

## EUROPEAN ROLLER *CORACIAS GARRULUS* IN ESTONIA 2000–2011

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**Abstract.** The main cause for the rapid decline in the roller population in Europe is due to major changes in agricultural practices and forestry (lack of nesting and feeding sites, use of pesticides). Information on mortality in wintering areas and during the migration is rather poor. In the 1950s, thousands of pairs were breeding in Estonia, yet a rapid decline occurring in the European population also affected the Estonian population. In order to improve the breeding conditions and to enhance the population growth of rollers, which is cut off from the southern population, a nest-box program was launched in 2000. An example set by the Latvian colleagues was followed, and 100 nest-boxes were set up in SE-Estonia, information on random observations was collected and active searching for the species was carried out in suitable habitats. In the first decade of this century one or two breeding roller pairs have been registered annually. However, in 2011 none was recorded which probably means that it was probably too late to improve the nesting conditions of the roller.

### Introduction

The European Roller (*Coracias garrulus*) is the only representative of the *Coraciidae* family occurring in Estonia or in Europe generally (Cramp 1986). Rollers are mostly insectivorous yet occasionally they feed on small vertebrate such as lizards and snakes (Fry & Fry 1999). Autumnal

diet also includes fruits and berries (BWPI 2008). Rollers breed throughout the Eurasian temperate and steppe zone, the Mediterranean Sea region to north-west Africa and the western Himalayas (Cramp 1986). In Europe, the breeding population is estimated to 55 000–117 000 breeding pairs and forms 50–74% of the global range. In the 20th century, the roller was a common breeding species in the entire Europe. However, in the past century, the species has gone extinct in Germany, Denmark, Finland and Sweden, following Czech and Slovenia (BirdLife International 2008). The roller population in Europe is fragmented (Tucker & Heath 1994) and population trend is declining in 18 of 29 countries (Kovacs *et al.* 2008). The overall European decline of the past ten years has been 30% (BirdLife International 2004). The main causes of a widespread decline are considered the loss of suitable habitat due to changing agricultural practices, loss of nest sites and use of pesticides (Tucker & Heath 1994, Kovacs *et al.* 2008). The European Roller is considered globally Near Threatened in the IUCN Red List for birds (BirdLife International 2008).

The roller is a cavity nesting species and mainly breeds in natural cavities and fissured rock-faces (Cramp 1986), but they also nest in abandoned woodpecker cavities (Avilés & Folch 2004, Kumari 1954). In areas where natural cavities are scarce rollers nest in nest-boxes which have a suitable opening size (Kose 2003), but also in the openings of buildings and bridges (Avilés & Folch 2004). Several local action plans implemented in Europe in the purpose of enhancing the breeding conditions of the roller are based on erecting nest-boxes in suitable biotopes (Sosnowski & Chmielewski 1996, Avilés *et al.* 1999, Bohus 2007).

In the 1950s and 1960s the European Roller was a common breeding species in Estonia, with thousands of pairs (Mank 1994) breeding throughout the country, including the islands Saaremaa, Hiiumaa and Ruhnu (Leibak *et al.* 1994). Following a rapid decline in the 1970s due to agricultural intensification, changes in agricultural practices, especially the use of heavy machinery and pesticides (Table 1). According to the Estonian Nature Conservation Act, The European Roller belongs to the protected category I. The species can only be

sighted in South-Estonia, mostly in Valga County which is a former distribution midpoint (Kose 2003). In the Estonian Red List of Threatened Species, the European Roller is listed as Critically Endangered (<http://elurikkus.ut.ee/prmt.php?lang=est>). The number of the rollers has continuously been declining during the past 20 years. Thus, a project was initiated by the Estonian Ornithological Society in 2000. The aim of the project was to enhance the breeding conditions of the roller in Estonia and also collect information on habitat preferences in terms of breeding and foraging. One of the reasons why the Estonian population, like the rest of the European populations, has undergone a decline, may lie in the lack of suitable nesting sites. Therefore, nest-boxes were placed in suitable habitats. In order to study foraging, nest material (excrements and food leftovers) was analysed, which later was collated with previous studies (Vahi 1962) on the diet of the roller.

