

On breeding biology of the Roller (*Coracias garrulus*) in the Komárno town surroundings (SW Slovakia, Danubian basin)

K bnízdni biologii mandelíka hajníbo (Coracias garrulus) v okolí Komárna (JZ Slovensko, Podunajská rovina)

Mirko Bohuš

Comenius University, Faculty of Natural Sciences, Dept. of Ecosozology & Physiotactics,
Mlynská dolina, SK-842 15 Bratislava; e-mail: bohus@fns.uniba.sk

Bohuš M. 2002: On breeding biology of the Roller (*Coracias garrulus*) in the Komárno town surroundings (SW Slovakia, Danubian basin). *Sylvia* 38: 51–59.

Breeding ecology of the Roller (*Coracias garrulus*), i.e. its foraging and breeding habitats, nest cavity type, clutch size, number of nestlings, timing of breeding, food etc. were studied in the surroundings of the Komárno town in SW Slovakia. Grasslands were the most important foraging habitat. Groups or solitary trees of the White Poplar were preferred for breeding. Within 20 breeding attempts, Rollers used cavities made by the Black Woodpecker in five cases (75% of the attempts) and cavities made by the Green Woodpecker in three cases (25%). The average height of the occupied cavities was 11 m. Nestlings left the cavities during July. Large bush-crickets were the dominant food. In 1990, helper behaviour was recorded in one case. In order to maintain the breeding population of the Roller in the area, grasslands, tree and bush linear stands and old White Poplar stands must be preserved. Pollarded willows should be also preserved as an important food source for cavity producers.

Príspevek je zaměřen na potravní biotopy, bnízdni prostředí a dutiny, velikost snůšky, počet mláďat a období bnízdění, potravu a vybrané poznámky k chování mandelíka hajníbo (Coracias garrulus) v okolí Komárna, jibozápadní Slovensko. Nejvýznamnějším potravním biotopem byly porosty trav. Pro bnízdění byly preferovány malé skupiny nebo solitérní topoly bílé. Ve 20 případech bnízdění mandelíci použili pět dutin po datlu černém (75 % bnízdění) a tři po žlutě zelené (25 % bnízdění). Průměrná výška bnízdni dutiny byla 11 metrů. Vyletování mláďat bylo pozorováno v červenci. V potravě dominovaly velké zelené kobylinky. V roce 1990 bylo zaznamenáno krmení mláďat třetím ptákem. K udržení bnízdni populace mandelíka hajníbo v oblasti je důležité zachování travnatých ploch, linoových porostů stromů a keřů, starých topolů bílých a management blavatých vrb, které skýtají potravu pro producenty dutin – velké datly.

Keywords: Roller, foraging habitat, breeding habitat, food, breeding ecology, conservation.

INTRODUCTION

The Roller (*Coracias garrulus* L.) is classified as an endangered species in the Slovak Red List (Krištín et al. 1998, Kriš-

tín et al. 2001) and as a critically endangered species according to Slovak legislation.

Until approximately the middle of 20th century, the Roller had been a common breeder in the Danube basin in Slovakia (Balthasar 1934, Kleiner 1940, Bališ 1952, Ferienc 1955, 1956, 1965, Turček 1957 Balát 1963). The species' distribution range in Slovakia then reached up to the northern highlands along the rivers Váh, Nitra, Žitava, Hron, and Ipeľ (Turček 1942a, 1942b, 1955, Sládek 1946, 1957, 1958, Randík 1954, Varga 1962, Kaňuščák 1975). An abundant population was found primarily on the Žitný island (Ferienc 1955, 1956, 1965) and in the Trnava highlands (Matoušek 1956, 1958).

Notes on population decrease or local extinction in many sites of southwestern Slovakia in the 1960s and 1970s were published by Balát (1963), Štrychová (1965), Matoušek (1974), Balát in Hudec (1983), Kaňuščák (1984), Šťastný et al. (1987) and Binder (in verb.).

The majority of the cited authors consider lack of breeding cavities, conversion of grasslands into arable land and consequent changes in food supply to be the most important causes of this decline. However, an analysis of the causes has never been carried out in Slovakia.

