breeding territory (TRYJANOWSKI et al. 1999). Accordingly, YOSEF (1992) found that in the desert, where the species nests in shrubs, the average nest height was 0.95 m (n=33). In general, the course of the species' breeding season is also consistent with data reported by other authors. The nest construction process begins in early April or even in late March in warmer years, e.g., on 28th March 2001 in Białowieża (HÖLKER 1993b). The Great Grey Shrike's breeding season begins the earliest in southern regions of Western Europe, where eggs tend to be laid in late March or in early April (PANOV 1996). In the harsh climate of Eastern Europe the breeding season starts later, with 7th May marking the average timing of breeding (ŽURAVLEV & PAMCELJUZIN 1974). In Poland the species' breeding activity tends to peak in April, while the last clutches appear in the second half of May, which is consistent with data reported for moderate latitudes (BASSIN 1982, SOLIS & REBOLLO 1985, YOSEF 1992, HÖLKER 1993b). Great Grey Shrikes lay from 3 to 9 eggs, with most clutches comprising 4 to 7 eggs (PANOV 1996). In Poland, nests with 6 to 7 eggs constitute as much as 56.4% of all clutches. The average clutch size in Poland – 5.6 ± 1.6 eggs – falls within the range reported for other regions, with mean values ranging from 5 in the Middle East (YOSEF 1992) to 7.1 in Finland (PANOV 1996). The final breeding success, assessed on the basis of nest card analysis, amounts to 48.8% and is relatively small compared to findings reported by other authors: 56.6% in south-eastern Germany (PANOV 1996), 63% in Israel (YOSEF 1992), and the impressive 72.7% in Westphalia (HÖLKER 1993b). This may result from the fact that hatching success and fledging success were calculated in different nest samples, which, in turn, was necessary due to the limited number of nest cards providing complete information about the nest's fate (n=39).

The main causes of losses include depredation and adverse weather (YOSEF 1992, ANTCZAK et al. 2004). There are also other factors that may significantly decrease the breeding success. These include: nest abandonment caused by spring fires, or the nestlings' entanglement in the string used for nest construction (ANTCZAK et al. 2004). In the analyzed sample, predators probably caused nest destruction (18%, n=39).

Behaviour related to nest construction is observed in most birds (HANSELL 2000). Nest size and structure play a significant adaptive role (COLLIAS 1997, ALA-BRUDZIŃSKA et al. 2003). Their main functions are: stabilizing thermal conditions

and humidity, decreasing detectability by predators, and an anti-parasite effect (ALABRUDZIŃSKA et al. 2003). Proper nest size and structure ensure effective thermal isolation and prevent eggs or nestlings from falling out of the nest (MØLLER 1990). Nest location is also far from random. Plants surrounding the nest protect it from the sun, rain and wind, and guard it from predators (COLLIAS 1997). Nest size, structure, and location are thus important aspects of the breeding strategy, and – as such – are subject to natural selection pressures (ALABRUDZIŃSKA et al. 2003). As a result, many traits related to nest construction are species-specific (HANSELL 2000). The Great Grey Shrike's nest is a spacious structure built mainly of twigs and stalks (SOLIS & REBOLLO 1985, YOSEF 1992, PANOVA 1996). The twigs forming the outer layer of the nest are interlaced with the surrounding branches of the tree or shrub where the nest is located. Such a manner of fixing the nest prevents damages caused by rain or wind (YOSEF 1992). The middle and inner layers are usually made of feathers, grass blades, animal hair and fur, as well as wool and moss (PANOVA 1996). String, which was found in 24.4% of the analyzed nests (n=66), is an important construction material, mentioned in earlier reports (SOLIS & REBOLLO 1985). The analysis of nest cards supports ornithologists' and ecologists' speculation that the frequency of using string for nest construction is increasing over time. This tendency may be associated with the growing quantity of string in the environment. String is widely available in agricultural regions and – as previously mentioned – nest structure is largely determined by substrate availability. Furthermore, when there is a shortage of long hair (from wild or farm animals), which was traditionally used for strengthening the nest structure, string may serve as a substitute. Therefore, the presence of string in the nest structure seems to be a significant problem, especially when its effect on the breeding success is considered. The analyzed nest cards reported one case of a fledgling's entanglement in the string present in the nest. ANTCZAK et al. (2004) mention nestling entanglement in string as the main cause of partial losses. Hence, it is worth analyzing this aspect of the Great Grey Shrike's breeding biology and determining the actual rate of nestling entanglements. It may be also interesting to verify the already mentioned association between the quantity of string in the environment and its relative proportion in the nest structure, and to find out whether Great Grey Shrikes use string instead of, or merely in addition to, other construction materials.

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