A kárpát-medencei szalakóta populáció vonulási útvonalai, telelő- és pihenőterületei

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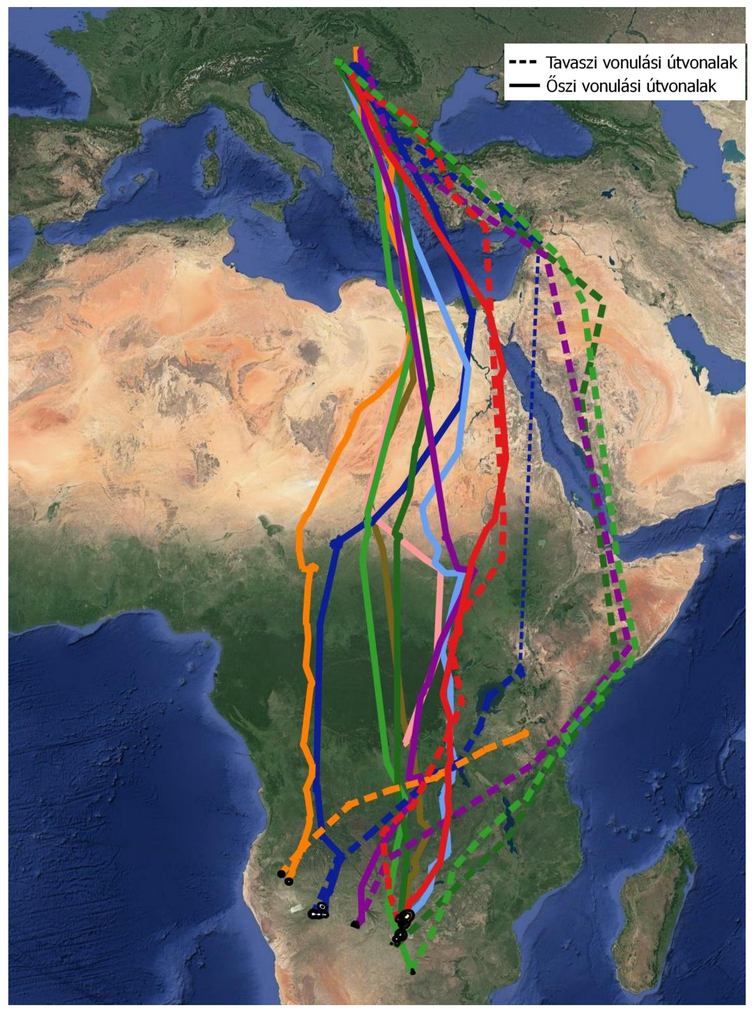
Bevezetés

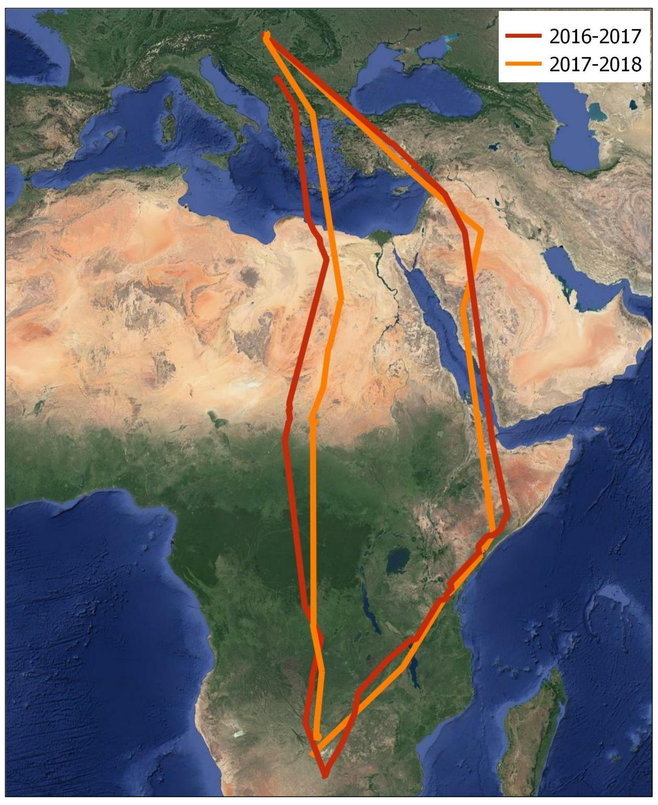
- Szalakóta (*Coracias garrulus*) közepes méretű, hosszú-távú vonuló
- Eltérő vonulási útvonalak és konnektivitás az európai populációknál (Finch *et al.* 2015)
- A gyűrűzési adatok alapján a hazai populációnál az Arab-félszigeten keresztülmenő tavaszi útvonal feltételezhető (Finch *et al.* 2016).
- A LIFE13/NAT/HU/000081 LIFE+ project célja a kárpát-medencei szalakóta populáció vonulási útvonalainak, pihenő-és telelőterületeinek feltérképezése



1. ábra A jelölt szalakóták vonulási útvonalai és telelőterületei (50 %, 90%,95% KDE)

Módszerek

- 10 adult szalakóta vonulásának követése 2015 és 2017 között
- 5 grammos PTT-100 adó (Microwave Telemetry Inc., Columbia, MD, USA), beállítások: 8-h ON/ 15-h OFF (2015 a) és 10-h ON/ 24-h OFF (2016-2018)
- A jelölt egyedek reprezentálták a hazai szalakóta szubpopulációkat (Borsodi-Mezőség, Hortobágy, Kiskunság, Dél-Alföld, Dunántúl)
- 7 tavaszi megkerülési adat (1931-2017) (MME Gyűrűző központ)

