

Short communication

Birds and rodents destroy different nests: a study of Blackcap *Sylvia atricapilla* using the removal of nest concealment

VLADIMÍR REMEŠ*

Laboratory of Ornithology, Palacký University, Tř. Svobody 26, CZ-771 46 Olomouc, Czech Republic

Nest predation is a major factor limiting the reproductive output of small passerines (Ricklefs 1969). Thus, selecting safe nest-sites is critically important for these birds. Nest concealment can inhibit transmission of visual, chemical or auditory cues to predators (Martin 1993). However, although there are numerous studies demonstrating the positive effects of concealment on nest survival (reviewed in Martin 1992), other studies were unable to find such an effect (e.g. Willson & Gende 2000).

There are at least two reasons for the mixed results. First, we typically do not know the identity of nest predators. Different predators can select for different aspects of nest concealment, with the net result that there is no single best 'value' of concealment, and nests differing in their concealment may be depredated at similar rates (Filliater *et al.* 1994). Moreover, densities of different predators can fluctuate both among years and among sites, with net selection varying temporally and geographically. Secondly, the majority of studies have simply used a correlational approach. However, as the effects of concealment may be confounded by other nest-site features or with parental quality, an experimental approach is needed to separate independent effects of concealment. I am aware of only two experimental studies of the effects of concealment on nest survival (Howlett & Stutchbury 1996, Stokes & Boersma 1998).

In this study I investigated the effects of concealment, height and season on nest survival in the Blackcap *Sylvia atricapilla*. I used natural Blackcap nests baited with artificial plasticine clutches to identify predators. I manipulated concealment by removing part of the foliage obscuring nests and tested whether different types of nest predators (birds vs. rodents) selected for different degrees of nest concealment.

METHODS

The Blackcap is a small (*c.* 20 g), insectivorous, migratory passerine that breeds from late April to July in mature forests and wood-lots, building its thin-walled, open-cup

nests in shrub and herbaceous layers, approximately 1 m above the ground. For details of the general breeding biology from similar habitats see Weidinger (2000) and Remeš (2003).

I conducted this study during two breeding seasons (2000, 2001) in a deciduous forest near Grygov (49°31'N, 17°19'E, 205 m asl) in the eastern Czech Republic. The forest was dominated by Oak *Quercus* spp., Ash *Fraxinus excelsior*, Lime *Tilia* spp., Bird Cherry *Prunus padus* and Elder *Sambucus nigra*.

I worked on two study plots (total area 30 ha, 150 m apart). Nests were located primarily in Bird Cherry, Elder and Nettle *Urtica dioica*. I estimated the degree of concealment of each nest visually as a percentage of the nest bowl obscured by foliage (10% increment). I estimated horizontal and vertical concealment 1 m from a nest in the four cardinal directions and 1 m above a nest, and averaged these five estimates to obtain a single percentage for a nest.

In every second nest found I removed some of the foliage concealment by cutting twigs and leaves and removing them from the vicinity of a nest. In the vicinity of control nests, I spent an equivalent amount of time to that needed for foliage removal (*c.* 3 min). I estimated concealment of every nest twice: (1) when it was found and (2) when baited with plasticine eggs (in experimental nests also after foliage removal).

I baited Blackcap nests with four brown plasticine eggs (clutch size in this population averages 4.7 eggs) of similar colour and size to natural eggs, i.e. 20 × 15 mm. The time between fledging/failure of a nest and its baiting was 7.3 ± 0.3 days (mean ± se). Each plasticine egg was mounted on a thin wire anchored to the nest cup to prevent its removal. Clutches were checked after 14 days, equivalent to the egg-laying plus incubation period of natural Blackcap clutches, and removed. A predation event was recorded if any of the four plasticine eggs was marked by a potential predator. Predators were identified by noting triangular bill marks (bird predation) or incisor marks (rodent predation).

