

The effect of nest usurpation on breeding success of the black-billed magpie *Pica pica*

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The breeding of some birds, such as raptors or owls that do not build their own nest, is often limited by the availability of nests constructed by other bird species. When breeding habitats substantially lack natural nest sites (e.g., cavities in trees or cliffs), a strong conflict over the nest site can occur between raptors and other birds breeding in the nests suitable also for raptors. The nest site selection of the Eurasian kestrel (*Falco tinnunculus*) was studied in an extreme situation when nests of the black-billed magpie (*Pica pica*) served as the only suitable nest sites for kestrels. It was found that 42% of new magpie nests were usurped and 30% of old nests were occupied (re-used) by raptors, mainly by the kestrel. The nest height above the ground was the main predictor of nest usurpation. Other variables, such as laying date, nest volume or perimeter of the nest tree were not significant predictors. A tendency to build nest sites closer to the ground observed with an advancing breeding season may therefore represent a strategy of magpies to override nest usurpation. Nonetheless, while the magpie pairs nesting in lower heights were more likely to escape from nest usurpation, they suffered from a higher, though not significant, predation rate relative to the magpies nesting in higher positions. Three possible hypotheses which can explain why kestrels and possibly other raptors have a tendency to take over new nests rather than to occupy old ones are discussed.

Key words: *Pica pica*, *Falco tinnunculus*, nest usurpation, breeding success, interspecific interference.

Introduction

The breeding success of the magpie *Pica pica* (L., 1758) has been widely investigated (e.g., BAEYENS, 1981; EDEN, 1985; SACHTELEBEN et al., 1992). Several factors, such as brood parasitism (SOLER et al., 1995, 2001a), nest predation (MØLLER, 1991; REDONDO & CASTRO, 1992), and other kinds of interspecific interference (BAEYENS, 1981) were reported to affect their

breeding success. The above-mentioned factors are largely related to magpie nest characteristics since magpies construct nests that are conspicuous for predators and parasites (SOLER et al., 1998), but also for species, such as raptors that do not build their own nests and use magpie nests to lay their own clutches.

Magpies usually build large domed nests (see ERPINO, 1968 for more details), whereas the nest size has recently been proposed as a reliable sig-

nal of pair quality (SOLER et al., 1995, 2001b; NEVE & SOLER, 2002). Despite some earlier suggestions that nests without or with a reduced nest roof are exposed to a higher predation risk than roofed ones (BAEYENS, 1991; EDEN, 1985), higher nest safety may attract raptors to use such nests. Abandoned or old magpie nests are re-used as a shelter or nesting place by other bird species, such as owls, ducks (ERPINO, 1968), falcons (BECKER, 1987; SHELTER & BECKER, 1990) and tree sparrows *Passer montanus* (L., 1758) (P. Prokop, personal observations). The Eurasian kestrel *Falco tinnunculus* L., 1758 (hereafter kestrel) naturally nested mainly on cliffs, but nowadays is highly dependent on the availability of old corvid nests (VILLAGE, 1983; CARILLO & APARICIO, 2001). In the areas with a reduced number of suitable sites for nesting, the availability of nests built by magpies often becomes a limiting factor for the breeding of kestrels, resulting in the interference between magpies and kestrels.

In this study, the factors affecting magpie nest usurpation by kestrels and owls were examined in an area with no natural (e.g., cliffs) or artificial (nest-boxes) nest sites available for such raptors. Since the nest usurpation by kestrels in these habitats was likely to exert a strong pressure on the breeding of magpies, it was predicted that magpie nest site selection would be aimed to lower the risk of nest usurpation by kestrels.

Methods

The study was carried out in an agricultural land nearby the town of Senec in W Slovakia (48°21' N, 17°39' E; altitude approximately 350 m a.s.l.). The study area (5 × 1 km) was covered with fragmented groves consisting of acacia (*Robinia pseudoacacia*). The bush vegetation was represented by white-thorn (*Crataegus* spp.), elder (*Sambucus nigra*) and sweet-brier (*Rosa canina*). During the investigation, no nest-boxes or other natural cavities were available in the study area.