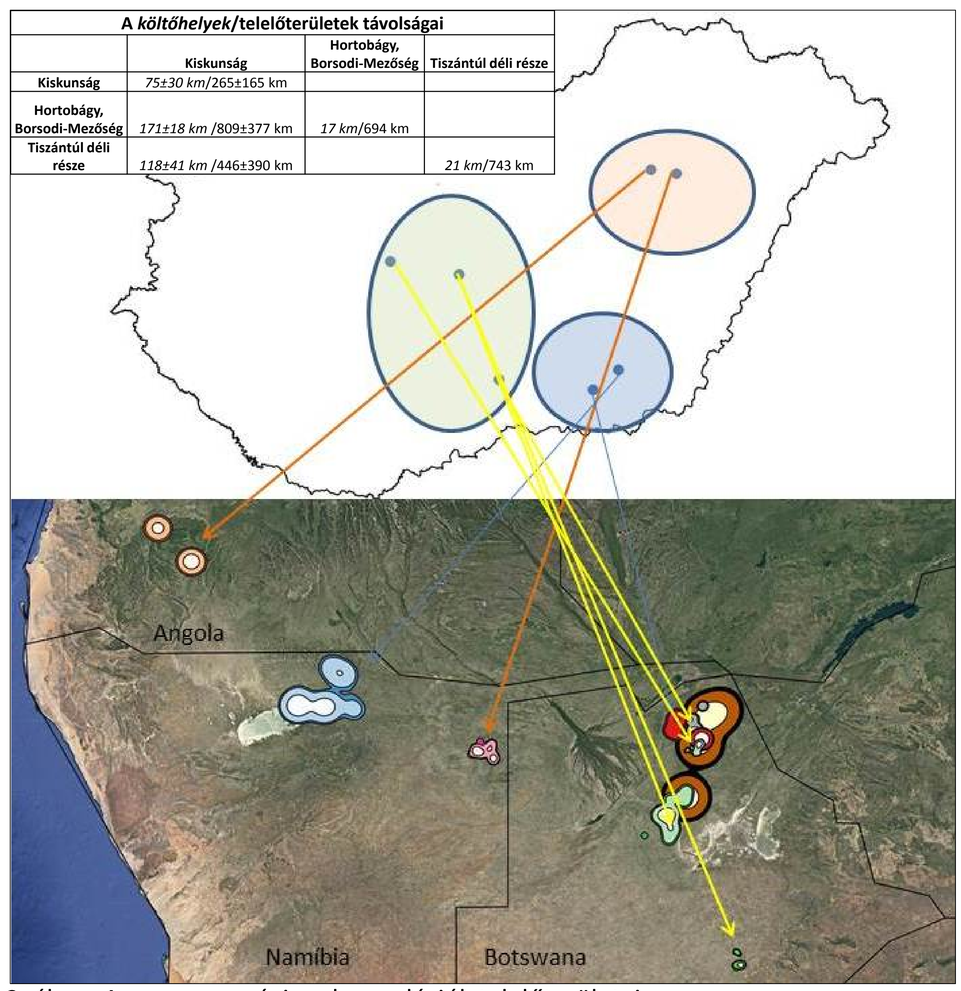


3. ábra Eleven vonulási útvonalai

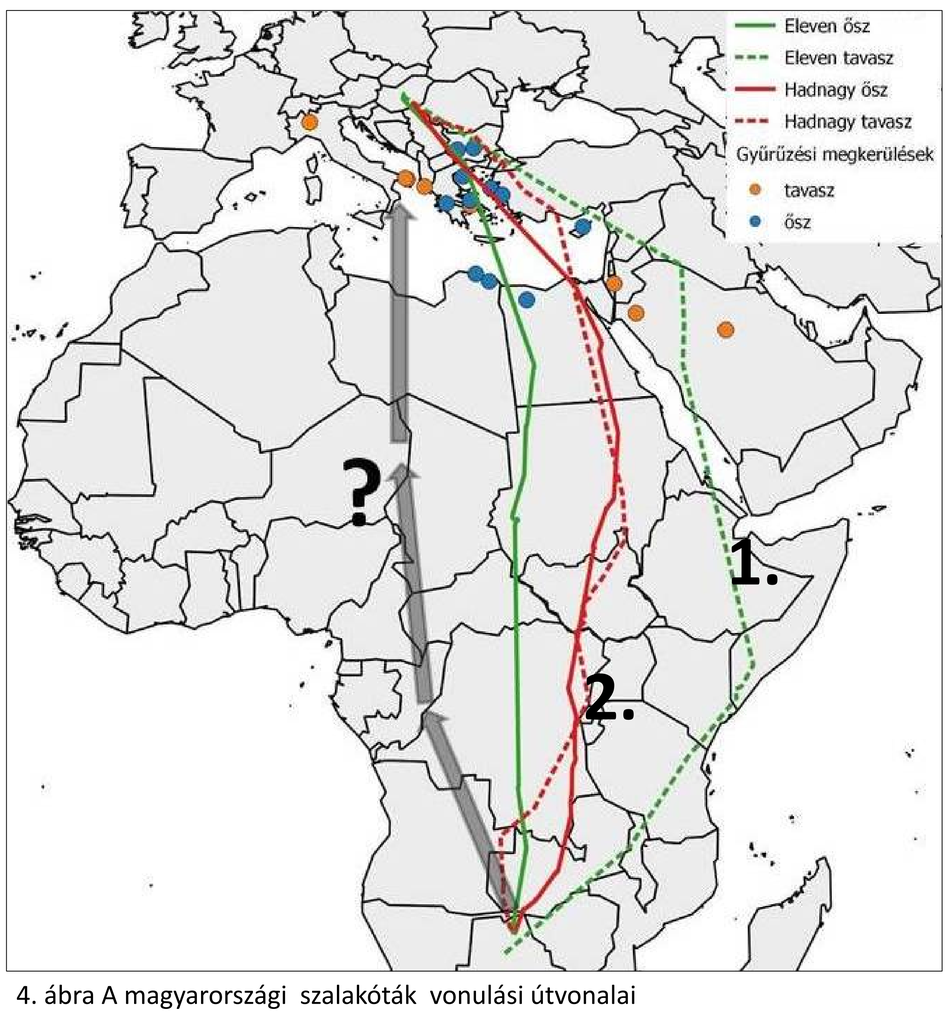
Eredmények

- Magas mortalitás: őszi vonulás alatt 3 egyed (Magyarország, Szerbia, Kongó), 2 egyed a telelőterületen és egy a tavaszi vonulás során (Tanzánia)
- Széles frontvonalú őszi vonulás, Száhel övezeti pihenőhelyek (szept-nov; Csád, Szudán) (1. ábra)
- Telelőterületek: Angola, Namibia, Botswana (1-2. ábra)
- Vonulási konnektivitás: szubpopulációnként eltérő (2. ábra)
- 2 igazolt és egy feltételezett tavaszi vonulási útvonal, a domináns keleti hurokvonulás (1. és 4. ábra)
- A tavaszi vonulási útvonal hosszabb az őszinél a keleti hurokvonulás esetén (10186±248 km vs 8524±394 km) a Nílus völgyében közel azonos (fordított) (8943 km vs 9313 km)
- A tavaszi vonulás időtartama 22,2± 10,2 nappal rövidebb őszinél
- A két éven keresztül követett egyed: megegyező vonulási útvonal (3. ábra)

A *költőhelyek*/telelőterületek távolságai			
	Kiskunság	Hortobágy, Borsodi-Mezőség	Tiszántúl déli része
Kiskunság	*75±30 km*/265±165 km		
Hortobágy, Borsodi-Mezőség	*171±18 km* /809±377 km	*17 km*/694 km	
Tiszántúl déli része	*118±41 km* /446±390 km		*21 km*/743 km



