Factors affecting the survival of real and artificial great reed warbler's nests

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Abstract: Nest predation experiments are based on either real or dummy nests, and little effort has been made to perform comparative studies with both types of nests. We studied the breeding phenology of the great reed warbler (*Acrocephalus arundinaceus*), and compared the survival of real nests with artificial nests in May at Lake Velence, Hungary. Each artificial nest resembled a great reed warbler nest and contained one plasticine and one quail (*Coturnix coturnix*) egg. An additional experiment was completed during the late breeding season in July, when we used the abandoned great reed warbler nests with quail and plasticine eggs and compared their survival rates with those of artificial nests. Furthermore, we tested the effects of vegetation structure (reed-density, -height and -thickness) and the effect of other nest site characteristics (distance from edge, water depth) on nest success. Great reed warblers laid 4.88 ± 0.074 eggs and fledged 1.72 ± 0.194 (35.3%) nestlings based on data from 25 nests. Successful warbler broods started a week earlier than non-successful broods. Nest survival of artificial nests was lower compared to both the real great reed warbler nests and to the abandoned great reed warbler nests with quail and plasticine eggs. The nest cover (reed density and height) significantly increased the survival of both real and artificial nests, but only during the middle of the breeding season, in May.

Key words: *Acrocephalus arundinaceus*, nest predation, nest site, vegetation structure, Mayfield-method, clutch initiation.

Introduction

Predation has long been recognised as one of the most important cause of nesting failure in birds (Ricklefs, 1969; Wilcove, 1985). There are many studies investigating nest predation, e.g. 156 papers in 2002, according to the Web of Science. However, most of these experiments are based on either real or dummy nests, and little effort has been made to perform comparative studies with both types of nests (Major & Kendal, 1996). Most recent papers support the view of Major & Kendal's review (1996), that artificial nest studies are inaccurate for providing absolute nest predation rates, but are generally sufficient for relative assessment, e.g. to compare nest predation levels in different habitats (Wilson et al., 1998; Buler & Hamilton, 2000; Dion et al., 2000; but see Davidson & Bollinger, 2000; Pärt & Wretenberg, 2002).

Marshes are ideal for investigating the role of nest predation. Marsh dwelling bird species suffer from heavy nest predation. In addition, the relatively simply habitat structure facilitates the study of ecological rules, e.g. habitat selection (e.g. Van der Hut, 1986; Hoi & Winkler, 1994; Jobin & Picman, 1997; Báldi & Kisbenedek, 1999). Many studies have investigated nest predation of marsh-nesting passerines (Ille et al., 1996; Jobin & Picman, 1997; Honza et al., 1998; Eising et al., 2001; Dyrcz & Nagata, 2002; Sawin et al., 2003). However, most of them were based on either real or dummy nests (with the exceptions: Hansson et al., 2000; Hoi et al., 2001). Therefore, there is little testing of the reliability of artificial nests as surrogates of real nests. The environmental factors influencing nest survival is also of crucial interest. Therefore, the purposes of this paper were: (i) to describe the breeding parameters of great reed warblers (*Acrocephalus arundinaceus* L., 1758) at Lake Velence, Hungary; (ii) to compare the survival rates of real and artificial nests in the mid- and late breeding season, and (iii) to compare the nest site characteristics of successful and failed real and artificial nests in the mid- and late breeding season.