The probability of an artificial clutch surviving was analysed by logistic regression. To identify variables associated with the probability of nest depredation by different types of predators, I performed logistic regressions with three different response variables: (a) nest survived vs. depredated by any predator, (b) nest survived vs. depredated by a bird predator and (c) nest survived vs. depredated by a rodent predator. Interactions of continuous variables with year were always non-significant and thus removed. In the predator-specific analyses, I excluded clutches depredated by both kinds of predators. All the analyses were done in JMP (SAS Institute Inc. 1995).

RESULTS

In total, there were 108 nests, from which 60 were control and 48 experimental. Of these, in 2000 there were 60 nests (33 control, 27 experimental), and in 2001 there were 48 nests (27 control, 21 experimental).

*Email: remes@prfnw.upol.cz

Nest concealment measured when the nest was found decreased with nest height ($t = -2.1$, $P = 0.03$) but did not change with nest initiation date, year or experimental treatment (all P values > 0.05 , $n = 108$, ls means \pm se: experimental nests $87 \pm 2\%$, control nests $81 \pm 2\%$). After concealment was reduced in approximately half of the nests, its relationship to nest height disappeared and nest treatment (experimental vs. control) was the sole significant predictor ($t = 12.0$, $P < 0.01$, $n = 108$, ls means \pm se: experimental nests $29 \pm 3\%$, control nests $76 \pm 2\%$). Again, neither date nor year had any effect.

The proportion of nests depredated by both types of predators together differed significantly between years (Fig. 1, Table 1). However, the proportion depredated by birds vs. rodents did not differ (Pearson $\chi^2_1 = 0.1$, $P = 0.71$, $n = 66$). Artificial clutches in natural Blackcap nests survived better with higher nest concealment, whereas nest height or date had no influence (Table 1, Fig. 2). The probability of nest depredation by birds increased strongly with decreasing concealment and increasing nest height, whereas the probability of rodent depredation increased only with decreasing nest height (Table 1, Fig. 2).

DISCUSSION

Different nest predators (birds vs. rodents) selected for different nest-site characteristics in terms of nest concealment and height. Diurnal, visually orientated birds depredated less concealed nests with greater probability (see also Dion *et al.* 2000, Weidinger 2002), whereas there was no effect of concealment on depredation by nocturnal rodents, which chiefly use olfaction to find food. The effect of nest height on the probability of nest depredation by birds vs. rodents may be caused by different spatial patterns of activity of these two predator types. Whereas birds (most probably Jay *Garrulus glandarius* and woodpeckers *Picoides* spp.) forage predominantly in canopies and shrubs, rodents (most probably mice *Apodemus* spp., and Bank Vole

Clethrionomys glareolus) forage mainly on the ground, although they can climb shrubs and trees.

These results demonstrate the substantial potential, driven by the composition of nest predator fauna, to alter patterns of selection on nest-site characteristics, as previously suggested (Filliater *et al.* 1994, Dion *et al.* 2000). In line with this, Clark and Nudds (1991), reviewing 28 studies on natural nest survival in relation to concealment, found that concealment was a significant predictor of nest survival in 16 of 20 studies in which the predominant nest predators were birds, but only two of eight studies in which mammals were the major predators (see also Martin & Joron 2003).

To minimize bias introduced by using artificial nests (Major & Kendal 1996, Weidinger 2001) I used natural Blackcap nests. Plasticine clutches were of clutch size, egg

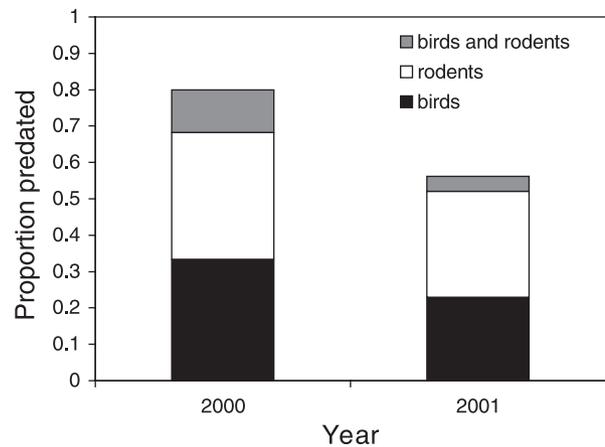


Figure 1. The proportion of natural Blackcap nests baited with artificial clutches depredated by different types of predators, separated for 2000 ($n = 60$) and 2001 ($n = 48$). The proportion of depredated nests differed significantly between years: Pearson $\chi^2_1 = 6.3$, $P = 0.01$, $n = 108$.