2. ábra A magyarországi szubpopulációk telelőterületei



4. ábra A magyarországi szalakóták vonulási útvonalai

Diszkusszió

- A Száhel-övezet fontos pihenőhely a őszi és a tavaszi vonulási időszak alatt, de a mortalitás az egyenlítőtől délre eső területeken volt jelentős
- Változatos tavaszi vonulási stratégiák:
  - hazai populáció fő tavaszi vonulási útvonala az Arab-félszigeten keresztüli hurokvonulás, amely a litván populációra is jellemző (Finch *et al.* 2015)
  - Hadnagy által követett útvonalat eddig csak a ciprusi populációnál írták le (Finch *et al.* 2015)
  - tavaszi gyűrűs megkerülések az osztrák és balkáni populációkra jellemző (Finch *et al.* 2015) nyugati irányú hurokvonulást valószínűsítik
  - egymástól 20 km-re költő egyedeknél eltérő vonulási útvonal és telelőterület
- Vonulási konnektivitás: a teljes hazai populációt tekintve gyenge, a szóródás jellemző, de szubpopulációként eltérő: erős (Kiskunság) és gyenge (Tiszántúl; Hortobágy-Borsodi-Mezőség)

Irodalom

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Finch, T., Saunders, P., Avilés, J.M., Bermejo, A., Catry, I., de la Puente, J., Emmenegger, T., Mardega, I., Mayet, P., Parejo, D., Račinskis, E., Rodríguez-Ruiz, J, Sackl, P., Schwartz, T., Tiefenbach, M., Valera, F., Hewson ,C.M., Franco, A.M.A., Butler, S.J. (2015) A pan-European, multipopulation assessment of migratory connectivity in a near-threatened migrant bird. Divers Distrib 21:1051–1062

Köszönetnyilvánítás

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Distribution, population changes and conservation of the European Roller *(Coracias garrulus)* in Hungary

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ABSTRACT—The European Roller *(Coracias garrulus)* is a strictly protected species in Hungary; however, its population has shown a slight increase during the past decades. Our goal was to overview the conservation status of the species in Hungary since the end of the 19th century. Using archive data, we demonstrate the changes in distribution and population size of the European Roller, review the changes of the European population and summarize the conservation activities that have been carried out since the 1980s. According to historical data on spring migration collected systematically by the volunteers of the Hungarian Institute of Ornithology at the turn of the 20th century, the distribution of the species used to cover the entire country at that time. A moderate decline started after 1950 and become more intensive by the 1980s, resulting in a collapse in range in the Transdanubian region and a population decline in other regions. By the end of the 1990s the European Roller disappeared from the Western part of the country and the number of breeding pairs has reached the lowest number ever recorded in Hungary. This pattern is in accordance with the trends observed in Europe in the 1970s and 1980s. The targeted conservation measures, starting in the late 1980s, have successfully reversed these negative trends. Both national and international projects have been continued on the research and long-term conservation of this species in Hungary and in the neighbouring countries.

Keywords: European Roller, artificial nest boxes, habitat conservation, population decline.

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Introduction

As in many countries in Europe, the avifauna of Hungary has changed significantly since the beginning of the 20th century. In Central and Eastern European countries the intensification of agricultural production between 1960 and 1980 was similar to that in Western European countries, but it was less intensive *(Donald et al., 2001; Verhulst et al., 2004)* and this has resulted in the maintenance of more low-intensity farmland habitats and in smaller decline of farmland and grassland bird species *(Tucker & Evans, 1997).* Most of the iconic bird species of the Hungarian steppes and agricultural habitats showed a dramatic population decline during the last century and their spatial distribution changed as well. The Great Bustard *(Otis tarda)* is a large, omnivorous, ground-nesting species which was regularly hunted in the first part of the 20th century. Then, the estimated population size was about 12,000 individuals and 2000-3000 in the 1970s an 1980s in the Carpathian basin, but by 1994 the entire population consisted of only 1300 individuals in Hungary *(Magyar et al., 1998).* This decline was caused by the agricultural intensification, use of chemicals, hunting, and mortality during the migration.

Two large raptor species, which are now typical breeding species of open habitats, occurred almost exclusively in the mountainous regions in Hungary. The Saker Falcon *(Falco*

cherrug) was numerous after World War II *(Haraszthy, 1998),* although never common *(Chernel, 1899)* and breeding predominantly in the hills and gallery forests. Its overall population declined to about 30 pairs by the 1970s due to heavy persecution *(Haraszthy et al., 1998)* and probably the intensive use of pesticides such as dichlorodiphenyltrichloroethane (DDT), similarly to the case of the Peregrine Falcon (*Falco peregrinus) (Bagyura et al., 2012).* It started to re-conquer the lowlands as a consequence of the disappearance of main prey species like the European Suslik *(Spermophilus citellus)* from mountain areas and also of halted persecution *(Bagyura et al., 2012).* In the middle of the 20th century the Imperial Eagle *(Aquila heliaca)* was a rare, but regular breeder in the Hungarian hills; which, most probably, did not breed regularly in the open lowland areas *(Horváth, 2009).* The Red-footed Falcon *(Falco vespertinus)* was a common species in the early 20th century and large colonies were recorded still in 1934 *(Haraszthy et al., 1998).* Its overall European population suffered a large decline between 1970 and 1990 *(Palatitz et al., 2009).* In Hungary, after a moderate decline until the 1990s, the population collapsed as a consequence of the 90% decline in the Rook *(Corvus frugilegus)* population caused by an eradication campaign in the 1980s *(Fehérvári et al., 2009).*

The insectivorous Lesser Grey Shrike *(Lanius minor)* was thought to be the most numerous shrike species in Hungary at the beginning of the 20th century *(Herman, 1901).* Between 1970 and 1990, the Hungarian population decreased, and nowadays the species is concentrated in some places in the Great Plain, but also occurs in a smaller number on the southern slopes of foothills *(Magyar et al., 1998).* The Hungarian Lesser Grey Shrike population was estimated in 1998–1999 to be 3000-5000 breeding pairs *(Lovászi & Bártol, 2013).*

All of the aforementioned species have high international conservation concern and targeted conservation projects helped to maintain the population of Great Bustard or even increase those of the Saker, Imperial Eagle and Red-footed Falcon. Besides the abovementioned species, populations of common farmland birds also declined between 1999 and 2012 *(Szép et al., 2012).*

The European Roller *(Coracias garrulus)* used to be a common species in Hungary and it was also widespread in Europe, but since the beginning of the 20th century the extent of breeding range and size of its populations in Europe decreased significantly. In this paper our main goal was to review the available data on distribution and changes of the European and Hungarian populations in the last century and summarize conservation measures on the European Roller in Hungary.