Material and methods

Our study was carried out during the breeding season of 2002 in C Hungary at Lake Velence (24 km^2; 47°11′ N, 18°32′ E). We looked for great reed warbler's nests from late April before the start of breeding. We visited the nests in 3–5 day periods until hatching of the nestlings or predation of the nest. If the laying date was not directly observed, we determined it, since the warblers lay an egg per day and then brood the eggs for 12 days (CRAMP & BROOKS, 1992; CSÖRGŐ, 1998). For each nest we recorded the following breeding parameters: 1 – number and size (length and width) of eggs laid; 2 – number of hatched eggs; 3 – number of fledglings. We also measured parameters of the vegetation at each great reed warbler nest: 1 – density of old reed (measured by introducing a half metre long stick into the reed next to the nest, then the number of reed stems touching the stick were counted); 2 – density of new reed; 3 – height of old reed (it was assessed within a 1 m radius circle around the nest); 4 – height of new reed and 5 – reed-thickness (using a calliper rule, we measured the diameter of 10 randomly chosen stems within a 0.2 m radius circle around the nest). Finally at each nest the distance from the reedbed edge, the water depth (measured in the open water at the closest point from the nest), the nest height, and the nest external diameter was measured. We considered a nest successful, if it fledged any nestling.

We investigated the timing of breeding of great reed warblers. We used the Mann-Whitney test to analyse if there is a difference in the initiating of breeding of survived and failed nests. To standardise the laying dates, 28th April (first laid egg in the first nest) was considered as the 1st day.

We also placed out artificial nests next to each real nest at a distance of *ca.* 30 metres. The nests were made of chicken wire and lined with grasses, resembling in size and appearance the nests of the great reed warbler and each contained one fresh quail, *Coturnix coturnix* (L., 1758), and one small plasticine egg (the latter similar in size and shape to the great reed warbler's egg). A dummy nest was put out at a height of 70 cm above the water level, when the real nest next to it contained at least the first egg, and it was collected just after fledging or failing of the real nest. The artificial and the real nests in a pair were controlled on the same day. A dummy nest was considered successful, when both eggs were found, and neither of them showed any sign of damage (by the time when the real nest fledged). At each artificial nest the same reed parameters, the distance from the edge and water depth were recorded.

In July we performed another nest predation experiment using the abandoned great reed warbler's nests and artificial nests. The dummy nests were put out next to the real nests as described earlier. Both types of nests contained one quail and one plasticine egg. After a 6–8 days exposure we collected all of the nests.

Using the Mayfield nest survival method we calculated the daily survival rates for both experiments and nest types (MAYFIELD, 1975). These rates were compared between the real and artificial nests and between the two experiments using the z-test according to HENSLER & NICHOLS (1981). The effect of vegetation characteristics (and distance from edge; water depth) on nest survival was examined by performing discriminant analyses (forward stepwise method) for all the nests, where the grouping variable was the condition of the nests after the experiments (survived or not survived). We performed four discriminant analyses for the same parameters, two in the mid season for the active great reed warbler nests and for the artificial nests and two in the late season for the abandoned great reed warbler nests with artificial eggs and for the dummy nests. The models were carried out using Statistica software (STATSOFT, 1995).

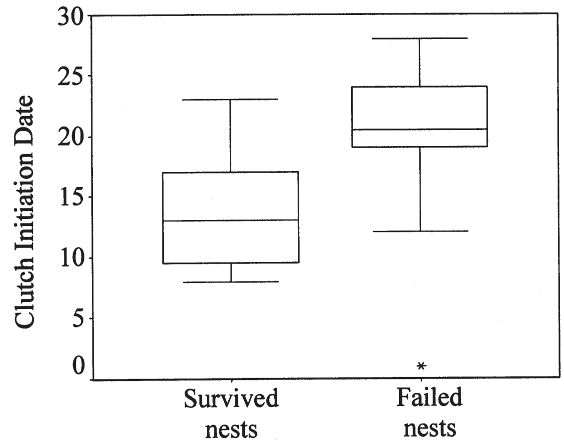

Fig. 1. The medians, quartiles and the minimum and maximum clutch initiation dates of survived and not survived great reed warbler (*Acrocephalus arundinaceus*) nests at Lake Velence, Hungary. The first day was considered as 28th of April, when the first egg was laid, and it is signed with an * as an outlier date.