Table 1. Logistic regression of the influence of nest concealment (measured when the experiment was initiated), nest height (\log_{10} -transformed), date of initiation of experiment (day 1 = 1 January) and year (2000 = 0, 2001 = 1) on the probability of artificial clutch depredation by (a) both predator types together, (b) bird predators and (c) rodent predators, all over a 14-day period. Modelled is the probability of clutch survival, so positive parameter estimates mean higher nest survival with increasing value of the factor.

Factor	Both			Birds			Rodents		
	Parameter \pm se	Wald χ^2	P	Parameter \pm se	Wald χ^2	P	Parameter \pm se	Wald χ^2	P
Concealment	0.016 \pm 0.007	4.8	0.03	0.031 \pm 0.011	8.6	< 0.01	0.011 \pm 0.009	1.5	0.22
Height	0.084 \pm 0.950	< 0.1	0.93	-3.595 \pm 1.523	5.6	0.02	2.724 \pm 1.309	4.3	0.04
Date	0.012 \pm 0.018	0.5	0.50	0.017 \pm 0.022	0.6	0.44	-0.001 \pm 0.022	< 0.1	0.95
Year	0.617 \pm 0.238	6.7	0.01	0.296 \pm 0.329	0.8	0.37	0.738 \pm 0.303	5.9	0.02

Overall models: (a) $R^2 = 0.09$, $\chi^2_4 = 12.5$, $P = 0.01$, $n = 108$, intercept \pm se = -3.732 ± 3.505 ; (b) $R^2 = 0.26$, $\chi^2_4 = 22.8$, $P < 0.01$, $n = 64$, intercept \pm se = 2.027 ± 4.841 ; (c) $R^2 = 0.11$, $\chi^2_4 = 10.7$, $P = 0.03$, $n = 68$, intercept \pm se = -4.893 ± 4.277 .