Methods

The European Roller (Coracias garrulus)

The European Roller is a medium-sized bird species, breeds throughout temperate, steppe, and Mediterranean zones. It avoids closed forests and, over most of its breeding range, is predominantly associated with open habitats with plenty of hollow trees. The species inhabits old parks, gallery forests, orchards, willow stands, and dry plains with scattered old trees, but usually avoids intensive cultivation. The European Roller is a secondary cavity nesting species. It is able to use various breeding sites all over Europe, usual-

ly, it uses the old holes of Black Woodpeckers *(Dryocopus martius)* and Green Woodpeckers *(Picus viridis)* and Bee-eater *(Merops apiaster)* burrows *(Casas-Crivillé et al., 2005),* but may also nest in sand banks, cliff faces, buildings, and artificial nest-boxes. In Hungary, the species predominantly breeds in tree hollows and cavities, the use of sand or loess bank is rare *(Lendvai, 1990; Fenyvesi pers. com 2015).* Rarely, Rollers breed in Magpie *(Pica pica)* nests or burrows *(Chernel, 1899).* Old buildings as nesting sites are common in Portugal *(Catry et al., 2011),* Italy and Spain, but are rarely recorded in the Carpathian basin. Colonial breeding together with Common Kestrels *(Falco tinnunculus)* and Western Jackdaws *(Corvus monedula)* was recorded in the wall of a castle ruin in Oponice in the late 1940s *(Turcsek, 1942)* and in an old building Kölesd-Felsőhidvégpuszta in 1942–1948 *(Bernáth, 1954).* The species used to breed in large parks as well (Keszthely, Helikon park: *Keve & Sági 1970;* Iszkaszentgyörgy: *Tapfer, 1978*). Only little information is available on the former habitat use of Rollers. Riparian forests along the Tisza River (in the 1950s *Gallé & Molnár pers. com.;* Mártély: *Sterbetz, 1974*) and Danube River (Csallóköz: *Turcek, 1957*) were reported as breeding habitat for the species. It used to breed in cavities of old trees along the shore of Lake Balaton between Keszthely and Fenékpuszta and in small woods *(Keve & Sági, 1970),* old orchards and wooded pastures in the Transdanubian region *(Haraszthy, 1984).* By the end of the 1980s, white poplar woods in the Kiskunság remained the most typical habitat for the European Roller *(Haraszthy, 1984).* In the vicinity of pastures, lonely trees and small woods were also used as nesting sites by Rollers *(Sterbetz, 1985).* The species is polyphagous, eating a wide variety of invertebrates and occasionally vertebrates *(Cramp, 1985; del Hoyo et al., 2001).* They prey on insects, mainly Coleoptera and Orthoptera and occasionally vertebrates *(Avilés & Parejo, 2002; Tidmarsh, 2004; Kiss et al., 2014).*

Molnár (1998) found a higher ratio of Coleoptera than Orthoptera in the nestlings' diet, although video recordings showed significant preference of both taxa *(Kiss et al., 2014).* Vertebrates never dominate in the diet of Rollers *(Szijj, 1958; Glutz & Bauer, 1994; Sosnowski & Chamielski, 1996),* exceptionally they may feed on amphibians, and only one case is known where anurans comprised 70% of their diet *(Barthos, 1906).*

Data collection

We used various archive sources to reconstruct of the former distribution area of the Hungarian population of the European Roller. The Hungarian Institute of Ornithology set up an observers' network to investigate bird migration in the Carpathian basin in 1894. Large number of observers reported their spring observations on migrant species to the Institute, which have been published in the periodical *Aquila* for three decades. Among these data we used those locations where European Rollers' arrival had been reported to identify the species occurrence until 1926. For the second half of the 20th century, we used the partial results of the distribution mapping of breeding birds in Hungary, which was conducted between 1978 and 1985 by the coordination of MME BirdLife Hungary. Furthermore, we reviewed the available Hungarian literature concerning the European Roller *(Szeőts, 1922; Bársony, 1934; Studinka, 1934; Vertse, 1934; Agárdi, 1939; Turcek, 1956; Andrássy, 1957; Sterbetz, 1959, 1974; Antal et al., 1959; Bernáth, 1954, 1958; Sóvágó, 1957; Schmidt, 1959; Béress, 1964; Keve & Sági, 1970; Bécsy, 1974; Marián, 1975; Tap-*

fer, 1978; Legány, 1983; Kertész, 1990; Finke, 1994; Szabó, 1996; Molnár, 1997; Kasza & Marián, 2001) and we also included unpublished data.

Results and discussion

Changes in the European population of the species

The European Roller used to be a widespread species in Europe. According to the literature, the decline started in the northern part of its breeding range. At the beginning of the 19th century it was a common breeder in Denmark and it was thought to be extinct in 1868, however large numbers (n=227) of occurrence data were recorded until 1964, mostly during the breeding period *(Christensen & Rasmussen, 2015)*. In Sweden, in the mid-1800s the European Roller occurred generally in the southeastern parts up to the line of Halmstad-Jönköping–Karlstad–Gävle. The last recorded breeding on mainland was in Småland in 1943, but a small population remained in Fårö until 1967 *(Tjernberg, 2010)*. According to *Lemmetyinen (1987)* Rollers bred near Turku in the late 18th century and the species has not breed in Finland since 1940.