In the Komárno district, Rollers continue to breed, but the overall breeding population density in the region is very low. A larger concentration is found only in a relatively small area, in which specific environmental conditions are still preserved. The first reference to this population was made by Bohuš (1989); notes on the situation in the district with special regard to the area under discussion were published by Janák & Lengyel (1999).

This paper is focused on the summarising of the original data on the Roller's foraging and breeding habitats and the use of breeding cavities, food and breeding behaviour in the surroundings of the town of Komárno during the last two decades of the 20th century, and at

the characterising of the area of occurrence.

METHODS

The data were collected during the period 1983–2000; the site was not checked in 1991, 1993, 1998 and 1999. The presence of foraging Rollers was investigated during May, June and July using the method of line transects with stationary observation points. When observing the foraging bird, the foraging habitat description was recorded. Binoculars 7 x 50, 10 x 50 and 20 x 50 were used. The use of foraging habitats was quantified in a relative range. Breeding cavities were localised by observing adults feeding their nestlings or incubating the eggs. In these cases, the species of the nest tree and its location, as well as the kind of the cavity (its origin) and its height were recorded. The height of cavity entrance was determined by calculation, based on angle measurement from the 25m distance. Direct nest check was carried out only infrequently. The start of egg laying was estimated following the schedule for egg incubation and feeding of nestlings by Balát in Hudec (1983). The food spectrum was defined using visual observations of adults during foraging and flights towards the nest. Prey composition was identified by examining the colour slides taken in 1985, 1986, 1989 and 2000 during the landing of adults by their nest cavities or during feeding of nestlings.

SITE CHARACTERISTICS

The area of the site was approximately 9 km². Agricultural crops included barley, wheat, maize, sunflower and alfalfa. The size of individual fields did not usually exceed 30 hectares. Approximately one quarter of the total site area was covered by grasslands, reeds and sedges. Within the site, depressions in the form of me-

andering old dried river branches and oxbow lakes occurred, some of which were covered with shallow water during wet years. In the majority of arable land plots, pollarded willows (solitary or small groups) were found. Trees and shrubs occurred mainly in linear stands between the fields or in groups. The most abundant tree species were willows (*Salix* sp.), with a smaller number of Black Poplars (*Populus nigra*), White Poplars (*Populus alba*), or poplar hybrids (*Populus x canadensis*). There were only a few woodland stands within the site; less than 3 hectares in size. There is usually a shrub layer in the tree lines; in some areas, trees have been completely replaced by shrubs. The total length of tree lines in the area is around 30 km, the length of electric and phone lines is about 7 km.

The centre of the site with the most important nest trees (i.e. White Poplars) is a depression (old dry meandering river beds) about 4.2 km long. In the depression, grasslands (appr. 25 ha in size) with solitary trees and groups of pollarded willows and some small groups of old Black and White Poplars are found. Till the end of the 1990s, grasslands were grazed by cattle and, more often, mown. Since 2000, they have only been mown. The adjacent plots are large fields (appr. 50 ha and more) of barley, wheat, maize, sunflower and alfalfa.

In comparison with other areas of the Komárno district, the site is unusual with its high abundance of grasslands (grazed or mown), relatively small plots split by tree lines, groups and solitary old trees with suitable cavities.

RESULTS AND DISCUSSION

Foraging habitats

Foraging was recorded in grasslands (mown or grazed), mainly after mowing,

in arable fields (barley, wheat, alfalfa and young maize), meadows, field roads and reeds. In the majority of observations, rollers perched on dry branches at the top or sides of tree crowns, on posts or wires (perch height appr. 4–15 m), or even on low piles of fresh hay following the mowing of grass (perch height appr. 0.1–0.2 m). The radius of foraging Rollers was at most 150 m around the perch, but they mostly hunted only up to 50 metres from the perch. In the year 2000, foraging during a cruising flight over a barley field was first observed. Three pairs of Rollers, breeding in a loose colony, foraged in this way during 3 days of observation (3–5 July 2000). This foraging behaviour was cited by Cramp (1985) from several sources.

The minimum recorded distance of a foraging site from a nest cavity was several tens of metres; the maximum was 1.8 km. In central Poland, Sosnowski & Chmielewski (1996) reported the maximum distance of a foraging site from a nest to be 2.3 km; Cramp (1985) mentioned a range of 3 km.