During 1932(1933) to 2011 a total of 114 rollers have been ringed in Estonia and there also exists one recovery (a nestling ringed by Urmas Kirsimäe on July 13th 1973 in Valga County was recovered dead on September 22nd in 1977 in Moldova (former Moldavian SSR); Kastepõld 1980).

## Material and methods

In 2000, a total of 100 nest-boxes (floor 20 x 25 cm, tall 40 cm, diameter of the opening 8–10 cm) were placed in known breeding sites of the roller in Võru and Valga Counties. Nest-boxes were placed in suitable roller habitats (mainly agricultural land and open pasture fields, inside and near sparse forests) and were mostly installed 4–5 m high, on trees and electric poles but also on a few buildings. Nest-boxes were placed in the surroundings of known nest sites, if feasible. Main criteria for erecting nest-boxes was the following: a) high and arid, sunny habitats, b) the edges of clearings (preferably southerly), c) forest-agriculture mosaics, d) agricultural practice (preferably mowed grasslands and other cultivation practices, presence of livestock and herding), e) presence of suitable lookout posts (close to electric and telecommunication circuits).

During 2000 to 2005, surveys were conducted in the breeding season within the entire study area and all the nest-boxes were inspected and maintained. However, since 2006 only areas where rollers were registered breeding (Hargla–Taheva region in Valga County) were surveyed.

Unoccupied nest-boxes were maintained, occupied nest-boxes and eggs were photographed, clutch size was registered. Water testing was conducted for rotten eggs and in order to determine the incubation stage of the eggs. Next inspection of the occupied roller nests took place at the time when nestlings were approximately 20 days old. Nestlings were ringed and body parameters were measured. Adult birds were not caught nor ringed as it is considered to be harmful for such rare and threatened species.

There is only one recovery of all the nestlings ringed during the project – one bird was sighted and photographed at Lake Peipus in June 2008.

In 2001 and 2010, nest material was taken out of one roller nest-box in the purpose of conducting food analysis. The majority of the nest material contained nest material of the Common Starling (*Sturnus vulgaris*), excrements of roller nestlings and food leftovers. Nest material was placed within plastic bags and later analysed by a specialist, on the basis of which later the diet of the roller brood was determined.

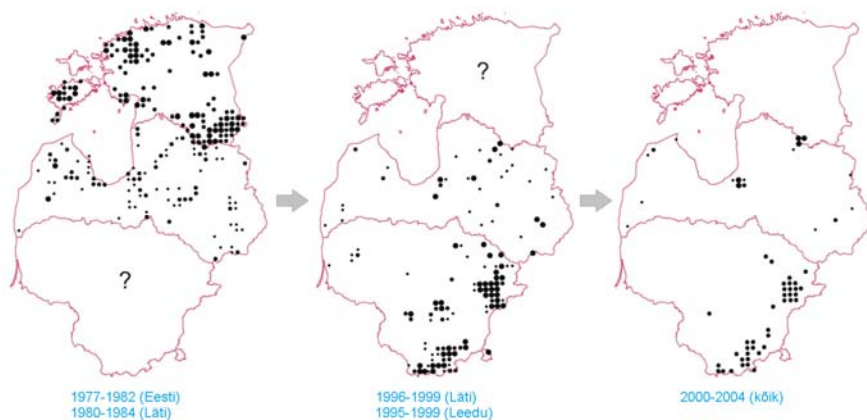
## Results

Population size and range. Collating different publications on the population size of the rollers breeding in Estonia with the results of the current project show that the European Roller has practically gone extinct in Estonia (Table 1, Fig. 1). In the 1950s and 1960s the roller was a common species, with thousands of breeding pairs all across Estonia (Mank 1994), but hereafter the numbers experienced a continuous decline, being less than 100 breeding pairs in the early 1990s (Lõhmus *et al.* 1998). In the last decade the population size of the roller has been similar to that in the early 19th century, when it also was a rare species in Estonia (Meyer 1815) with only a few breeding pairs.

