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ACTION PLAN FOR THE EUROPEAN ROLLER

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The Flyway Action Plan for the European Roller

(*Coracias garrulus*)

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Milestones in the production of the Plan

International Species Action Plan (ISAP) Conference January 2017, Kecskemét, Hungary

Draft 1.0 sent to all Contributors by 20 April, 2017.

Draft 2.0 sent to CMS Scientific Council by 21 May, 2017.

Reviews

The Flyway Action Plan for the European Roller should be reviewed every ten years. (First review due in 2027). An emergency review will be undertaken if there is a sudden major change liable to affect one of the population or subspecies.

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Geographical scope of the FAP

The Flyway Action Plan for the European Roller (ERFAP) covers all Range States that include the migration routes, stopover sites and the wintering grounds of the European Roller's two subspecies (*Coracias garrulus garrulus* and *Coracias garrulus semenowi*).

Overall goal of The Flyway Action Plan for the European Roller

The overall goal of the Flyway Action Plan for the European Roller (ERFAP), in the long term, is to improve the conservation status of the European Roller in the ERFAP range, achieving a favourable conservation status of the species across its range.

1. Biological assessment

The European Roller is a medium sized, primarily insectivorous species (31–32 cm, wingspan 52–58 cm). Its body mass is 120-160 g, varying according to sex and condition (wintering weight c. 120 g (del Hoyo et al., 2001)). Sexes are similar, although blue colours in males are more vibrant, and the violet of the rump is wider (Blasco-Zumeta & Heinze, 2010). There is only a small difference in biometric data between the sexes; males have slightly longer wings than females (20.08±1.32cm and19.62±0.94cm respectively) (Silva et al., 2008). Juveniles are paler, with browner cheeks, distinctly brown throat and breast, shorter outermost tail feathers with no dark spots at their tips. The second-year birds have unmoulted greater coverts and very worn flight feathers and tail (Blasco-Zumeta & Heinze, 2010).

The European Roller is a polytypic species with two subspecies:

- *Coracias garrulus garrulus*: NW Africa, SW, SC & E Europe and Asia Minor E through NW Iran to SW Siberia;
- *Coracias garrulus semenowi*: Iraq, Iran (except NW), Pakistan, south Kazakhstan, Turkmenistan, and possibly NW China (W Xinjiang);

Subspecies *semenowi* is slightly paler, with neck, underparts, great and median upper wing coverts more greenish.

1.1. Distribution throughout the annual cycle

The European Roller is a long-distance migrant. The breeding season starts from the beginning of May and lasts until the end of July. Autumn migration begins in August/September (Rodriguez-Ruiz et al., 2014; Finch et al., 2015; ROLLERPROJECT, LIFE/13/NAT/HU/000081). Birds spend ca. 1-1.5 month (from September until late November) at stopover sites in the Sahel Belt and overwinters in an area extending from Angola to South Africa and Kenya. Different breeding populations use different but overlapping wintering areas, and individuals from the same population might use different wintering regions (Rodriguez-Ruiz et al., 2014; Finch et al., 2015; ROLLERPROJECT, LIFE/13/NAT/HU/000081). Spring migration takes place between March and June, mainly in April/May (Kovács et. al., 2008; Finch et al., 2015).

1.2. Global distribution and European population

The Roller breeds throughout temperate, steppe, and Mediterranean zones enjoying reliably warm summer climates. Predominantly a lowlands species but ascends in Moroccan High Atlas to 2,000 m in Caucasus no higher than 800–1,000 m and in central Europe only to that level in isolated cases, 400–600 m being normal limit (Cramp 1998). Normally avoids deserts, semi-deserts, and treeless grasslands, and shows no attachment to water but will inhabit lines or groups of poplars. The very approximate estimate of the global population is between 200,000-600,000 individuals (IUCN 2017), 40 per cent of this breed in Europe, out of which 11,900-22,800 breeding pairs in the EU 28 (BirdLife International, 2015). The European population is still declining.

Following a moderate decline during 1970-1990, the species has continued to decline by up to 25 per cent across Europe during 1990-2000. It is extinct in Germany, Denmark, Sweden, Finland and the Czech Republic. The species recently became extinct in Slovakia, Estonia and possibly in Slovenia. Small and declining populations occur in Austria, Belarus, Latvia, Lithuania, and Poland. Declines have also been reported from Russian regions (Malovichko, 1999) and north-eastern part of Ukraine (Knysh, 2007). However, several Roller populations show increasing trends, mostly in Southern

Europe (France, Italy) and conservation measures were also successful (Rodriguez-Ruiz et al., 2011; Kiss et al., 2014, Ružić et al. 2017).