Results

Of the 25 great reed warbler nests, 13 (52%) were destroyed by predators – 6 nests during incubation, 7 nests after hatching; 11 (44%) were classified as successful and one nest (4%) was considered as deserted. The warblers laid 4.88 ± 0.074 (SE) eggs (100%) on average, from which they hatched 3.28 ± 0.192 eggs (67.2%) and fledged 1.72 ± 0.194 (35.3%) nestlings. The mean length of the eggs (n = 112) was 23.05 ± 0.090 mm (clutch mean: 23.10 ± 0.195 mm), while the mean breadth was 16.30 ± 0.043 mm (clutch mean: 16.31 ± 0.077 mm).

The nests built by the warblers were 12.16 ± 0.160 cm high and 9.36 ± 0.068 cm wide. The nests were found generally at a height of 69.88 ± 1.828 cm from the water-surface and were hung on 3.12 ± 0.175 pieces of new (with a mean diameter of 6.02 ± 0.115 mm) and on 5.04 ± 0.214 pieces of old (with a mean diameter of 6.04 ± 0.088 mm) reed stems.

Comparing the laying date with the survival of great reed warbler nests, we found that the surviving nests were constructed significantly earlier than the failed nests (Mann-Whitney test; $z = -2.473$, df = 23, $P < 0.05$; Fig. 1). The difference between the medians of the two groups was eight days (median laying date of survived and failed nests: 10 May and 18 May).

The survival of the artificial nests in May was significantly lower than the survival of the warbler nests in the same period (z-test; $z = 4.178$, df = 48, $P < 0.01$; Fig. 2). We also found a similar difference between the abandoned and artificial nests in July (z = 2.466, df = 48, $P < 0.01$). However, we could not find any differences between the two experiments comparing the survival of the real nests and abandoned real nests (z = 1.608, df = 48, *ns*), and comparing the survival of the artificial nests (z = 0.155, df = 48, *ns*).

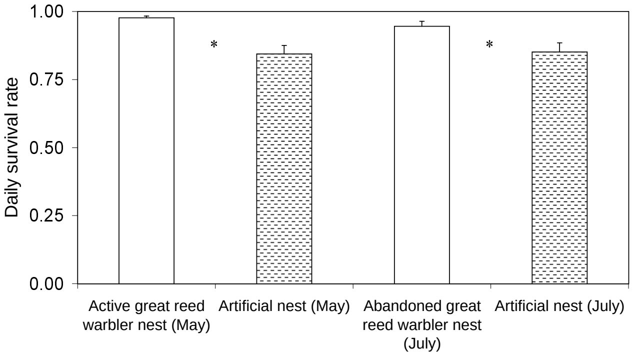

Fig. 2. Daily survival rates of active great reed warbler nests and artificial nests in May, abandoned great reed warbler nests with quail and plasticine eggs and artificial nests in July at Lake Velence, Hungary. Artificial nests contained one quail and one plasticine egg. Asterisks indicate a significant difference at a level of $P < 0.01$ between experiments in May and between the experiments in July.

The results of the discriminant analyses showed that the characteristics of survived and failed nests were different, but only in the middle of the breeding season (Tab. 1). The survival of the great reed warbler nests was higher in taller reed and above shallower water. Density and the height of new reeds were higher for the surviving artificial nests in May. The discriminant analyses in the late season did not show any difference between the surviving and failed nests.

Discussion

In our study area great reed warbler nests were laid generally in the first 2 metres from the edge of reedbeds and reed-islands of Lake Velence, and the most important cause for their nesting failure was nest predation. We found that early nesting great reed warblers reproduced better than late breeding birds probably due to the fact that the early ones nested at reed edges with taller reeds. In this way they could reduce the probability of nest predation because of better vegetation cover and less visibility. Aebischer et al. (1996) showed that early arriving Savi's warbler (*Locustella luscinioides* Savi, 1824) males have higher breeding success than late males because of higher mating success and more successful clutches. Ille et al. (1996) also found that the start of egg-laying positively correlated with nest cover (i.e. safe nest sites) in the case of the opportunistically polygynous marsh warblers (*Acrocephalus palustris* Bechstein, 1798), but in the case of monogamous reed warblers (*Acrocephalus scirpaceus* Hermann, 1804) there was no correlation in the start of egg-laying with nest cover.