**Table 1.** Estimated numbers of breeding roller pairs in Estonia.*Tabel 1. Eestis pesitsevate siniraa paaride arvukushinnangud.*

<i>Aasta, period / Year, period</i>	<i>Arvukus / Numbers</i>	<i>Allikas / Reference</i>
Beginning of 19th c.	haruldane / rare	Meyer 1815
1950s	tuh. paare / thousands of pairs	Mank 1994
1970s	150–200 paari / pairs	Mank 1994
1980	200 p	Kumari 1982
1971–1992	150–200 p	Lilleleht and Leibak 1993
1993–1997	50–100 p	Lõhmus <i>et al.</i> 1998
1998–2002	5–15 p	Elts <i>et al.</i> 2003
2003–2008	1–5 p	Elts <i>et al.</i> 2009
2009–2010	1–5 p	Lüütsepp, O., Kalamees, A. (unwrit.)
2011	0–5 p	Kalamees, A., Lüütsepp, O. (unwrit.)

Along with the declining population size also the breeding range of the roller has decreased in Estonia and elsewhere in the Baltics (Fig.1). Within the former distribution midpoint, the roller can only be sighted in South-Estonia (Kose 2003), however, according to the latest data, it does not breed there anymore (Kalamees & Lüütsepp 2011).

**Figure 1.** Range decrease of roller in the Baltics (after Racinskis *et al.* 2004).*Joonis 1. Siniraa levila vähenemine Baltikumis (Racinskis *et al.* 2004 järgi).*

Up to 2010, monitoring data (Table 2) shows at least one roller pair every year breeding in Estonia, yet 2011 is the first year when no breeding attempt was registered. In 2003 and during 2005 to 2007 two breeding pairs have been registered per year, and in these years also the number of fledglings has been the highest. Unsuccessful breeding was registered in two years: in 2004 when nest predation occurred during the incubation period and in 2009 when nestlings died due to an unfavourable breeding season.

**Table 2.** Breeding success of rollers in 2001–2011.

*Table 2. Siniraa pesitsuse tulemuslikkus 2001–2011 seire andmetel.*

Aasta Year	Pesitsuspaare No. of pairs	Kurna suurus Clutch size	Mädamune Rotten eggs	Lennuvõimestunud poegi No. of fledglings
2001	1	3	0	3
2002	1	3	0	3
2003	2	4+1	0+0	3+1
2004	1	3*	-	0
2005	2	4+4	1+3	3+1
2006	2	4+4	1+2	1+2
2007	2	5+4	4+0	1+4
2008	1	3	1	2
2009	1	2	2	0
2010	1	3	1	2
2011	0	-	-	-

\* - pesa rüüstati / nest was depredated

**Nesting habitat.** The study revealed that rollers occupied nest-boxes within agricultural habitats, surrounded by suitable feeding areas such as cornfields and meadows, forest edges and gardens. Occupied nest-boxes could be placed lower from the ground (min 3.5 m) and could have smaller dimensions than presumed. It appeared that the optimal diameter of the opening size for the roller was 6.5 cm (the mean opening diameter of occupied nest-boxes). Nest-boxes with an opening diameter of 8–10 cm (opening sizes of the nest-boxes placed during the

project) were often depredated by corvine birds and the European Pine Marten (*Martes martes*). Latter may also be the reason why rollers often preferred old starling nests to special nest-boxes placed during the project. Yet, during 2001 to 2003 and in 2006 the rollers successfully bred in project nest-boxes.

