ORNIS SVECICA 10:149–154, 2000

Nest height and nesting losses of rural and urban Blackbirds *Turdus merula*

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Abstract

Nest height and nesting losses of first broods in the Blackbird *Turdus merula* were studied during April and May in 1990 and 1992. Data were collected in Slovenia in one rural (Dravsko polje) and two urban areas (Ljubljana, Maribor). The Blackbird nests were located 0.7–8.0 m above ground level in urban areas and 0.1–4.4 m above ground on rural land. Nests in urban environments were on average located significantly higher (2.6 and 2.1 m) than in rural areas (1.5 m). Mean nest height in the two urban areas also differed significantly. In contrast, the height of trees and bushes in which nests were located did not differ between areas. This suggests that the Blackbirds adjusted their nest location in response to local conditions, e.g. different predation pressure in urban and rural areas. Nesting losses were comparatively low and varied between localities (Ljubljana 78%, Maribor 59% and Dravsko polje 76%), but the differences were not significant. Daily nest survival rates were calculated (the Mayfield method) separately for egg and nestling stages for urban and rural habitat. Values for egg stage was 0.984 for Maribor and 0.978 for Dravsko polje, whereas values for nestling stage in Ljubljana was 0.989 and in Dravsko polje 0.983.

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Received 12 January 2000, Accepted 13 April 2000, Editor: Å. Lindström

Breeding conditions for birds in urban habitats are different from those in surrounding rural areas, the main differences being the constant presence of people in high density, densely located buildings, high numbers of domestic animals, less vegetation, warmer climate and artificial lighting in urban areas (e.g. Luniak et al. 1990). Urbanization of birds is going on all over the world and is well studied (Rolando et al. 1997). It reveals many problems of adaptation in birds, like the forming of new population structures, and interspecific interactions among birds colonizing a habitat with new ecological opportunities (Luniak et al. 1990). Therefore, the phenomenon of urbanisation provides an opportunity for testing the adaptive potentials in birds.

The Blackbird *Turdus merula* is a suitable study species because it inhabits very different habitats, including forests, farmland and urban areas (Cramp 1988, Glutz Von Blotzheim & Bauer 1988, Mulsow & Tomiałojć 1997, Gregory & Baillie 1998). Blackbirds have been studied extensively in urban areas (see references in Hatchwell et al. 1996a, b), but not in rural habitats. In this paper I present data on differences in Blackbird nest height between urban and rural areas and discuss the reasons for such differences.

Material and methods

Data were collected in Slovenia at three sites, where data about egg size were also collected (Vogrin 1997a). The study was carried out in the cities of Ljubljana (46°03'N, 14°30'E) and Maribor (46°32'N, 15°40'E) and on the Dravsko polje (rural land) (46°25'N, 15°45'E). Both cities were founded in the 12th century, and the population of Ljubljana is currently about 272 000, whereas the population of Maribor is about 134 000 (Statistical Office of Republic of Slovenia 1996). In the parts of the cities where nests were searched, small blocks of flats and single family houses with gardens predominated.

On Dravsko polje the landscape is composed of intensively cultivated fields, some meadows, traditional orchards and small villages and is

representative for agricultural areas in this region. For the proportion of habitats see Vogrin (1997b). Maribor and the Dravsko polje belong to the sub-Pannonic phytogeographical areas, whereas Ljubljana belongs to the prealpine area (Marinček 1987). More detailed information on the study areas may be found in Vogrin & Vogrin (1998, 1999).

The study was conducted in April and May in 1990 and 1992, i.e. in the early part of Blackbird breeding season in Slovenia (pers. obs.). Since Blackbirds have regularly at least two broods, this study concerns only the first clutches/broods.

Nests were searched for mainly during the egg laying period. A few nests were found also by observation of nest-building by adult birds. In cities nests were searched in suburban areas, whereas on the Dravsko polje nests were searched for mainly in agricultural areas, including hedges and small isolated woods. To limit the disturbance of nests and surrounding vegetation (to avoid desertions and predator attraction), we avoided more visits then two per nest. Any potential bias, due to lower-located nests being easier to find, was ignored because such nests were represented more or less equally in all study areas. At each nest we measured the height from the ground to the nest bottom (nest height) to the nearest 0.1 m as well as the height of the host tree or bush.