Magpie breeding attempts were examined from March to June 2002. Once or twice a week, a total of 60 magpie nests were monitored, including both new ($n = 43$) and old ($n = 17$) ones. The laying date of first eggs (1 = 1st March), nest height, number of fledglings, perimeter of the nest tree and the nest volume were recorded. The nest volume was calculated as $4/3(\pi ab^2)/1000$ (in litres), where a was the largest radius of the ellipsoid nest and b the half of the nest width. The presence of kestrels was noted throughout the breeding season. The nest usurpation refers to cases when: (i) a kestrel was detected nearby the magpie nest tree (usually sitting on a tree beside the nest tree), and (ii) magpie eggs were destroyed and the nest was subsequently usurped by a raptor. In some cases,

kestrels destroying magpie eggs were witnessed. After having detected a nest with magpie eggs, disappearance of eggs and chicks without remains at or below such nests was considered as a predation by an unknown predator (WIKLUND, 1995). New magpie nests in which no egg was detected (possibly because of a predation before visit) were excluded from the analysis ($n = 2$). None of the nests that were depredated was subsequently occupied by raptors. The use of old, abandoned magpie nests by a raptor was considered as nest occupation. The successful breeding attempts refer to cases when at least one magpie chick fledged.

The data were checked for normal distribution (Shapiro-Wilk test) and log-transformed if necessary. All statistics were two-tailed. The presented values are means ± SE.

Results

Breeding success of magpies

Only 25.6% (11/43) of breeding attempts were successful. The nest predation and nest usurpation accounted for 43.75% (14/32) and 56.25% (18/32), respectively, of the failed breeding attempts. The probability of predation before egg hatching (8 of 14 nests depredated during egg-laying and incubation period) and after eggs hatching (6 of 14 nests depredated during chick feeding period) did not differ significantly from the expected values (Chi-square test: $\chi^2 = 0.286$, $df = 1$, $P = 0.59$). There was no significant difference in the likelihood of fledging of at least one chick between parents nesting in the nests built in trees (7 of 34 nests, 20.58%) and bushes (4 of 9, 44.44%) (Fisher exact test, $P = 0.20$). Importantly, the proportion of depredated nests tended to be higher for the nests built in bushes (5 of 9 nests, 55.5%), as compared to those built in trees (9 of 34, 26.4%) (Fisher exact test, $P = 0.12$). It is important to mention that considering nest volume and laying date, there was no significant difference between the nests located in trees and those in bushes (nest volume for the nests built in trees: mean 49.43 ± 3.88 , range 22–104, $n = 25$; in bushes: mean 42.29 ± 9.64 , range 13–111, $n = 9$) (laying date for the nests built in trees: mean 43.0 ± 3.12 , range 27–76, $n = 25$; in bushes: mean 40.0 ± 7.30 , range 13–74, $n = 9$) (Mann-Whitney U -test, $P > 0.10$).

Nest usurpation of new magpie nests

More than a half (see above) of the failed breeding attempts occurred due to the nest usurpation by raptors. Namely, 88.9% (16/18) of usurpations were caused by kestrels and 11.1% (2/18) by the long-eared owl *Asio otus* (L., 1758). Raptors initiated their breeding attempts significantly later

Table 1. Possible factors affecting breeding success of magpies examined by stepwise discriminant analysis.

Breeding	Nest height (m)	Date of the 1 st egg laying (days)	Nest volume (L)	¹ Perimeter of the nest tree (cm)
Successful	4.81 ± 0.83	41.18 ± 5.10	42.12 ± 3.84	73.57 ± 17.54
Depredated	5.02 ± 0.62	47.15 ± 5.37	52.29 ± 8.17	75.62 ± 12.75
Usurped by raptors	6.78 ± 0.47	33.70 ± 5.75	52.38 ± 5.86	70.43 ± 8.78

Key: Data represent means ± SE; ¹calculated only for nests placed in trees.