However, a moderate decline was reported from the 1950s, and the period from the 1970s to the early 1990s seems to be a critical for the rest of the Roller population in Europe. *Lüütsepp et al. (2011)* reviewed the literature about the European Roller population in Estonia and they found it had been a common species in the 1950s (thousands of breeding pairs; *Mank, 1994*). After the decline the population size was estimated only 150–200 pairs in the 1970s and 1980s and less than 100 breeding pairs in the early 1990s *(Löhmus et al., 1998)*. Interestingly, the species was rare in the early 19th century *(Lüütsepp et al. 2011)*. The European Roller is extinct now as a breeding species in Estonia. The same decline was also observed in Latvia and Lithuania *(Racinskis et al., 2004; Rašomavičius, 2007),* but small populations still exist there. The Belarus population was large (more than 10,000 breeding pairs) in the 1960s, but after a sharp decline between the 1970s and the 1980s, it was about 600–900 pairs in 1997 *(Red Book of Belarus)*. In 2016 only 10-20 breeding pairs were recorded *(Tarantovich & Russkikh, 2017)*. At the end of the 1970s, the number of Rollers in Poland was estimated to be 1000 pairs, and in the mid-1980s it was about half of that (500–600 pairs), then in the early 1990s, there were about 360–380 pairs and 112–133 pairs in 1998. The marked decline from the 1980s continued until nowadays, the number of breeding pairs was 16-20 in 2016 *(Górski& Krogulec, 2017)*. The last breeding of the European Roller in Switzerland was recorded in 1896 *(Cramp, 1985)*. In Germany 95–134 pairs were recorded in 1961 and only 20–27 pairs in 1976 *(Creutz, 1979)*. The last—unsuccessful—breeding attempt in Germany was in 1991 *(Robel, 1991)*. The Austro-Slovene population collapsed during the 1960s and 1970s *(Sackl et al., 2004)*. The Austrian population was about 300–500 pairs in 1950, but only 50 in 1981, 10 pairs in 1993. After a short increase from 2002 to 2006, it declined again to 2 pairs 2016 *(Tiefenbach & Nebel, 2017)*. In Slovenia, Rollers were also frequent between 1950 and 1960, but a sharp decline was observed from 1980–1986 *(Bracko, 1986)*. In the current territories of the Czech Republic and Slovakia the species started to decline in some areas from the end of the 19th century. The last confirmed breeding was in 1987 in the Czech Republic. It had been a

common breeder in the Danube basin in Slovakia *(Bohus, 2002)* and a decline started from the 1950s here as well *(Cramp, 1985; Bohus, 2002)*. In Western Slovakia (Komárno district) altogether 40 breeding attempts were registered between 1983–2008 *(Bohus, 2008),* five between 2007–2011 (last one in 2010) and none since 2011 *(Bohus, 2011)*. In Vojvodina, the Roller was a common breeder in the 1950s and it also underwent a serious decline between 1980–1990, only 8-11 breeding pairs was found in 1996, but as a result of a conservation program, it reached 160–170 pairs by 2015 *(Ružić et al., 2017)*.

The first breeding of Rollers in Portugal was only confirmed in 1973, it is believed to have bred within the country since the beginning of the 20th century *(Marques et al., 2005)*. The Spanish population was estimated at around 6600 breeding pairs with a negative population trend between 1970 and 1990 *(Samwald & Štumberger, 1997),* but no detailed information is available on its former distribution. The French population was 400–500 pairs in the 1970s and 1980s, and it is increasing since then *(Tron et al., 2008)* with a spatial expansion as well *(Schwartz, 2017)*.

In summary, a significant decline has been observed throughout almost the entire European distribution range of the species. The decline started from the 1950s, but it was the fastest and most significant in the 1970s and 1980s in many countries, causing a large reduction of the number of breeding pairs, a range contraction and even extinction in several cases. The fringe populations in the northern distribution range and in the mountainous regions (Switzerland) started to decline earlier (19th century) and collapsed by the 1950s.

Nowadays, an approximate estimate of the global population is between 200,000–600,000 individuals *(IUCN, 2017),* 40% of this breed in Europe, out of which 11,900–22,800 breeding pairs in the EU 28 states *(BirdLife International, 2015)*. The European population is still declining. In Hungary the species is strictly protected by law.

Changes in the population of the species in the Carpathian basin during the 20th century

The European Roller used to be a common species in Hungary, especially in the foothills *(Keve, 1960) (Figure 1)*. The locations of returning Rollers during springtime also suggested that the species had been frequent in the Transdanubian region, especially in Somogy, Baranya and Vas Counties, and on the Hungarian Little Plain. As this was not the result of a systematic survey, we suggest that areas with similar characteristics to those of Zala County but lacking any observers were also suitable nesting habitats for the species. Surprisingly, much fewer records were found from the Hungarian Great Plain than it would be expected based on the current distribution of the species. The Kiskunság, Nyírség and Tápióság regions with the riparian forests along the Tisza River *(Finke, 1994)* and old forest patches e.g. Nagyerdő (Debrecen; *Bársony, 1934*), Nagycsere *(Bársony, 1934)* Ohat, Újszentmargita *(Ecsedi, 2005)* were breeding sites in North-Eastern part of the Hungarian Great Plain. The European Roller was very frequent in the Hanság *(Studinka, 1934)* and in Bugac *(Vertse, 1934)* in the 1930s. Outside the current borders of Hungary, the species occurred regularly in the lower valleys of mountainous areas of Transylvania and Slovakia and in the Partium region. However, it was never common around Jelenec *(Forgách, 1902)*. The majority of Békés and Szolnok counties were most probably never occupied by the species. Most of the European populations declined significantly in the 1970s and 1980s. In Hungary, populations breeding the hills *(Haraszthy, 1984)* and those alongside the Tisza

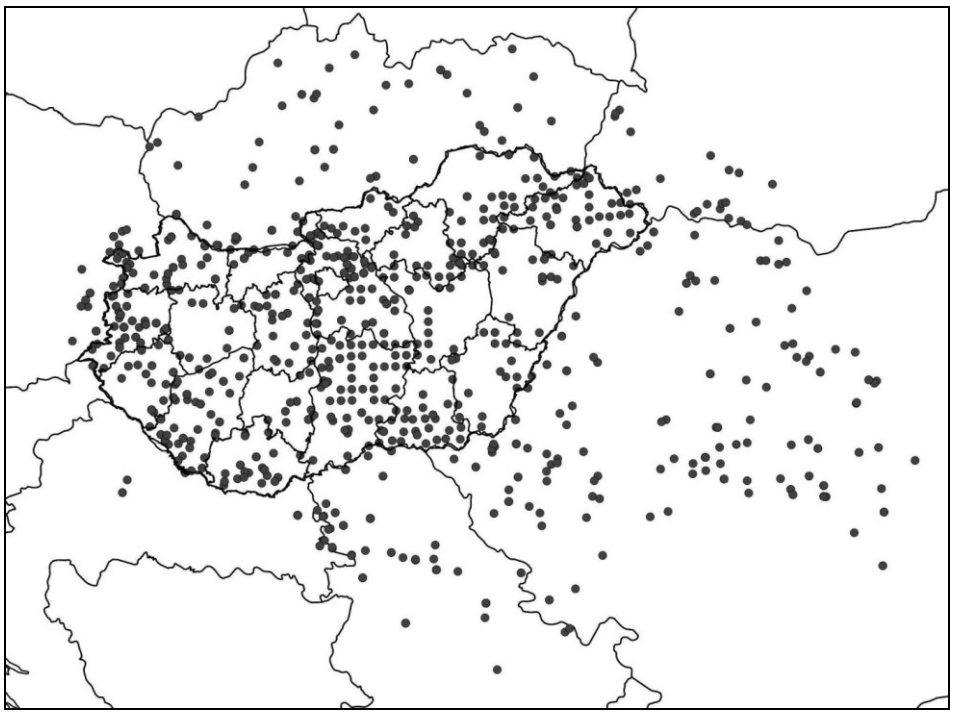

Figure 1. Distribution of the European Roller *(Coracias garrulus)* in the Carpathian basin based on archive data
1. ábra. A szalakóta *(Coracias garrulus)* elterjedése a Kárpát-medencében irodalmi adatok alapján