A nest was assumed to have failed if it was empty before the expected hatch date or if there was evidence of predation, destruction or desertion. Clutch loss was attributed to predators if the eggs disappeared during incubation, if large fragments of egg shell remained (Brown et al. 1987), or if one or more eggs were taken from the clutch, apparently causing desertion of the remaining eggs.

Nest success was estimated also by using the Mayfield method (Mayfield 1961, 1975). This allowed me to use all nests checked at least twice. If exact information about the date of nest failure was unavailable, I assumed that the nest was lost half-time between two visits. Daily survival (or predation) rates of nests were calculated for the egg stage (egg laying and incubation combined) and the nestling stage separately. Error terms were calculated from Johnson (1979).

For statistical comparison Chi-square, Kruskal-Wallis, Mann-Whitney U and Spearman rank correlation tests were used (Sokal & Rohlf 1995). Daily nest survival rates were compared using t-test. Data were analysed using the SPSS 6.0 statistical programs. Note that sample sizes in Tables 1 and 2 vary due to missing data.

Results

During the study 91 Blackbird nests were found. Blackbirds located their nests between 0.7 and 8.0 m above ground level in cities (N = 54, Table 1) and between 0.1 and 4.4 m in rural land (N = 37). The median height of the nests varied between the localities. Nests in urban environments were located significantly higher than in the rural land (Kruskal-Wallis test = 14.6, df = 2, $P < 0.001$). Moreover, nest height also varied significantly between the two cities (Mann-Whitney U test = 162.5, $P < 0.05$). In all three sites in which nests were located I found a positive significant correlation between nest height and the height of trees, bushes and human artefacts (Dravsko polje: $r_s = 0.77$, Ljubljana: $r_s = 0.77$, Maribor: $r_s = 0.82$, $P < 0.0001$ in all areas).

Heights of trees and bushes (Table 2) used for the Blackbird nests did not differ significantly between the three sites (Kruskal-Wallis test = 3.97, df = 2, n.s.), and neither did it differ significantly between the two cities (Mann-Whitney U test = 198.5, n.s.).

Among the 91 nests in this study, 22 % were found in coniferous trees, 67% in deciduous trees and 11% on human artefacts (Figure 1). The percentage of nests built on artificial structures was greater in the

Table 1. Nest height of the Blackbird *Turdus merula* in three different places in Slovenia.
Höjd över marken hos koltrastbon på tre olika lokaler i Slovenien.

	Ljubljana	Maribor	Dravsko polje
Mean ± SD (m) *Medelhöjd ± SD (m)*	2.6 ± 1.4	2.1 ± 1.2	1.5 ± 0.9
Median (m)	2.30	1.70	1.30
Min. (m)	0.7	1.0	0.1
Max. (m)	8.0	5.0	4.4
N	30	24	37

Table 2. Height of trees and bushes used for Blackbird *Turdus merula* nests in Slovenia.
Höjden hos träd och buskar använda som boplats för koltrastar i Slovenien.

	Ljubljana	Maribor	Dravsko polje
Mean height ± SD (m) *Medelhöjd ± SD (m)*	4.5 ± 2.53	5.2 ± 5.98	3.7 ± 3.54
Median (m)	2.50	3.90	2.75
Min. (m)	1.5	1.9	0.2
Max. (m)	13	20.0	14.5
N	28	22	35

bigger city, Ljubljana, than in Maribor. On rural land all nests were located in deciduous trees.

Nesting losses varied between localities (Ljubljana 78%, n = 30, Maribor 59%, n = 24 and Dravsko polje 76%, n = 37 respectively), but the differences were not significant (Chi-square = 1.4, df = 2, P > 0.05). Daily survival rates of nests with eggs were slightly higher in urban habitat, and the same was true for nests with nestlings (Table 3). However, the differences were not significant (t = 2.40, P > 0.05 and t = 2.18, P > 0.05, respectively).