Table 1. Estimated population size and trend of the European Roller' (*Coracias garrulus*) breeding populations in Europe based on: ISAP conference 2017 and * data from European Union (EU27) Red List assessment (BirdLife International 2015), more recent estimations are not available (in italic).

Country (EU counties in bold)	Estimated population size (pairs)	Trend (2008-2016)
Albania	1-3	large decline
Armenia	400-700*	small increase
Austria	2	large decline
Azerbaijan	2,000-10,000*	large increase
Belarus	10-20	large decline
Bosnia and Herzegovina	0-2	unknown
Bulgaria	2,500-4,000	small decline
Croatia	15-20	large increase
Cyprus	1,000-3,000	moderate decline
Czech Republic	0	extinct
Denmark	0	extinct
Estonia	0	extinct
Finland	0	extinct
France	1,143-1,499	moderate increase
Germany	0	extinct
Greece	300-500*	stable
Hungary	1,350-16,00	moderate increase
Italy	1000	large increase
Kosovo (UN Res. 1244)	3-7*	unknown
Latvia	15-20	moderate decline
Lithuania	10-15	large decline
Montenegro	15-25	unknown
Poland	16-20	large decline
Portugal	64-100	moderate decline
Serbia	230-270	large increase
Republic of Moldova	30-60*	moderate decline
Romania	*4,600-6,500*	unknown
Russian Federation (European)	7,000-10,000*	moderate decline
Slovakia	0	extinct
Slovenia	0-4	possibly extinct
Spain	2,000-6,000	unknown
Sweden	0	extinct
The FYR of Macedonia	400	stable
Turkey	12,000-30,000*	large decline
Ukraine	*4,000-5,000*	reported decline
Estimated population size (2016)	**41,104 -80,767**	**Moderate decline (-29 %)**
Estimated population size from ISAP (2008)	**55,357-117,008**	

1.3. Habitat requirements on breeding areas

The European Roller avoids closed forests and, over most of breeding range, is predominantly associated more with open habitats with plenty of hollow trees. It inhabits old parks, tree-lined river banks, orchards, willow stands, and dry plains with scattered old trees, but usually avoids intensive cultivation. It is a secondary cavity nesting species, i.e. it needs natural hollows for breeding. Usually, it uses the old holes of Black Woodpeckers (*Dryocopus martius*) and Green Woodpeckers (*Picus viridis)* and bee-eater burrows (Casas-Crivillé et al. 2005), but may also nest in sand banks, cliff faces, buildings and, increasingly, artificial nest-boxes. The species is polyphagous, eating a wide variety of invertebrates and occasionally vertebrates or even fruits (Cramp, 1998; del Hoyo et al., 2001).

1.4. Diet

They prey on insects, mainly Coleoptera and Orthoptera followed by Araneae and Hymenoptera (Avilés & Parejo, 2002; Tidmarsh, 2003; Kiss et al., 2014). Animals other than insects comprise about 3 per cent of prey: scorpions, millipedes, centipedes, spiders, worms, molluscs, frogs, lizards, snakes, small mammals and birds (del Hoyo et al., 2001).

1.5. Habitat requirements during migration and wintering

Information on this aspect of their ecology is very scarce. It is believed to winter primarily in dry wooded savannah, and bushy plains (BirdLife International, 2008); in the United Republic of Tanzania also in sisal fields, and clearings of montane forest; and in West Africa in cultivated derived savannah woodland, also in edges of secondary forest below 1500 m (del Hoyo et al., 2001).

1.6. Breeding biology

The European Roller is considered to be monogamous, but social polygyny (Catry & Catry, 2016), extra-pair paternity and extra-pair maternity have also been recorded (Sánchez-Tójar et al., 2015). Participation of a helper in nestling rearing is rare (Avilés & Sanchez, 2000; Bohus, 2002). Normally the species is solitary and territorial, but semi-colonial breeding also occurs. The egg laying period is mostly May and June, with clutch size usually 4-5 (2-9); mean clutch size varies between 3.79 in Hungary (Kiss et al., 2014), 3.59 (Poland, Sosnowski & Chmielewski 1996), 4.23 (Spain, Avilés et al., 1999). Incubation lasts about 17-28 days and starts before the clutch has been completed (Cramp 1998; Avilés et al., 1999; del Hoyo et al., 2001, Guillaumot 2016). The fledging period is 26-27 days (del Hoyo et al., 2001). The reproductive success (fledglings/successful nest) in the declining the Polish and German population (the latter is extinct now) was between 1.5 – 1.8 (Creutz, 1979; Sosnowski & Chmielewski, 1996) but higher (3.74) in an increasing Spanish population (Avilés et al., 1999). Both parents take part in nestling care.