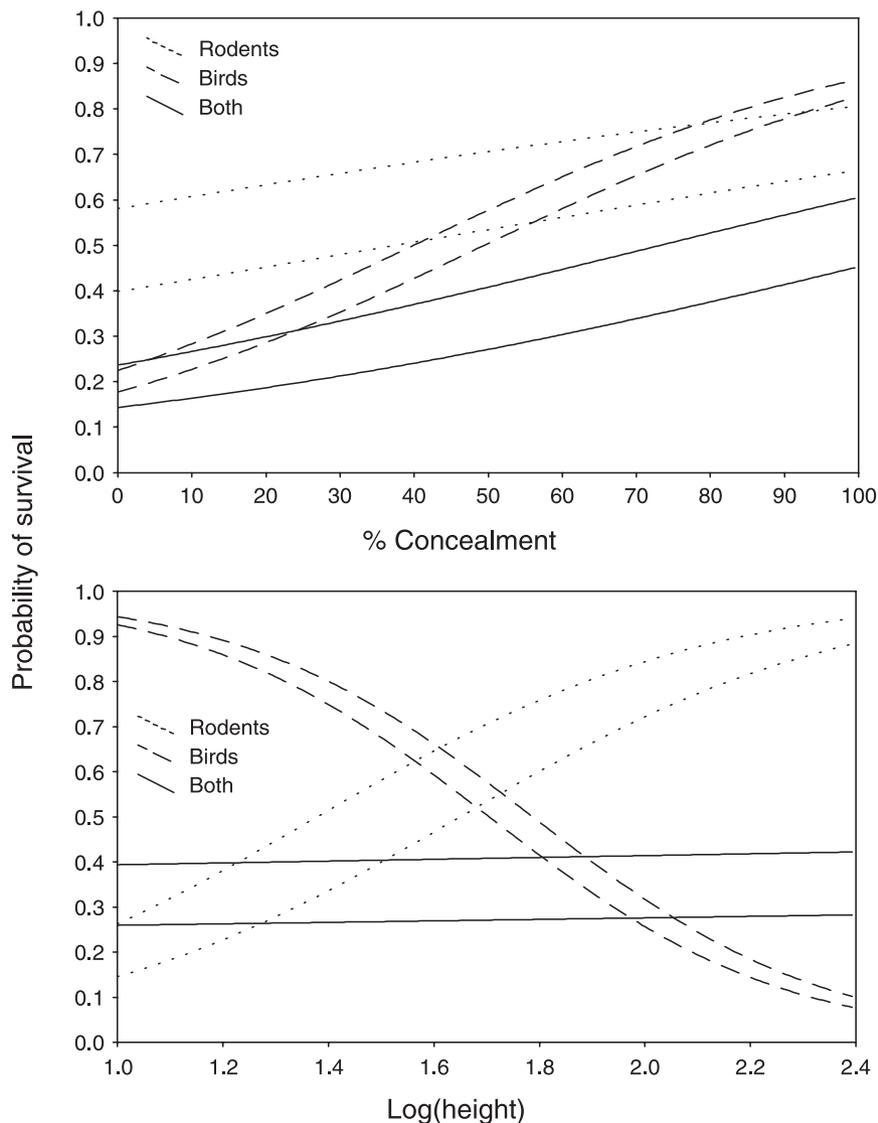


Figure 2. The probability of survival of natural Blackcap nests baited with artificial plasticine clutches in relation to nest concealment (%) and height (cm) over a 14-day period, separated for nest mortality caused by different types of predators, in 2000 (lower curves) and 2001 (upper curves). Projections are made from multiple logistic regressions for nests initiated on 30 May and 0.5 m high (above) or with 50% concealment (below), respectively.

size, egg shape and egg coloration as similar to a natural situation as possible. Although plasticine eggs may bias the composition of predators depredate the nests, e.g. because of the smell of plasticine (Maier & DeGraaf 2001), my results are not based on comparing predation rates on natural vs. artificial nests but on comparing predation patterns by different types of predators (birds vs. rodents) on the same kinds of nests (natural nests with artificial clutches).

In natural nests, parental activity adds an additional layer of complexity to the benefits and costs of nest-site selection with respect to nest concealment. Parental activity

around natural nests can disclose nests to visually orientated predators (Martin *et al.* 2000). The influence of concealment on nest survival may be different in natural nests, because parents defend nests and concealment can influence the ability of a parent to detect an approaching predator (Koivula & Rönkä 1998). Parents may also compensate for poor nest concealment by more vigorous nest defence (McLean *et al.* 1986). Moreover, concealment may affect not only the probability of nest survival but also the survival probability of the incubating parent (Wiebe & Martin 1998). However, the selection patterns

on nest concealment and height uncovered in this study with artificial clutches may be understood to show the basic vulnerability of nest-sites to predation that the parents must cope with and take into account when selecting a nest-site.

To find out whether the different predation patterns revealed in this study represent the natural situation, it is necessary to identify predators at natural nests. Existing results from studies with video cameras are promising in this respect (e.g. Sanders & Maloney 2002).

I thank K. Weidinger for valuable comments on the manuscript. I was supported by Palacký University (grant IG32103014) and Ministry of Education of the Czech Republic (MSM153100012).