River have started to decrease first; although it was still a common breeder between 1947 and 1953 in the gallery forests along Tisza River *(Sterbetz, 1974).* When the distribution between the first half of the 20th century and 1970–1986 is compared in Hungary, a large decline can be seen in the Transdanubian region. A slight increase in the numbers on the Great Plain *(Figure 2)* may be, in part, the consequence of an increased effort of observers in the area. It is difficult to give an estimate on the population size of European Rollers in the first half of the 20th century *(Table 1).* In 1950, the population in Austria was about 300-500 pairs *(Samwald & Samwald, 1989),* but in Hungary all of the available sources reported the species to be very common where suitable habitats were present *(Keve, 1960, 1984; Székessy, 1973).* By the 1970s–1980s the population collapsed in Austria, Slovakia, Belarus, and Poland. No proper population census is available for Hungary from that time, but it is estimated to be over 1000 pairs *(EBCC database).* In the 1990s the population was about 300-600 pairs *(Haraszthy, 1998; Magyar et al., 1998),* probably the lowest number estimated ever. Another estimate of 100-150 pairs for the Hungarian population *(Cramp, 1985)* is considered inaccurate. After the beginning of targeted conservation efforts at the end of the 1980s, the decline halted and then the population started to increase slowly. Nowadays, the

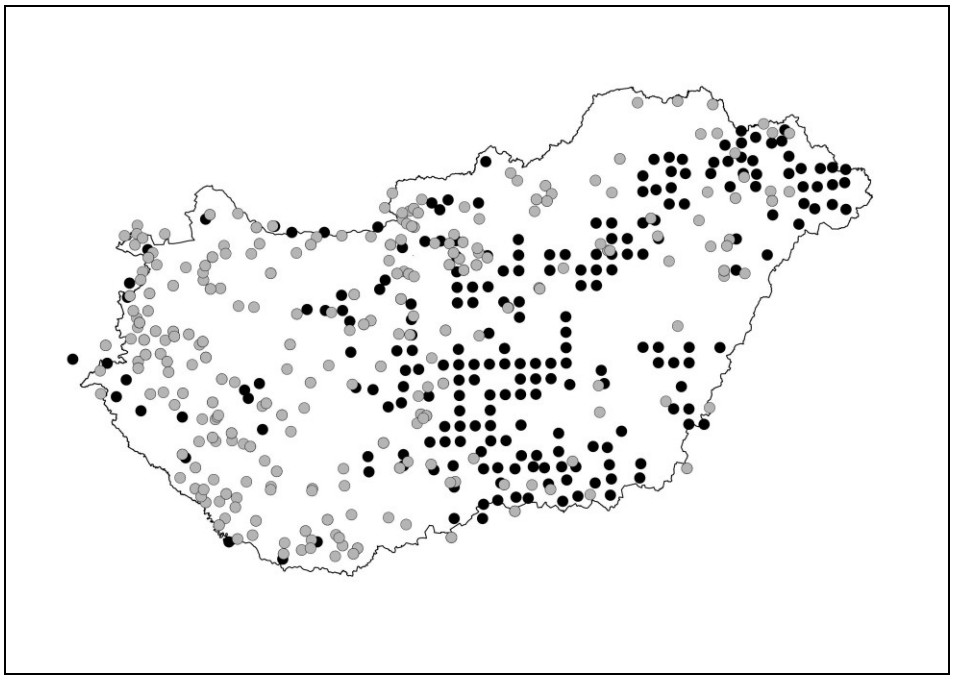

Figure 2. Distribution of the European Roller *(Coracias garrulus)* during the 20th century in Hungary (gray dots 1894–1938, black dots 1978–1985)
2. ábra. A szalakóta *(Coracias garrulus)* 20. századi elterjedése Magyarországon (a szürke körök 1894–1938 közötti, a fekete körök 1978–1985 közötti adatokat jeleznek)

estimated population size is about 1400–1600 pairs and almost all of them are located in the Hungarian Great Plain. The last confirmed breeding attempt was recorded in 2006 in the Transdanubian region before its local extinction *(Tokody et al., 2008)*. Recolonization started in 2014 with 2 pairs and continued with 4 pairs in 2015, 6 in 2016 and 7 in 2017 *(Fenyvesi L. pers. com.) (Figure 3)*.

Threats

The decline of the European populations between the 1950s and 1990s was probably caused by a combination of several factors. The breeding and foraging habitats of the species have undergone significant changes since Wold War II. As a secondary cavity nester, Rollers require old, hollowed trees for breeding, especially in its northern distribution range. Changes in forestry practices have resulted in removal of old trees and forests and led to lack of suitable nest sites *(Creutz, 1979; Bohus, 2002; Kovács et al., 2008; Lüütsepp et al., 2011)*. In Sweden, many old forests had been harvested and the young tree plantations were not appropriate for nesting any more for the Rollers *(Tyrberg, 1988)*. Gallery

Period	Min	Max	Source
1985–1992	1000	1600	rough estimation based EBCC database, most probably less
1994	500	600	*Haraszthy, 1998*
1990s	100	150	*Cramp, 1985*
1998	300	600	*Magyar et al., 1998*
1995–2002	400	700	BirdLife Hungary Monitoring Centre
2003–2007	600	1000	*Hadarics & Zalai, 2008*
2008–2012	750	1050	MME Monitoring Centre
2013	–	1100	Monitoring data of BirdLife Hungary and national park directorate staff
2014	1190	1300	Monitoring data of BirdLife Hungary and national park directorate staff
2015	1350	1550	Monitoring data of BirdLife Hungary and national park directorate staff
2016	1400	1600	Monitoring data of BirdLife Hungary and national park directorate staff