Food analyses. According to Vahi (1962), rollers are eating a wide variety of insects (mainly *Coleoptera*; 29 species) but also *Formicidae*, *Diptera*, *Leptidoptera*, *Orthoptera* (3 species), *Myriapoda*, amphibians (*Rana sp.*) and small rodents (*Sorex sp.*). Food analysis in the latter study was carried out using roller excrements taken from nest-boxes and food leftovers (n=3), but also stomach analyses (n=17).

The results of the roller nest material analysis along with the study results carried out by Vahi (1962) are presented in table 3. Nest material analyses of 2001 revealed a total of 8 species, yet leftovers of some species (probably Ground Beetles *Carabidae*) were not able to be identified and also the number of individuals was not recorded. In the nest material analysis of 2001, Dung Beetle (*Geotrupes stercorosus*) dominated, followed by Summer Chafer (*Amphimallon solstitialis*) and Black Longicorn Beetle (*Spondylis buprestoides*). Summer Chafer was not recorded in the analyses of 2010.

Nest material analysis of 2010 revealed 19 different species of prey, mainly Longhorn Beetles (*Cerambycidae*; 40%), Ground Beetles (38%) and Scarab Beetles (*Scarabaeidae*; 18%). The predominant species in the analysis of 2010 was Bitbock (34%; *Spondylis buprestoides*). These 19 species of prey also included two insect species (*Broscus cephalotes* and *Carabus nemoralis*) which in former food analyses of the roller have not been present. Food analyses show that the roller is extremely polyphagous. In Estonia they mainly prey upon *Coleoptera* whereby the selection of species is rather casual.

**Table 3.** Diet of the roller**Tabel 3.** *Siniraa toidusedel*

Mardikalised ( <i>Coleoptera</i> )	Esinemissagedus / Frequency %		
	Vahi 1962	2001	2010
Tüvesikk ( <i>Spondylis buprestoides</i> )	22	X	34
Metsasitikas ( <i>Geotrupes stercorosus</i> )	6	X	(2*)
Silejooksik ( <i>Carabus glabratus</i> )	5	-	(2)
Sitasitikas ( <i>Geotrupes stercorarius</i> )	5	-	(2)
Juunipõrnikas ( <i>Amphimallon solstitialis</i> )	(0.7)	X	-
Mügrijooksik ( <i>Broscus cephalotes</i> )	-	-	14
Aiajooksik ( <i>Carabus nemoralis</i> )	-	-	8
Hiilasitikas ( <i>Geotrupes vernalis</i> )	(0.3)	(+)	(2)
Põllujoosik ( <i>Carabus cancellatus</i> )	(1.4)	(+)	(2)
Kuldpõrnikas ( <i>Cetonia aurata</i> )	(1.3)	(+)	4
Harilik raisamatja ( <i>Necrophorus vespillo</i> )	(0.1)	(+)	-
Süsijooksik ( <i>Pterostichus niger</i> )	(0.4)	(+)	6

\*täiendav analüüs tegemisel, X teistest arvukam, (+) esindatud, kuid ei ole viie arvukama liigi hulgas, - puudub analüüsi liiginimekirjast, () ei ole viie arvukaima liigi hulgas.

\*needs further analysis, X more numerous than other items, (+) present, but not among five most abundant items, - not present, () not among five most abundant items.

## Discussion

Estonia is the northern range limit of the European Roller and the species has continued to decline all across Europe and the western part of Russia (BirdLife International 2008). It is to be expected that first populations to go extinct are range edge populations. In order to stop the decline of the roller, the European Species Action Plan was drawn. Nevertheless, the species has continued to decline across its global range, including Lithuania and Estonia. Only in Latvia the population has reached its stable stage, however, the breeding area does not extend to the northern part of the country anymore and is mainly concentrated close to Riga (Racinskis *et al.* 2004).