Since nest height varied significantly between areas, whereas nesting losses did not, I predicted that nest height had no significant effect on nesting losses. I tested my expectation with logistic regression and it was confirmed (R = 0.37, P > 0.001). The main cause of nesting losses was predation (85 %). Since the accuracy of predator identification from nest appearance and the presence or absence of egg or nestling remains is limited, we could assume that the predation is even higher. Potential predator observed were Hooded Crows *Corvus cornix*, Magpies *Pica pica* and *Martes* spp.

Discussion

Blackbirds are very flexible in their choice of nest sites (Cramp 1988, Glutz Von Blotzheim & Bauer 1988) which I could confirm also in my study. The height of the nests in my study areas were close to those found in Poland and in the Czech Republic (Cramp 1988).

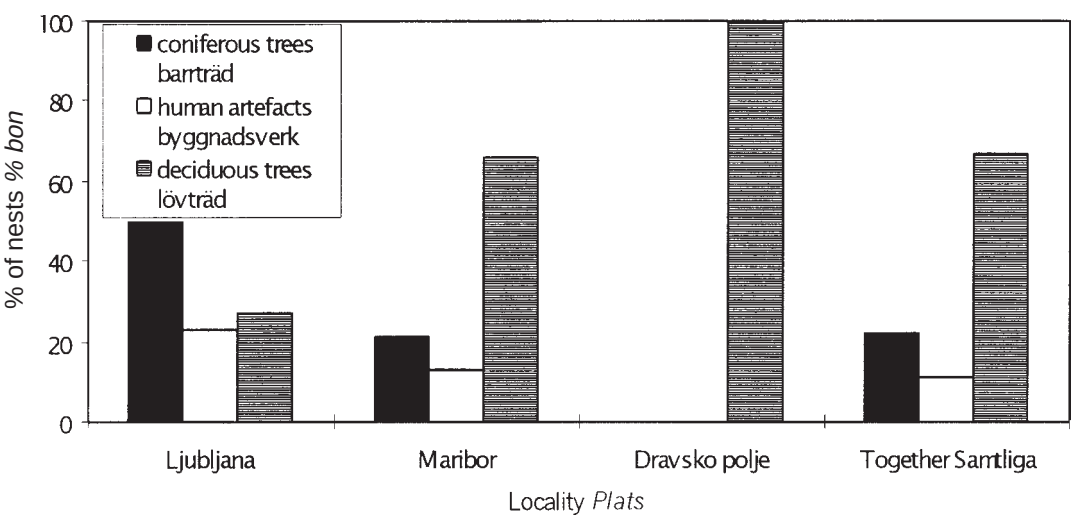

Figure 1. Percentage of nests of the Blackbird *Turdus merula* located in coniferous trees, deciduous trees and on human artefacts in two urban areas (Ljubljanda, Maribor) and one rural area (Dravsko polje) in Slovenia.
Andelen koltrastbon (i procent) i barrträd, i lövträd respektive på byggnadsverk i två städer (Ljubljana, Maribor) och på landsbygd (Dravsko polje) i Slovenien.

Table 3. Daily nest survival rates of Blackbird *Turdus merula* in relation to habitat (Ljubljana, Maribor = urban, Dravsko polje = rural), calculated using the Mayfield method. Mean nest survival ± SD (no. of nests).
Daglig överlevnad hos koltrastbon i olika habitat (Ljubljana, Maribor = stad, Dravsko polje = landsbygd), uträknat enligt Mayfield-metoden. Medelvärde ± SD (antal bon).

	Ljubljana	Maribor	Dravsko polje
Egg stage *Äggperioden*	–	0.984 ± 0.012 (14)	0.978 ± 0.011 (26)
Nestling stage *Boungeperioden*	0.989 ± 0.008 (25)	–	0.983 ± 0.014 (10)

Several studies of the Magpie have found that nests in urban areas are located significantly higher than in rural land (Prinzinger & Hund 1981, Moller 1982, Jerzak 1988, Gorska & Gorski 1997). The same was true also in my study of the Blackbird. My results are in agreement with those of Luniak et al. (1990) who found that urban Blackbirds built nests higher than non-urban birds.