Table 1. Changes in the numbers of European Roller breeding pairs *(Coracias garrulus)* in Hungary
1. táblázat. A szalakóta *(Coracias garrulus)* fészkelő állományának változása Magyarországon

forests were ideal both as breeding and foraging grounds; the hollowed willows offered suitable breeding holes, grazed and mowed grass-banks served as feeding sites. The population breeding in this type of habitat suffered a rapid decline in Slovenia *(Bracko, 1986)* and also in Hungary *(Haraszthy et al., 1998).* The structure of gallery forests have changed a lot due to the replacement of native tree-species by hybrid poplar plantations and the increased abundance of different invasive species such as False Indigo-bush *(Amorpha fruticosa),* Red Ash *(Fraxinus pennsylvanica)* and Box Elder *(Acer negundo).* The increase of invasive tree species resulted denser and more closed forests compared to the ancient gallery forests of the 1950s and made this habitat less suitable for European Rollers *(Kovács et al., 2008).*

The agricultural intensification has caused a decline of numerous bird species, including the European Roller *(Donald et al., 2006).* Besides loss of nesting places, it affected also negatively the food supply due to changes of foraging sites such as conversion of grasslands into arable land *(Bohus, 2002)* and maize cultivation *(Samwald & Samwald, 1989),* drainage of the most fertile lands throughout the riverine lowlands and their transformation into monocultures *(Sackl et al., 2004).* Furthermore, intensive agricultural practices can have a negative effect on the Rollers' breeding success *(Avilés & Parejo, 2004).* The intensification of agriculture decreased the number of grazing livestock and the lack of grazing resulted less suitable foraging places, as tall and dense grass cover reduces the hunting success of Rollers *(Kovacs et al., 2008).*

Wood pasture used to be typical habitats for The European Roller as old, large trees provided nesting sites and grazed grasslands between trees ensured foraging sites. Wood pasture used to be a common habitat in the Transdanubian region, in Nyírség and in the Northern Hills *(Varga & Bölöni, 2009).* The transformation of agroforestry into large-scale production at a global scale and the establishment of a Soviet type agricultural system in the 1950s–1960s resulted in a large decline of open wood-pasture-like areas *(Varga et al., 2015).* While the process started with the "urbarium warrant" of emperor Franz Joseph I in 1853 prescribing separation of forest and pasture, grazing in woods was stopped eventually as aconsequence of Act no. VII of 1961 on forestry and game management. *Varga et al. (2015)* also found that the intensive shrub encroachment and development of secondary woodland were significant between 1963 and 1984 and, as a consequence, an open wood-pasture area in Olaszfalu, a typical wood pasture of Bakony Hills, declined by 19%. This

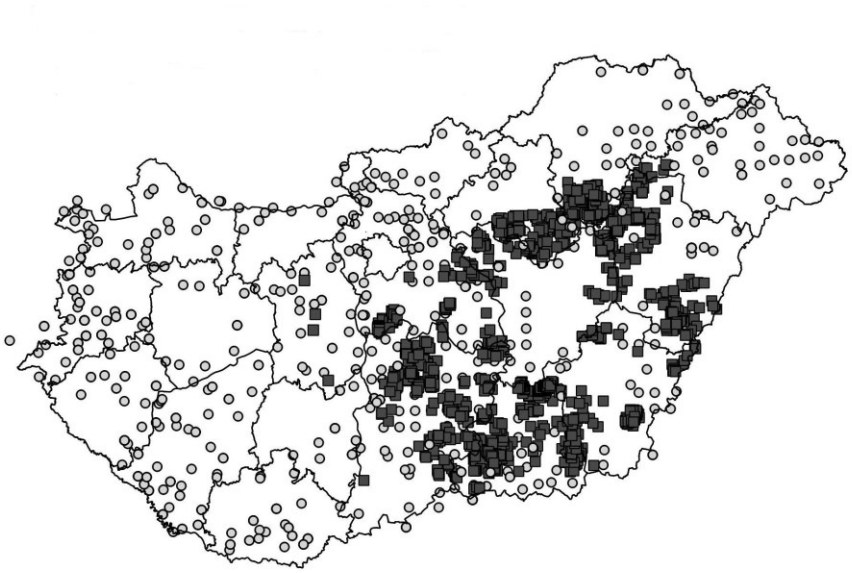

Figure 3. Current location of European Rollers *(Coracias garrulus)* breeding in artificial nest-boxes (dark squares) and its distribution during the 20th century (circles)
3. ábra. A szalakóta *(Coracias garrulus)* 20. századi elterjedése (körök) és a mesterséges odúban költő párok előfordulása (sötét négyzetek)

time period overlap with the decrease of the European Roller population in the Transdanubian region, therefore we can suggest that changes in the silvopasture system in Hungary might also contribute to the decline of the species in those regions.

Using different chemicals (herbicides and pesticides) may cause secondary toxicity to insectivorous bird species like the European Roller. Several sources reported the contribution of the increased pesticide use to the collapse of Roller populations in Europe *(Bracko, 1986; Lüütsepp et al., 2011).* Using pesticides (mostly against different Orthoptera-species) was an important factor in the extinction of the European Roller from Sweden *(Tyrberg, 1988).* While agricultural use of DDT was banned in Hungary in 1968, it still might have contributed to the population decline from the 1970s on.

Inbreeding of the fringe populations of European Roller in Northern Europe (Poland, Latvia, Estonia, etc.) has been mentioned as a potential cause for the decline, however, it has not been proven by evidence so far *(Lüütsepp et al., 2011).*

Electrocutions by uninsulated medium voltage pylons are dangerous for all perching bird species. Rollers usually hunt from an open perch up to 10 m above ground, so electric wires and pylons provide an ideal perch for them. Data of electrocuted European Rollers at power lines has been reported in Hungary *(Ambrus, 1992; Csibrány, 2016)* and in Bulgaria *(Demerdzhiev et al., 2014).*

The European Roller is a long-distance migrant. Illegal shooting and trapping in the region of the Mediterranean, Middle East and North-Africa may increase the mortality during migration *(Kovács et al., 2008)*. Overexploitation is one of the main drivers of bird extinctions globally *(BirdLife International, 2013a)* and this is the second most significant threat (after habitat loss/degradation driven primarily by unsustainable agriculture) to migratory birds *(Kirby et al., 2008)*. Habitat degradation and loss along the migration pathway (stopover sites (Sahel region) and wintering grounds) could be also behind the population decline *(Tokody et al., 2017)*. Toxic pesticides, such as DDT, are still extensively used on the wintering grounds in eastern and central Africa *(van den Berg, 2011)*.