Nest cavities

During the study period, 20 cases of breeding in 8 cavities were recorded. Five cavities had been made by Black Woodpeckers (*Dryocopus martius*), three by Green or Grey Woodpeckers (*Picus* sp.; most probably *Picus viridis*, since *Picus canus* has never been seen at the site). The preference of Black Woodpeckers' cavities is even higher when all breeding attempts are assessed: 75% (15/20) of them were in cavities made by Black Woodpeckers. Samwald & Samwald (1989) reported breeding of Rollers in Green Woodpeckers' cavities with only one exception of breeding in a rotted hollow in eastern Styria. Sosnowski & Chmielewski (1996) found in central Poland that 79% of pairs bred in Black

Woodpeckers' cavities, 11% in Green Woodpeckers' cavities, and 10% in rotted hollows. Data on the used nest cavities (year of breeding, nest tree species and location, origin of the cavity and its height) are given in Table 1.

of other tree species. In Slovakia, near the town of Trnava, Matoušek (1956) found Roller nest cavities in oaks and he also mentioned breeding in the hollows of fruit trees (apple and walnut trees) at one site. Sládek (1957) reported breed-

Table 1. Characteristics of nest cavities of the Roller.

Tab. 1. Hnízdní dutiny mandelíka hajníbo.

cavity number číslo dutiny	year of breeding rok hnízdění	tree species druh stromu	location of tree umístění stromu	cavity made by dutina po	height of cavity entrance/výška vletového otvoru
1	1983, 1984	<i>Populus alba</i>	group/skupina	<i>Dryocopus martius</i>	10 m
2	1990, 1995, 1996, 1997	<i>Populus alba</i>	solitary tree/ solitérní strom	<i>Dryocopus martius</i>	11 m
3	1985, 1986, 1987	<i>Populus alba</i>	alley/alej	<i>Picus</i> sp.	10 m
4	1986, 1990, 2000	<i>Populus alba</i>	alley/alej	<i>Dryocopus martius</i>	8 m
5	1988	<i>Populus alba</i>	alley/alej	<i>Picus</i> sp.	12 m
6	1989, 2000	<i>Populus alba</i>	alley/alej	<i>Dryocopus martius</i>	6 m
7	2000	<i>Populus alba</i>	alley/alej	<i>Picus</i> sp.	14 m
8	1989, 1990, 1994, 1997	<i>Populus alba</i>	group/skupina	<i>Dryocopus martius</i>	16 m

Cavities no. 1 and 2 were situated in the same tree. Cavities no. 3, 4, 5, 6, and 7 were located in one alley.

All cavities were situated in old trees with diameter of more than 60 cm. The cavity entrance was always oriented towards open space, allowing for direct flight into the cavity. Interestingly enough, all the used cavities were situated in White Poplars, though Black and Green Woodpeckers' hollows were found in Black and hybridised Poplars throughout the site. At the study site in 1998, Janák & Lengyel (1999) found occupied Roller nest cavities at a height of 8, 9 and 12 m, all being situated in White Poplars (see Breeding habitat). Although the use of nest cavities depends primarily on the existing supply, there are published data from Slovakia, former Czechoslovakia and neighbouring countries (Poland, Austria) showing the use

ing of two pairs of Rollers in cavities in willows and poplars (in a park in the town of Zlaté Moravce). Sládek (1958) found nest cavities of Rollers also in Giant Sequoias, Japanese Red Cedars and oaks (in the Mlyňany arboretum). In former Czechoslovakia, Balát (in Hudec 1983) reported breeding of Rollers mostly in oaks ($n = 27$) and pines ($n = 6$); only two hollows were found in White Poplars. In eastern Styria, Samwald & Samwald (1989) reported that of a total of 67 nests, most were found in oak ($n = 16$) and hornbeam ($n = 14$) hollows, while of other tree species, the Rollers used hollows in willow ($n = 3$) and aspen trees ($n = 3$). Sosnowski & Chmielewski (1996) found in central Poland that of a total of 99 nests, the most frequently used nest trees were pines ($n = 57$) and willows ($n = 19$), followed by poplars ($n = 5$) and alders ($n = 4$).