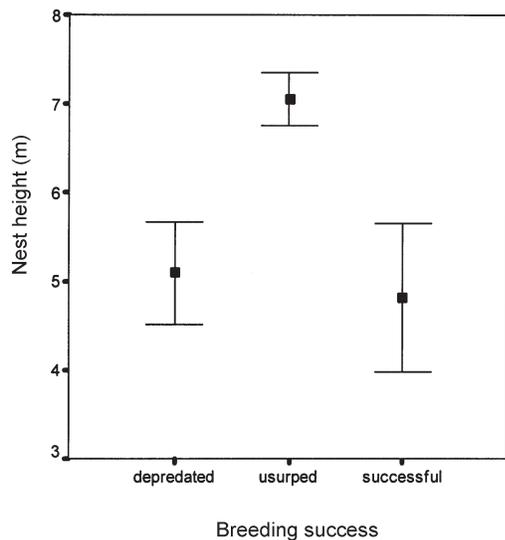


Fig. 1. Nest height as a predictor of breeding success of magpies. Data represent means ± SE.

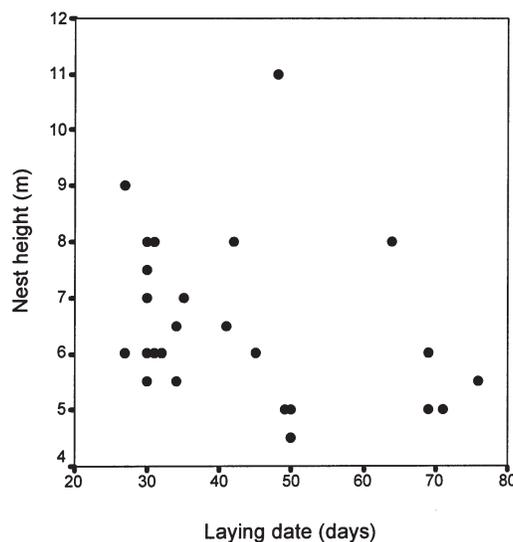


Fig. 2. The relationship between nest height and laying date. The circles represent nests built in trees, whereas the nests built in bushes are represented by triangles.

(mean 53.72 ± 3.47 , range 20–81, $n = 18$) than magpies (mean 42.66 ± 2.99 , range 13–76, $n = 34$) (Mann-Whitney U -test: $U = 177$, $P = 0.018$). The interval between magpie brood destruction by raptors and the subsequent laying date of kestrels was observed to last at most 20 days.

A stepwise discriminant analysis revealed that only the nest height explained the likelihood of nest usurpation by kestrels (Wilks' Lambda = 0.75, $df = 2$, $\chi^2 = 9.09$, $P = 0.011$). Usurped nests were located significantly higher than depredated (but not occupied by kestrels) or successful nests (Tab. 1, Fig. 1). No significant difference was found between the nest height of successful ($n = 11$) and depredated ($n = 14$) nests (logistic regression analysis with nest predation as a dependent variable: $\chi^2 = 0.85$, $df = 1$, $P = 0.77$).

The majority of new magpie nests (79.1%) were built in trees, whereas only nine (20.9%)

were located in bushes. Nest usurpation occurred more frequently on the nests placed in trees (18 of 34), than in bushes (0 of 9) (Fisher exact test, $P = 0.006$). Excluding the nests built in bushes, a negative correlation between laying date and nest height ($r_s = -0.44$, $P = 0.028$, $n = 25$; Fig. 2) was found. However, nest volume did not correlate with nest height ($r_s = -0.27$, $P = 0.19$; $n = 25$). Only the perimeter of a nest tree correlated significantly with the nest height ($r_s = 0.65$, $P = 0.0001$).