Nest height differences between urban and rural environments in the Magpie may be due to tree species availability rather than being an adaptation to differential predation pressures (Kavanagh et al. 1991), but this explanation is not likely for the Blackbird.

What could be the reason in the Blackbird? I suggest two possibilities. First, the presence of people, cats and dogs might have been an important factor limiting the abundance of breeding birds nesting near the ground (see Luniak 1980). In my study areas, denser human populations could have influenced the nest height of the Blackbird. For example, in Ljubljana where there are more people present (989/km^2), the Blackbirds built nests higher than in Maribor (627/km^2) and in the Dravsko polje (190/km^2). Since nesting trees were of similar height in all three areas, I suggest that building nests higher in urban than in rural areas is an anti-predator strategy. Moreover, in both cities low canopy layer is scarce and there is less heterogeneity of microhabitats (pers. obs.). In such areas, in general, predation is higher than in habitats with rich understory cover (see Major & Kendal 1996 for review). It could be that Blackbirds in urban environments avoid trees and bushes with low understory cover and build nests higher on the same trees and bushes.

In contrast with this, Yahner & Scott (1988) point out that a greater number of tree nests were preyed upon than ground nests, and birds were the major predators. However, these authors used artificial nests which could be the main reason for higher predation rates on tree nests (see e.g. Major & Kendal 1996 and references therein).

The main avian predators elsewhere are corvids (e.g. Andrén 1995 and references therein); the main corvids in my study areas, Hooded Crow and Magpie, are more common in rural than in urban land (e.g. Vogrin 1998a, b). Thus, it could be that Blackbirds in urban areas, where corvids are less frequent, build nests higher in the trees to avoid people and mammalian predators, such as domestic cats and dogs. Thus, Blackbirds possibly respond directly to nest predation pressure by changing their nest site preferences.

However, there is also a second possibility for the difference in nest height location between urban and rural areas. Increased human activity causes drastic changes in the environment, including decreases in vegetation cover, especially the shrub and tree layers (e.g. Hooper et al. 1975, Bessinger & Osborne 1982). This is true also in my study areas, where in both cities bushes are scarce or almost completely lacking. Accordingly, the reason for higher nest sites in cities could be that bushes are more scarce in cities than in rural land. However, since height of bushes and trees among areas did not differ I consider this explanation less likely.

A similar pattern of nest placement in coniferous and deciduous trees to what I found in Slovenia was found by Nowakowski (1994) for Blackbirds that nested in city parks vs. birds that bred in the forest. As far as choice of tree species is concerned, I think that nest site choice in the Blackbird depends highly on local conditions, such as the presence of suitable trees.

Predation as a major cause of nesting losses in Blackbirds was also found elsewhere (Moller 1988, Tomiałojč 1995, Hatchwell et al. 1996b). On average, however, nesting losses in my study areas were comparatively low (Cramp 1988, Tomiałojč 1995, Hatchwell et al. 1996a). Nesting losses were particularly low in Maribor, but this could be also due to a small sample size. Survival rates in my rural area are also higher then data from farmland habitat from Oxford, England (Hatchwell et al. 1996a).

Acknowledgements

I thank the municipalities of Rače-Fram (Mr. Ledinek, Mrs. Antolič) and Slovenska Bistrica (Dr. Žagar) for partial financial help during the preparation of the manuscript. For help during field work I wish to thank Marjan Vogrin. Thanks to all who sent me literature. Two anonymous reviewers and Dr. Å. Lindström provided suggestions which greatly improved the presentation of my results. To all institutions and persons above I extend my sincere thanks.