The average height of occupied cavities was 11 m ($n = 20$; s. d. = 3.179; c. v. = 28.9%). In former Czechoslovakia, Balát in Hudec (1983) reported the average nest cavity height of 8 m ($n = 57$), while the minimum was 1.6 m. Matoušek (1958) reported cavity height limits of 8 and 18 m from the surroundings of Trnava; he interpreted the lowest observed height of 2 m as being an exception. In central Poland, Sosnowski & Chmielewski (1996) found the average cavity height to be 9 m ($n = 99$, with limits of 6 and 12 m). Samwald & Samwald (1989) show the average cavity height to be 7.5 m ($n = 57$), with limits of 1.3 and 15 m; cavities of up to 2 m were situated in old apple trees.

Breeding habitat

Nest cavities were found in three breeding sites situated 2.1, 5 and 6.4 km from one another.

The first breeding site was a White Poplar tree situated at the edge of a pollarded willow group, which was cut down in the early 1990ies and then reforested by young poplar hybrids. In this tree, more cavities suitable for nesting of the Roller were present. During the study period, breeding was recorded in two of them (see Table 1, cavities no. 1 and 2). The cavity no. 1 was destroyed when a branch broke off. The nest tree was situated approximately 30 m from a field road used by bicycles, motorcycles, and horse-drawn wagons.

The second most important breeding site was a small, approximately 45 m long alley of old White Poplars where breeding in 5 cavities (nos. 3, 4, 5, 6 and 7, see Table 1) was recorded. A field road used by farm machinery was situated in the alley, with the greatest amount of traffic occurring during periods of field work (often coinciding with the breeding season). Approximately 80 m

from the alley, a pen for cattle was located. A part of the site – a depression situated in dry, meandering, old riverbeds – was used as a cattle pasture. The cattle were led several times a day directly under the trees containing nest cavities.

The third breeding site consisted of a small group of White Poplars where the cavity no. 8 was found. The group was situated in the cultural landscape with a mosaic of fields, lines of trees and shrubs and shallow depressions with reeds and sedges. The closest road (a field road with bicycle, motorcycle, car and farm machinery traffic) was around 250 m away.

Clutch size, number of nestlings and timing of breeding

Four cavities were under direct observation. On 28 June 1987, in the cavity no. 3, two eggs and one nestling were recorded. On 15 June 1988, in the cavity no. 5, three nestlings were found. On 8 July 1989, in the cavity no. 6, four young were recorded. During the last third of June 1992, in the cavity no. 8, three nestlings were found.

The young left their nest cavity on 2 and 3 July 1986 (three fledglings from the cavity no. 4); on 8 July 1989 (the first nestling from the cavity no. 6) and on 4 July 2000 (cavity no. 6). In the other nests, desertion of the cavities by fledglings was estimated at 17 July 1985 (cavity no. 3) and 15 July 1986 \pm 2 days (cavity no. 3). In 1983, in the cavity no. 1, feeding of the young was observed still on 27 July. Considering the data given by Balát (in Hudec 1983) (length of incubation: 17–18 /19–20/ days, feeding of nestlings in cavity: 25–30 days), laying date of the first egg in 1986 was estimated to occur between 14 and 21 May, in 1989 between 19 and 26 May, and in 2000 between 16 and 23 May.

Food

Feeding of the young in nest cavities with bush-crickets (Ensifera), grasshoppers (Caelifera), mole crickets (*Gryllotalpa gryllotalpa*), dragonflies (Odonata), young voles (*Microtus* sp.), and, in early mornings, with earthworms (Lumbricidae) was recorded. Large green bush-crickets (probably *Tettigonia viridissima*) prevailed in the food. Within an analysis of 36 colour slides, 31 items were identified, 5 were not identified. There were 24 large bush-crickets (Ensifera) (66.7%), 5 mole crickets (*Gryllotalpa gryllotalpa*) (13.9%), 1 young mouse (*Apodemus* sp. or *Mus* sp.) (2.8%) and 1 snail (Gastropoda, probably *Arianta arbustorum*) (2.8%).

Some additional notes

On 29 June 1990, during the observation of the nest cavity no. 4, feeding of nestlings by a third adult Roller – a helper – was recorded. At 9:10, one adult bird was inside the cavity with the young; the second adult flew towards the cavity entrance, fed the young and then flew away; immediately afterwards, a third adult bird flew towards the hollow with food. Similar helper activity in the Roller was described by Aviles & Sanchez (1999) in Spain.