Nest occupation of old magpie nests

Since no occupation of the nests placed in bushes was detected, old nests built in bushes were excluded from further analysis. Only 30% (3/10) of old magpie nests built in trees were occupied by raptors. Nevertheless, the frequency of re-using old nests (nest occupation) by raptors did not signifi-

cantly differ from the frequency of using new nests (nest usurpation) (Fisher exact test, $P = 0.29$). It seems, however, that kestrels usurping new magpie nests laid their eggs earlier (mean 56.19 ± 3.18 , range of laying dates 33–81, $n = 16$) than kestrels occupying old nests (mean 76.0 ± 6.43 , range: 64–86, $n = 3$), but testing was impossible due to a small sample size.

Discussion

The results of this study show that kestrels commonly use magpie nests when having no other nesting opportunities for nesting. Although the difference between the frequency of occupying old and taking over new magpie nests was not significant, the question why kestrels invest their time and energy in usurping new nests when there are old magpie nests available still emerges. At least three possible explanations could be mentioned here.

First, old nests frequently remain undomed (personal observations) which is likely due to a reutilisation of the nest material by other magpies or carrion crow *Corvus corone cornix* L., 1758 (BAEYENS, 1981). Old nests may therefore represent a more vulnerable type of nest site (BAEYENS, 1981; RÖELL & BOSSEMA, 1982). In fact, SIEG & BECKER (1990) found that merlins (*Falco columbarius* L., 1758) preferred the abandoned magpie nests that were domed to those without a roof. Similarly, BECKER (1987) observed American kestrels (*Falco sparverius* L., 1758) to use magpie nests more often than cavities in trees and cliffs. These authors, similarly to BAEYENS (1981), suppose that using roofed magpie nests can provide a nesting pair and its brood with a better concealment and higher security. In this study, all new magpie nests were roofed. Although some of the old but occupied nests were not domed, it was not possible to compare the raptors' breeding success in these two types of magpie nests due to a small sample size.

Second, many of the old nests are damaged in the subsequent breeding season owing to reasons other than reutilisation of nest material, indicating that the breeding attempt in such nests carries a serious risk especially for the birds that are not able to assure its protection. During this study, destruction of an old undomed magpie nest following shortly after hatching of eggs laid by kestrel was observed. The nest was subsequently abandoned with no further breeding attempt initiated there.

Third, a higher preference for new magpie nests may be related to a different ectoparasite

load that is likely to be higher in old magpie nests. Since ectoparasites may negatively affect the fitness of avian nestlings (MØLLER, 1990; SOLER et al., 1999; SZÉP & MØLLER, 2000, but see DAROLOVÁ et al., 1997), kestrels may, by nesting in new magpie nests, reduce the costs of immune response. A high density of ectoparasites in old nests may therefore also explain why raptors invest their time and energy in the usurpation of new magpie nests.

The nests located closer to the ground have been reported to suffer from a higher predation risk (EDEN, 1985). However, such nests are less conspicuous and may provide magpies with more safety in the areas where human activity is responsible for the death of adult magpies and destruction of nest content (BAEYENS, 1981). In this study, magpies nesting in bushes were more likely to escape from nest usurpation, suffering, however, from a relatively higher predation rate. The selection of higher nest sites by raptors may be connected to their phylogeny, as they were commonly nesting in cliffs. The increasing occurrence of magpies to choose lower nest sites as the breeding season advances may in turn reflect a relative cost of nest predation as compared to nest usurpation. The idea whether magpies build their nest at lower heights when there is a high chance of nest usurpation should be confirmed experimentally.

Both predators and nest usurpers can affect magpie breeding success. In this study, nest usurpation by raptors occurred mainly in those magpie pairs that started to breed early. Recent studies showed that early breeding is related to the quality of a breeding pair (FITZPATRICK & PRICE, 1997; SOLER et al., 2001b), whereas the earlier breeding magpies were reported to have more possibilities to re-nest in the same breeding season (EDEN, 1985; BIRKHEAD, 1991). It is suggested that the nest site selection in magpies may not only be explained by their condition but also by a risk of nest predation relative to nest usurpation.

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