The European Roller is a species that expresses juvenile fidelity to a breeding area (Sosnowski ja Chmielewski 1996), and as the last representatives of this species in Estonia have presumably perished or have not been able to pair, the only probable addition of individuals into the Estonian breeding population is from Latvia. Rollers tend to form pairs on the wintering grounds and return to Europe together rather late in spring (Couzens 2005). However, if one mate dies on the wintering grounds, the other might not return. In 2011, there were no rollers sighted in their traditional breeding areas, and only two occasional sightings have been reported, which were not confirmed. Visual observations do not show any deficiency of suitable habitats in Estonia as there is enough variety of agricultural landscapes, which may be one of the key factors serving the roller. As the nest-box project has shown, also the lack of nesting sites cannot be the reason for the population decline in Estonia. As well, there is no food scarcity to limit rearing their young. The only exception was in 2009, when an unusually cold and wet breeding season resulted in unsuccessful breeding.

One of the reasons for the decline in the roller numbers in Estonia may be that the population is likely to have suffered from inbreeding; however, there is no proof of that. The reason for a large proportion of rotten eggs may be due to the fact that rollers lay eggs on unlined cavity, as a result of which some eggs remain unhatched. Vahi (1962) also observed the presence of rotten eggs in roller nests (e.g. clutch of 5 with 2 rotten eggs). As the latter study was carried out in 1954, during a population peak, when there were thousands of breeding pairs, it rules out inbreeding as a potential factor and the reasons must lie elsewhere. It is probable that the proportion of rotten eggs in roller nests has always been high in Estonia (range edge population), yet it was not noted, as the roller numbers were considerably higher and it did not affect the overall population size. There may also be other causes for the incidence of rotten eggs, such as the age of the birds or several pesticides and chemicals (e.g. DDT) used on wintering grounds in Africa (Maris Strazds, unwritten data).

The most important effect on the population decline probably have the wintering grounds in eastern and central Africa, which is where all

the rollers (from Europe to the Himalaya) are wintering (Couzens 2005) and, toxic chemicals, such as DDT, are still extensively used (van den Berg 2011). Also, threats that the rollers are opposed to along the migration route are of major significance. The rollers, among other species, are exposed to hunting (<http://mekshat.com/vb/showthread.php?t=407308>). These factors directly or indirectly affect the whole roller population.

The food analyses show a variety in the diet of the European Roller. In Estonia they mainly prey upon *Coleoptera* and the selection is highly casual. The variety of food objects suggests that the rollers hunt in diverse habitats. Yet, as the diet includes a quantity of flying insects, the reason for a variety of food objects in the diet may not result from diverse feeding habitats but rather from diverse *Coleoptera* species crossing the feeding areas of the roller. Nevertheless, the results point to a wide variety of food objects in the diet of the roller, therefore, the population decline in Estonia can not derive from poor food availability.

Observations carried out during the past decade provide proof of the fact that the population size of the European Roller in Estonia is extremely small and constitutes mainly of only a couple of breeding pairs in SE Estonia.

During 2000 to 2010, 1-2 breeding roller pairs have been registered annually, therefore steps have been taken to improve the breeding conditions of the species and to help the population to recover. Probably it was too late to improve the nesting conditions of the roller, for in 2011 not a single breeding attempt was registered. In 2012, another approach will be taken and nest-boxes imitating natural cavities of the woodpeckers will be placed in suitable habitats, for birds migrating to Estonia in the spring would also breed here.