In the last ten days of June 1992, during direct checks of the cavity no. 8 where three young were present, the base of an active Hornet *Vespa crabro* nest was found on the cavity ceiling. The ceiling was approximately 15 cm above the cavity entrance.

A loose breeding colony was identified in an alley of White Poplars (cavities no. 3, 4, 5, 6, 7). In 1986, simultaneous breeding of two pairs was observed (cavities no. 3 and 4; distance 19 m), and of three pairs in 2000 (cavities no. 4, 6 and 7 situated approximately in line; distance 6 m /4–6/ and 13 m /6–7/). During the

observations, no intraspecific conflicts were recorded, with the exception of one incident during the period when the young were leaving the cavity. At this time, the parents stopped feeding the young, but stayed in contact with the nestlings, which were sitting at the cavity entrance. One of the adults Rollers, often with prey in its bill, would entice a nestling with its typical short, sharp call of "cra ... cra ... cra ..." for an hour or more (up to half a day), until the nestling flew out. During this time, an attempt of another adult to feed the mewling, hungry nestling was observed several times. When this occurred, the parent attempting to entice the nestling attacked and flicked away the bird offering food. On the other hand, Rollers attacking a Kestrel (*Falco tinnunculus*) were often observed at both breeding and foraging sites. Rollers were always successful in these attacks.

On 1 May 1987, a nest of Jackdaws (*Corvus monedula*) was found in the cavity no. 3. On 28 June, Roller eggs and one nestling were found in the cavity. Information provided by a local gamekeeper indicated that in the previous year (1986), the same cavity was initially occupied by Jackdaws; the gamekeeper then found Jackdaw nest material and dead nestlings below the cavity.

CURRENT STATUS AND PERSPECTIVES OF THE ROLLER BREEDING POPULATION IN THE AREA

During the study period, only a few changes in land use were recorded in the area. Some small plots of meadows were ploughed-up (less than 10 ha in size). These changes probably had no significant negative impact on the local Roller breeding population. Almost all existing grasslands are still mown; the

extent of this activity is limited by occasional surface inundation in the depressed locations. Because of the importance of mown grasslands as a foraging habitat for Rollers, grass cutting can be considered to be a positive factor. At the end of the 1990s, approximately 25 ha of pastures were converted to mown grassland.

Throughout the area, no tree lines, groups, or solitary trees used by Rollers as perches were removed. However, most of the trees are old and some are decaying. This is particularly the case with old pollarded willows that need periodical cutting and planting. Pollarded willow management is only local and occasional. Should this situation continue, the stands of pollarded willows, comprising very old and decaying trees, will disappear. This may result in a decrease of perching opportunities for Rollers, as well as a decrease in the site's carrying capacity of large woodpeckers, which are important as cavity producers. Pollarded willows are an important habitat for large-bodied ants, which are necessary food for Green and Black Woodpeckers. In the long term, even should there be a sufficiency of old trees in the future, a lack of suitable hollows may occur. In the year 2000, within the entire area, the abundance of Black Woodpeckers was estimated at 3–4 pairs, and that of Green Woodpeckers at 4–6 pairs. During the winter of 2000/2001, an inventory of hollows in White Poplars was carried out, in which 72 roller-suitable cavities were identified. During the entire period of 1983–2000, Roller abundance was estimated at 5–7 breeding pairs per year in the area. In 2000, the abundance was estimated at 5 pairs (of those, 3 were actually observed in their nests; the remainder were observed as foraging individuals or couples in 2–3 locations outside the regular foraging sites of the breeding pairs). Despite the com-

petitiveness of Rollers in occupying the hollows, the supply of existing cavities may be considered sufficient.

In order to maintain the above-described breeding population of the Roller, which is a very rare bird in Slovakia at present, it will be necessary to preserve the current proportion of grasslands and to ensure the management of tree stands in the site.

In terms of further investigation, it will be important to examine the topic relations of the Roller to foraging habitats and the species' preference, spatial distribution and the area of foraging sites, and of the overall territory of breeding pairs. Despite the expected sufficiency of appropriate nest cavities with regard to the possible re-colonisation of potential sites, it would seem suitable to test the bird's preferences before positioning nest boxes, if such a course of action is decided upon.