REFERENCES

- Clark, R.G. & Nudds, T.D. 1991. Habitat patch size and duck nesting success: the crucial experiments have not been performed. *Wildl. Soc. Bull.* **19**: 534–543.
- Dion, N., Hobson, K.A. & Larivière, S. 2000. Interactive effects of vegetation and predators on the success of natural and simulated nests of grassland songbirds. *Condor* **102**: 629–634.
- Filliater, T.S., Breitwisch, R. & Nealen, P.M. 1994. Predation on Northern Cardinal nests – does choice of nest site matter? *Condor* **96**: 761–768.
- Howlett, J.S. & Stutchbury, B.J. 1996. Nest concealment and predation in Hooded Warblers: experimental removal of nest cover. *Auk* **113**: 1–9.
- Koivula, K. & Rönkä, A. 1998. Habitat deterioration and efficiency of antipredator strategy in a meadow-breeding wader, Temminck's Stint (*Calidris temminckii*). *Oecologia* **116**: 348–355.
- Maier, T.J. & DeGraaf, R.M. 2001. Differences in depredation by small predators limit the use of plasticine and Zebra Finch eggs in artificial-nest studies. *Condor* **103**: 180–183.
- Major, R.E. & Kendal, C.E. 1996. The contribution of artificial nest experiments to understanding avian reproductive success: a review of methods and conclusions. *Ibis* **138**: 298–307.
- Martin, T.E. 1992. Breeding productivity considerations: what are the appropriate habitat features for management? In Hagan, J.M. & Johnston, D.W. (eds) *Ecology and Conservation of Neotropical Migratory Landbirds*: 455–473. Washington, DC: Smithsonian Institution Press.
- Martin, T.E. 1993. Nest predation and nest sites – new perspective on old patterns. *Bioscience* **43**: 523–532.
- Martin, J.L. & Joron, M. 2003. Nest predation in forest birds: influence of predator type and predator's habitat quality. *Oikos* **102**: 641–653.
- Martin, T.E., Scott, J. & Menge, C. 2000. Nest predation increases with parental activity: separating nest site and parental activity effects. *Proc. R. Soc. Lond. B* **267**: 2287–2293.
- McLean, I.G., Smith, J.M. & Stewart, K.G. 1986. Mobbing behavior, nest exposure, and breeding success in the American Robin. *Behaviour* **96**: 171–185.
- Remeš, V. 2003. Effects of exotic habitat on nesting success, territory density and settlement patterns in the Blackcap (*Sylvia atricapilla*). *Conserv. Biol.* **17**: 1127–1133.
- Ricklefs, R.E. 1969. An analysis of nesting mortality in birds. *Smithson. Contrib. Zool.* **9**: 1–48.
- Sanders, M.D. & Maloney, R.F. 2002. Causes of mortality at nests of ground-nesting birds in the Upper Waitaki Basin, South Island, New Zealand: a 5-year video study. *Biol. Conserv.* **106**: 225–236.
- SAS Institute Inc. 1995. *JMP Statistics and Graphics Guide*, Version 3.2. Cary, NC: SAS Institute Inc.
- Stokes, D.L. & Boersma, P.D. 1998. Nest-site characteristics and reproductive success in Magellanic Penguins (*Spheniscus magellanicus*). *Auk* **115**: 34–49.
- Weidinger, K. 2000. The breeding performance of Blackcap *Sylvia atricapilla* in two types of forest habitat. *Ardea* **88**: 225–233.
- Weidinger, K. 2001. How well do predation rates on artificial nests estimate predation on natural passerine nests? *Ibis* **143**: 632–641.
- Weidinger, K. 2002. Interactive effects of concealment, parental behaviour and predators on the survival of open passerine nests. *J. Anim. Ecol.* **71**: 424–437.
- Wiebe, K.L. & Martin, K. 1998. Costs and benefits of nest cover for Ptarmigan: changes within and between years. *Anim. Behav.* **56**: 1137–1144.
- Willson, M.F. & Gende, S.M. 2000. Nesting success of forest birds in southeast Alaska and adjacent Canada. *Condor* **102**: 314–324.

Received 10 July 2003; revision accepted 10 June 2004;
first published (online) 18 August 2004
(doi: 10.1111/j.1474-919x.2004.00339).