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Sammanfattning

Bohöjd och boförluster hos koltrastar Turdus merula *i stad och på landsbygd*

Häckningsbetingelserna i städer skiljer sig från dem på landsbygden, framför allt genom hög täthet av människor, många byggnader, stora mängder husdjur, sparsammare vegetation, varmare klimat och konstgjorda ljuskällor. Allt fler fåglar söker sig till urbana miljöer vilket gör det möjligt att studera fåglars anpassningsförmåga. Koltrasten är i detta avseende en lämplig art då den förekommer både i stadsmiljö och på landsbygd, men endast ett fåtal studier har utförts i landsbygdsmiljö. Jag har studerat skillnaderna i höjd hos koltrastbon i olika miljöer och diskuterar tänkbara orsaker till dessa skillnader.

Material och metoder

Data samlades in i Slovenien i två städer, Ljubljana (46°03'N, 14°30'E, 272 000 inv.) och Maribor (46°32'N, 15°40'E, 134 000 inv.) och på landsbygden Dravsko polje (46°25'N, 15°45'E). Stadsmiljöerna dominerades av mindre våningshus samt villaträdgårdar. I Dravsko polje domineras landskapet av intensivt odlade fält, en del ängsmark, fruktodlingar och små byar. Området är mycket representativt för landsbygden i denna region. Studien utfördes i april–maj 1990 och 1992, vilket är den tidiga delen av koltrastens häckningsperiod i Slovenien. Endast förstakullar studerades.

Jag sökte efter bon främst under äggläggningen. För att begränsa störningarna besöktes bon endast två gånger. För varje påträffat bo undersöktes höjden över marken (till närmsta dm), samt höjden på det träd eller föremål där boet låg. En häckning antogs vara misslyckad om boet påträffades övergivet eller ifall det fanns tecken på predation eller att boet var övergivet. Boöverlevnaden (chansen att överleva en dag) beräknades med den s.k. Mayfield-metoden separat för ägg- respektive buongeperioden.

Resultat

Sammanlagt påträffades 91 koltrastbon. Boens höjd varierade mellan 0,7 and 8,0 m över marken i städerna och mellan 0,1 och 4,4 m på landsbygden (Tabell 1). Den genomsnittliga bohöjden var signifikant större i städerna än på landsbygden. Inom vart och ett av de tre områdena var bona placerade högre upp från marken ju högre trädet eller föremålet boet var placerat i var. Däremot var det ingen skillnad i den genomsnittliga höjden på boträd och -föremål mellan de tre områdena (Tabell 2). Av de 91 bona funna låg 22% i barrträd, 67% i lövträd och 11% på byggnader och föremål (Figur 1). På landet låg samtliga bon i lövträd.

Boförlusterna varierade mellan lokalerna (Ljubljana 78%, Maribor 59% och Dravsko polje 76%). Bonas dagliga överlevnadschans var något större i städerna, både för ägg- och boungeperioden (Tabell 3). Dock var inga av dessa skillnader statistiskt säkerställda. Risken för boförlust berodde inte på vilken höjd ett bo var byggt. Predation, i huvudsak från skata, kråka och mård orsakade minst 85% av boförlusterna.

Diskussion

Vår studie visade att koltrastar är flexibla i sitt val av boplats och resultaten var i linje med tidigare studier som visat att bon i städer ofta placeras högre än bon på landsbygden. Samma skillnad har påvisats för skata, men till skillnad från koltrast beror detta troligen främst på skillnader i tillgång på vissa trädarter. Det finns två möjligheter varför koltrastar i städer bygger sina bon högre än på landsbygden.

Den troligaste anledningen är att människor, katter och hundar är mycket vanligare i städerna och störningar och hot från dessa gör att koltrastarna bygger högre upp. Fågelpredatorer är också fåtaligare i städerna vilket underlättar höga placeringar av bon. En mindre trolig anledning kan vara den relativa bristen på lämpliga lägre buskage och undervegetation i städerna.

Vad gäller val av boträd så tror jag att koltrastarna är mindre nogräknade och att skillnaderna mellan lokaler främst beror på skillnader i tillgång på olika trädslag. Boöverlevnaden hos koltrastarna i denna studie var relativt hög, jämfört med andra studier av koltrastar.