ACKNOWLEDGEMENTS

Special thanks to Mr. Peter Rác for providing consultation on the subject of this paper, and for constructive annotation of an early draft of the manuscript. I would also like to thank Ms. Christine Irwin and Mr. Michal Deraj for their help with proof-reading of this paper. And I would like to express my gratitude to reviewers for their constructive criticism of the manuscript.

SOUHRN

Mandelíci hajní lovili potravu na loukách (především po pokosení), polích (ječmen, pšenice, vojtěška a mladá kukurice) a polních cestách; lov byl pozorován i v rákosinách. Akční rádius lovu od posedu byl 150 m, většinou však méně než 50 m. Minimální vzdálenost lovu od hnízda byla několik desítek metrů,

maximální 1,8 km. Ve dvaceti zjištěných případech hnízdění bylo použito osm dutin; 5 po datlu černém (15 hnízdění) a 3 po žluně zelené (5 hnízdění). Průměrná výška vletového otvoru dutiny byla 11 m. Všechny dutiny byly v topolech bílých, a to na třech různých stanovištích – v soliterním stromě (2 dutiny), v malé skupině stromů (1) a malé aleji (5). Vyletování mláďat bylo pozorováno v první a druhé dekádě července. V potravě přinášené mláďatům byly zjištěny většinou velké zelené kobylinky, méně byly zastoupeny krtonožky; po jednom případě krmení mladým bloudavcem a plžem. Kromě toho bylo pozorováno krmení sarrančemi, vážkami, braboši a po ránu také dešťovkami. V r. 1990 bylo zaznamenáno krmení mláďat dospělým ptákem mimo pár. Na lokalitě s dostatečným počtem vhodných dutin bylo zaznamenáno hnízdění mandelíků ve volných koloniích (v r. 1986 dvě hnízda v 19 m vzdálenosti, v r. 2000 tři hnízda 6 a 13 m od sebe). Na lovištích mandelíci úspěšně vstupovali do mezidrubových střetů s poštolkami; v kompetici o dutiny úspěšně konkurovali kavkám. Z hlediska udržení hnízdní populace mandelíka hajníbo na lokalitě se zdá být významným zachování trvalých travních porostů a jejich kosení, rovněž zachování starých stromů s dutinami po velkých šplhavcích pro hnízdění a jako vhodných posedů pro lov. Z hlediska zabezpečení úživnosti území pro datly černé a žluny (producenti dutin) je důležité zachování starých hlavatých vrb.