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- References.** — **Avile' s, J.M., Folch, A. 2004.** La Carraca *Coracias garrulus*. Libro Rojo de los Vertebrados de Espan~a. 297–298. — **Avile' s, J.M., Sanchez, J.M., Sanchez, A. & Parejo, D. 1999.** Breeding biology of the Roller *Coracias garrulus* in farming areas of the southwest Iberian Peninsula. *Bird Study* 46: 217–223. — **BWPi 2008.** Birds of the Western Palearctic interactive DVD ROM, versioon 2.0.1. — **BirdLife International. 2004.** Birds in Europe: Population Estimates, Trends and Conservation Status. Cambridge: BirdLife International. — **BirdLife International 2008.** *Coracias garrulus*. IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <[www.iucnredlist.org](http://www.iucnredlist.org)>. — **Bohus, M. 2007.** Breeding of the European Roller (*Coracias garrulus*) in south-west Slovakia during 2001–2006. *Tichodroma* 19: 11–16. — **Couzens, D. 2005.** Birds: A Complete Guide to all British and European Species. Harper Collins Publishers. — **Cramp, S. 1986.** Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Oxford: Oxford University Press. — **Elts, J., Kuresoo, A., Leibak, E., Leito, A., Lilleleht, V., Luigujõe, L., Lõhmus, A., Mägi, E., Ots, M. 2003.** Eesti lindude staatus, pesitsusaegne ja talvine arvukus, 1998–2002.a. *Hirundo*, 16: 58–83. — **Elts, J., Kuresoo, A., Leibak, E., Leito, A., Leivits, A., Lilleleht, V., Luigujõe, L., Mägi, E., Nellis, R., Nellis, R., Ots, M. 2009.** Eesti lindude staatus, pesitsusaegne ja talvine arvukus, 2003–2008.a. *Hirundo*, 22: 3–31. — **Fry, K & Fry, H. C. 1999.** Kingfishers, Bee-eaters and Rollers, new edition. Christopher Helm Publishers. — **Kalamees, A., Lüütsepp, O. 2011.** Siniraag on Eestist kadunud? *Tiirutaja*, 14: 2. Eesti Ornitoloogiaühing. — **Kastepõld, T. (koost) 1980.** Loodusvaatlusi 1978, II. Tallinn, 148 lk. — **Kose, M. 2003.** Siniraag. *Eesti Loodus*, 7/8, 46–49. — **Kovacs, A., Barov, B., Orhun, C., Gallo-Orsi, U. 2008.** Species Action Plan for the European Roller *Coracias garrulus*. [http://ec.europa.eu/environment/nature/conservation/wildbirds/action\\_plans/docs/coracias\\_garrulus\\_garrulus.pdf](http://ec.europa.eu/environment/nature/conservation/wildbirds/action_plans/docs/coracias_garrulus_garrulus.pdf). — **Kumari, E. 1954.** Eesti NSV linnud. Tallinn. 414 lk. — **Kumari, E. (koost) 1982.** Punane raamat. Tallinn, Valgus — **Lilleleht, V., Leibak, E. 1993.** Eesti lindude süstemaatiline nimestik, staatus ja arvukus. *Hirundo*, 12: 3–50. — **Lõhmus, A., Kuresoo, A., Leibak, E., Leito, A., Lilleleht, V., Kose,**

**M., Leivuts, A., Luigujõe, L., Sellis, U. 1998.** Eesti lindude staatus, pesitsusaegne arvukus 1991.-1997.a. *Hirundo*, 11: 63–83. — **Mank, A. 1994.** In: Leibak et al. *Birds of Estonia. Status, Distribution and Numbers.* Estonian Academy Publisher, Tallinn: 152–153., E., — **Racinskis Kalamees, A., Raudonikis, L. 2004.** Decline of Roller *Coracias garrulus* population in the Baltic states. Latvian Ornithological Society, Latvia. Poster. 16th International Conference of the European Bird Census Council. Bird Numbers 2004 Monitoring in a Changing Europe. Turkey. — **Sosnowski, J., Chmielewski, S. 1996.** Breeding biology of the Roller *Coracias garrulus* in puszcza pilicka forest (central Poland). *Acta Ornithol.* 31: 119–131. — **Tucker, G.M., Heath, H.F. 1994.** *Birds in Europe: Their Conservation Status.* Cambridge: Birdlife International. — **Vahi, J. 1962.** Siniraa vaatlusi Taevaskojas. *LUSAR* kd 55, lk 240–254. — **van den Berg, H. 2011.** Global status of DDT and its alternatives for use in vector control to prevent disease. *Ciencia & Saude Coletiva.* 16: 2: 575–590.