The daily survival rate of dummy nests was significantly lower than that of real nests both in May and July. Many comparative studies have shown that the loss of artificial nests is significantly higher than the loss of real nests (e.g. Wilson et al., 1998; Davidson & Bollinger, 2000; Berry & Lill, 2003; Boulton & Clarke, 2003). However, there are some studies, which found lower predation on dummy nests than real nests (e.g. Robel et al., 2003), or showed no difference between natural and artificial nests (e.g. Gregoire et al., 2003). We agree with Davidson & Bollinger (2000) and Berry & Lill (2003) that artificial nest experiments should use nests and eggs that mimic as closely as possible the real nests and eggs of the target species. According to some authors (Berry & Lill, 2003; Boulton & Clarke, 2003) dummy nests are suitable instruments for comparing nest predation pressure in different habitats or seasons, although artificial nests generally measure higher nest predation rates.

Table 1. Results of forward discriminant analyses (F to enter: 1.0; F to remove: 0).

	Active great reed warbler nest (May)	Artificial nest (May)	Abandoned great reed warbler nest (July)	Artificial nest (July)
Forward discriminant analyses	Wilks' Lambda: 0.633; $F(4, 20) = 2.901$; $P < 0.05$	Wilks' Lambda: 0.504; $F(3, 21) = 6.891$; $P < 0.005$	Wilks' Lambda: 0.955; $F(1, 23) = 1.074$; *ns*	Wilks' Lambda: 0.879; $F(1, 23) = 3.175$; *ns*
Survived nests	Height of new reed $F = 8.422$; $P < 0.01$;	Density of new reed $F = 16.463$; $P < 0.001$; Height of new reed $F = 6.895$; $P < 0.05$	–	–
Not survived nests	Depth of water $F = 7.563$; $P < 0.05$	–	–	–

Key: The grouping variable was the nest success after the experiments (survived or failed). In the second row the value of Wilks' Lambda, the F-value and the level of significance is given. A significant F value indicates that there is a difference between the survived or failed nests. In the lower cells only those variables are shown which contributed significantly to the difference of the model. Higher reed, and lower water depth could contribute to the survival of real nests, while reed stem density and reed height contributed to the survival of artificial nests in May. In July no variable entered the model.

This is supported by our results where we found similar differences in the survival rates of the two nest types both in May and July.

The surviving great reed warbler nests in May were in higher reeds, whereas the dummy nests in the same period were in denser and also higher reeds. Thus, it seems that reed height could be important for the survival of great reed warbler nests in the mid-season independent of whether they are artificial or natural. Batáry et al. (2004) also found at Lake Neusiedl that reed height and reed stem density were the most important variables, which increased concealment of the artificial nests. Several nest predation experiments in marshes suggest that there is a positive correlation between nest cover (e.g. reed stem density and reed height) and nest survival (Ille et al., 1996; Jobin & Picman, 1997; Honza et al., 1998; Hansson et al., 2000; Eising et al., 2001). Cuckoo parasitism can also be influenced by nest site characteristics – a more visible nest is more likely to be parasitised (Moskát & Honza, 2000, 2002). Hoi & Winkler (1988) also found a seasonal pattern of predation on experimental nests – the artificial nests survived less well in the middle of May than a week earlier. However, they thought that there is a positive relationship between nest predation rate and nest density. This could be another possible explanation for the higher survival of early nesting great reed warblers in our case. In the late season we found no difference in the investigated nest site characteristics between the surviving and failed nests. This finding is similar to the results of Batáry et al. (2004), which showed that the effects of reed characteristics on nest survival has more importance in April, before the new reed becomes established. Our results suggest that great reed warblers have to wait until the new reed stems begin to grow to choose the best nesting places. This could be the reason that great reed warblers are one of the latest to arrive among *Acrocephalus* warblers in Hungary (Moskát & Báldi, 1999).

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