LITERATURE

- Aviles J. M. & Sanchez J. M. 1999: Uncommon helper behaviour in the Roller, *Coracias garrulus*. *Alauda* 67 (1): 75.
- Balát F. 1963: Ptačí fauna Žitného ostrova. *Biologické práce* 9 (7). Vydavateľstvo SAV, Bratislava.
- Bališ M. 1952: Kvantitatívny výskum vtáctva lužných lesov Podunajska. *Dizertačná práca, Prírodovedecká fakulta UK, Bratislava*.
- Balthasar V. 1934: Ptactvo lužných lesov slovenského Podunají. *Bratislava* 18: 189–215.
- Bohuš M. 1990: K hniezdeniu a ochrane krakle belasej. *Živa* 38 (1): 38–39.
- Crampe S. 1985: The Birds of the Western Palearctic. IV. *Oxford Univ. Press, Oxford*.
- Ferianc O. 1955: Príspevok k stavovcom Žitného ostrova I. *Biológia* 10: 308–324.
- Ferianc O. 1956: Príspevok k poznaniu stavovcov Žitného ostrova II. *Biológia* 11: 282–298.
- Ferianc O. 1965: Stavovce Slovenska III. Vtáky II. *Vydavateľstvo SAV, Bratislava*.
- Hudec K. (ed.) 1983: Fauna ČSSR. Ptáci – Aves III/1. *Academia, Praha*.
- Janák M. & Lengyel J. 1999: K početnosti krakle belasej (*Coracias garrulus*) v okrese Komárno. *Rosalia* 14: 175–180.
- Kaňuščák P. 1975: Avifauna širšieho okolia Piešťan. *Biologické práce* 21 (4). Veda, Bratislava.
- Kaňuščák P. 1984: Doplnky k poznaniu avifauny širšieho okolia Piešťan. *Balneologický spravodajca* 1984. *Balneohistoria Slovaca* 23: 88–102.
- Kleiner E. 1940: Mitteilungen über die Ornithologie der mittleren Donau. *Folia Zoologica et Hydrobiologica* 2 (10): 450–479.
- Krištín A., Danko Š., Darolová A., Kocian L., Kropil R., Murín B., Stollmann A. & Urban P. 1998: Červený zoznam a ekozozologický status vtákov (*Aves*) Slovenska. *Ochrana prírody* 16: 219–232.
- Krištín A., Kocian L. & Rác P. 2001: Červený (ekozozologický) zoznam vtákov (*Aves*) Slovenska. In: Baláž D., Marhold, K. & Urban P. (eds): Červený zoznam rastlín a živočíchov Slovenska. *Ochrana prírody* 20 (Suppl.): 150–153.
- Matoušek B. 1956: Príspevok k oológii slovenskej avifauny. *Biologické práce* 2 (7). Vydavateľstvo SAV, Bratislava.
- Matoušek B. 1958: Vtáctvo Trnavskej nížiny. *Biologické práce* 4 (10). Vydavateľstvo SAV, Bratislava.
- Matoušek B. 1974: Vtáctvo ponticko-panónskeho dubového lesa „Dubník“ pri Šintave (Západné Slovensko). *Acta Rerum Natura-*

- lium Musei Nationalis Slovaci, Bratislava* 30: 219–255.
- Randík A. 1954: Rezervácia lužného lesa v Pohroní. *Ochrana přírody* 9: 85–86.
- Samwald O. & Samwald F. 1989: Die Blauracke (*Coracias g. garrulus*) in der Steiermark – Bestandsentwicklung, Phänologie, Brutbiologie, Gefährdung. *Egretta* 32 (2): 37–57.
- Sládek J. 1946: Krakľa belasá (*Coracias garrulus* L.) v Zlatomoraveckom parku. *Příroda* 1 (9–10): 169.
- Sládek J. 1957: Hniezdenie krakle belasej (*Coracias garrulus* L.) na budovách. *Acta Rerum Naturalium Museorum Slovenicorum* 3 (6): 2–6.
- Sládek J. 1958: Ornitofauna arboréta Mlyňany. In: Benčať F. (ed.): Přírodní podmínky Arboréta Mlyňany. *Biologické práce* 4 (12). Vydavateľstvo SAV, Bratislava: 111–151.
- Sosnowski J. & Chmielewski S. 1996: Breeding biology of the Roller *Coracias garrulus* in Puszcza Pilicka Forest (Central Poland). *Acta Ornithologica* 31 (2): 119–131.
- Štrychová A. 1965: Mandelík hajní (*Coracias garrulus* L.). *Živa* 13 /51/ (4): 158–160.
- Šťastný K., Randík A. & Hudec K. 1987: Atlas hnízdního rozšíření ptáků v ČSSR. *Academia, Praha*.
- Turček F. 1942a: Avifauna inundačných lúk okolia Nitry. *Technický obzor slovenský* VI., *Prírodovedná príloha* III.
- Turček F. 1942b: Beiträge zur Ornithologie von Nitra. *Aquila* 46–49: 301–302.
- Turček F. J. 1955: Vtáčie populácie troch typov lesných biocenóz na Slovensku. *Biológia* 10 (3): 293–308.
- Turček F. J. 1957: A Duna melletti ligeterdők madárvilága, tekintettel gazdasági jelentőségére. *Aquila* 63–64: 15–40.
- Varga J. 1962: Príspevok k poznaniu rozšírenia a ochrany stavovcov Trenčianskeho okresu. *Sborník prác z ochrany prírody v Západoslovenskom kraji. Krajské stredisko štátnej a pamiatkovej starostlivosti a ochrany prírody Bratislava-brad, Bratislava*: 67–93.

Došlo 8. srpna 2002, přijato 27. září 2002.

Received August 8, 2002; accepted September 27, 2002.