Conservation activities to protect European Rollers

By the end of the 1980s, the decline of the European Roller population was significant in Hungary. The first conservation measures started in 1988 to compensate the lack of nesting sites in the southern Great Plain. Local activists of BirdLife Hungary posted 36 "D-type" artificial nest boxes in the region of Szatymaz–Balástya–Kistelek in Csongrád County. This region has a mosaic type character; small agricultural fields with grasslands and Grey/White Poplar patches and treelines. Rollers have found the nest-boxes quickly and used them for breeding successfully. By 1995, out 87 artificial nest-boxes 21 were occupied by Roller pairs. This pilot study proved that provision of artificial nest boxes was a good method to increase the European Roller population *(Molnár, 1998)*. The nest-box program was expanded to all suitable grasslands in Southeast Hungary: i.e. Baksi-puszta (from 1990), Cserebökényi-puszta (1990), Vásárhelyi-puszta and Kék-tó (1998), as well as Csanádi-puszta (from 1996). By 2010, half of the 400 nest boxes were occupied by Rollers. Installing D-type nest-boxes started in the 1990s by the students of the College of Horticulture in Kecskemét and dozens of them were placed around Orgovány and Izsák. From 2001, the Kiskunság National Park Directorate continued this project, and in 2010 the number of nest boxes reached one hundred in Orgoványi-rét. The nest box programme in the Jászság region, starting in the early 1990s, was also very successful.

The first systematic survey of the European Roller population on the southern Great Plain was carried out in 1992 *(Molnár, 1998)*. The census covered about one third of Csongrád County and the data obtained were extrapolated to the entire region. The estimated population was about 100-130 pairs *(Molnár, 1998)*. The next monitoring was part of an extended survey during the process of IBA (Important Bird Areas) designation in 1998 when 133 pairs of European Roller were recorded. Local activists of BirdLife Hungary introduced the same method in the Bükk Hills region in 1993; about 50 nest boxes were mounted in the northern part of the Hungarian Great Plan. The local population grew from 60 pairs to 130 pairs by 1997 *(Szitta Tamás & Hák Flóra, pers. com.)*.

The year 2008 is considered a milestone for the conservation of European Rollers in Hungary; BirdLife Hungary was commissioned by BirdLife International to prepare an International Species Action Plan (ISAP) for the European Roller. A successful workshop was held with the representatives of 19 different countries, and the ISAP was published in 2008 *(Kovács et al., 2008)*. The first international project for the conservation of European Roller started in 2010 within the scope of an IPA programme. BirdLife Hungary was the leading beneficiary of the project "Conservation management and animal health monitor-

ing of Natura 2000 species" in partnership with the Kiskunság and Kőrös–Maros National Park Directorates and the Bird Study and Protection Society of Vojvodina (DZPPV/BSPSV). The general goal of the project was to reach and maintain a favourable conservation status of those habitats important for the target species. In Hungary, promoting the proper functioning of the Natura 2000 network was also addressed, while in Serbia the preparation of the designation of future Natura 2000 sites was targeted. Furthermore, the project aimed to ensure nesting opportunities for the two target species (European Roller and Red-footed Falcon) by installing artificial nest-boxes. Beyond the nest-box program (850 new nest-boxes were put out in Hungary and another 400 in Serbia) the project also aims to identify and quantify all natural nest-sites for both species within the project area. The territory mapping of breeding Roller pairs had been done twice during the breeding season (between May and July) in Csongrád and Bács-Kiskun County. 407 breeding pairs were found in the two counties and the estimated size of the breeding European Roller population was 400-430 pairs. In Csongrád county 75% of the population bred in artificial nest-boxes. The occupancy rate of the nest boxes was 55%. In case of treeless grasslands (Baksi-puszta, Csanádi-puszták, Cserebökényi-puszta) all pairs bred in artificial nest-boxes. Contrary, in Bács-Kiskun County 132 (86%) of the 153 pairs bred in natural cavities and the occupancy of the 71 nest boxes was only 33% *(Kiss & Tokody, 2010)*.

After the end of the IPA project a new, extended conservation project was drafted for the sustainable long-term conservation of European Rollers with the title "Conservation of the European Roller *(Coracias garrulus)* in the Carpathian Basin (LIFE13/NAT/HU/000081)", which has been funded by the *LIFE+* financial instrument of the European Union with a financing period between 2014 and 2020. BirdLife Hungary as coordinating beneficiary has been running the project with three associated beneficiaries in Hungary (Kiskunság and Bükk National Park Directorates and the Délalföldi Erdészeti Zrt.) and two partners in Romania (MILVUS Group and the Environment Protection Agency of Satu Mare).

The main goals of the project were to provide short- and long-term nest sites by artificial nest-boxes, reconstructions of former breeding and foraging habitats and to involve farmers into a volunteer program (Farmer for Rollers) to improve foraging and breeding conditions for the species. Habitat reconstructions are demonstrated to stakeholders farming in Natura 2000 areas (SPAs). Modern technologies (PTTs and UHF-loggers) are used for better understanding the habitat requirements of the European Roller, reveal migration routes, wintering areas and threats during migration. Based on these results conservation measures shall be introduced to reduce mortality.

Conclusions

As many birds of grasslands and farmlands, the European Roller also suffered a serious decline in Hungary, the number of breeding pairs and the distribution range at least have been halved by the 1990s. Former typical habitats such as gallery forests and foothills have been deserted almost entirely by Rollers. Targeted conservation measures such as provision of nest-boxes was proved to be an effective method to ensure suitable breeding sites in several parts of the country and contributed to the recolonization of Mezőföld region. The almost 30 years of conservation work have successfully stopped the negative population

trend, but the protection and improvement of natural breeding sites is still an important task to make the species less dependent on artificial breeding sites in the future.

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KIVONAT—A szalakóta *(Coracias garrulus)* fokozottan védett madárfaj Magyarországon, bár az utóbbi években országos állománya lassan emelkedik. Közleményünkben archív adatok felhasználásával bemutatjuk a szalakóta elterjedésének és populációnagyságának változásait a 19. század végétől, összevetjük azt az európai trendekkel, valamint összefoglaljuk az 1980-as évektől folytatott természetvédelmi munkák eredményeit. A Madártani Intézet jelentőállomásainak adatai alapján a szalakóta országszerte általánosan elterjedt faj volt a 20. század elején. Az állománycsökkenés az 1950-es években kezdődött és az 1980-as évekre vált intenzívebbé, a faj állománya jelentősen csökkent a Dunántúlon és az ország többi részén is. Az 1990-es évek elejére a szalakóta nagyrészt eltűnt mint fészkelő madárfaj az ország nyugati részéről és állománynagysága elérte történelmi mélypontját. A változás trendje hasonló volt Észak-Európában, ahol a csökkenés az 1970–1980-as években volt a jelentősebb. Magyarországon az 1980-as évek végén kezdődő természetvédelmi programok napjainkra sikeresen megállították ezt a folyamatot. Napjainkban is folytatódnak a nemzetközi és hazai projektek a faj kutatása és hosszú távú védelme céljából hazánkban és a környező országokban.

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