2. Conservation status

2.1. National protection status

The European Roller is a protected species in many countries, particularly in the Western parts of its range. More information on the species' legal protection is needed from countries along the migration route and on wintering places.

2.2. International protection status

a) IUCN Red List Category 1: Least concern

b) Bonn Convention on the Conservation of Migratory Species of Wild Animals

Appendix I and II. The species is listed in Category A in Annex II of the African-Eurasian Migratory Landbirds Action Plan (AEMLAP)

c) Bern Convention on the Conservation of European Wildlife and Natural Habitats

Appendix II

d) European Conservation Status2: SPEC2

e) EU Birds Directive: Council Directive on the conservation of wild birds (2009/147/EC) Category: Annex I

f) In 2012, the European Roller was listed as a priority for funding under the EU LIFE programme

g) An International Species Action Plan for the European Roller was accepted by the European Commission in 2008.

3. Migration route and wintering sites

Different populations have different migration routes, although their wintering grounds partly overlap. (Emmenegger et al., 2013; Finch et al., 2015.)

3.1. Migration route, stopover sites, and wintering area of the south-western breeding population of European Roller (*Coracias garrulus garrulus*)

The south-western European population of the species breeds mostly in Spain (in two sub-populations), Portugal, and southern France.

a) Autumn migration

According to three studies (Catry et al., 2014, Emmenegger et al., 2013, and Rodriguez-Ruiz et al., 2014 Finch et al, 2015.) Rollers leave their breeding grounds between late July and early September. The Balearic/Alboran route with a direct Sahara crossing seems to be used by French / north Spanish populations, whilst the Gibraltar route following the Atlantic coast of West Africa is used by south Spanish / Portuguese populations. (Finch et al, 2015)

The birds using the Balearic Island route enter Africa via Algeria, Tunisia and Libya, with stopover sites located in these countries (Rodriguez-Ruiz et al., 2014). After reaching Africa, all birds continue to migrate southwest through the Sahara Desert, or follow the west-coastal line to their first longer stop at the Sahel Belt in Senegal, Guinea, Mauritania and Mali (Rodriguez-Ruiz et al., 2014).

European Rollers migrating through the Strait of Gibraltar, and the Alboran Sea use stopover sites in Morocco, along the Atlas Mountains, and in Burkina Faso. The birds then follow the northern border of the Sahel Belt until reaching Niger, Nigeria, Ghana and Chad. This is an important region for Rollers because they spend a longer period (up to 41 days) there (Rodriguez-Ruiz et al., 2014).

A study from Portugal showed, that European Rollers tagged with geolocators followed a western-coastal route to Morocco and Mauritania, and spent their first longer stopover in West Africa. Their second stopover site was

in Niger, and western Chad, similar to Spanish birds. The Lake Chad region seems to be a very important site for migrating Rollers (Catry et al., 2014).

The coast of the Iberian Peninsula was the first stopover site of birds tagged in France. These birds then rested in Algeria for 24 days, then moved to their third stopover site in south-west Niger (6 days), before continuing to western central Africa.

Other birds used south-western Niger and western Chad as stopover sites, before they reached the border of Congo and Angola, one bird also made a stopover in Gabon (9 days) and afterwards in Congo (18 days; Emmenegger et al., 2013).

b) Wintering area

By late autumn (31 October – 22 December) Spanish birds arrive at their wintering sites; in Angola, Botswana, and Namibia where they spend 66 to 133 days (Rodriguez-Ruiz et al., 2014). Most of the Portuguese birds reached their wintering grounds in Angola in late October, although one individual might have reached Namibia (Catry et al., 2014). The wintering area of the French birds was in Angola, Zambia and Democratic Republic of Congo (Emmenegger et al., 2013, Finch et al. 2015).

c) Spring migration

Spring migration starts between 10 February and 1 April, when birds are heading to the Central African Republic, Chad, and Cameroon with quite short stopovers of 3 – 18.5 days. After that, they follow the northern border of the Sahel Belt to stop at Cote d'Ivoire, Liberia, Ghana, and Guinea (Rodriguez-Ruiz et al., 2014).

Some birds use a northern route from Chad to Mauritania, where they stay a little longer before crossing the Alboran Sea, to arrive back to the Iberian Peninsula (Rodriguez-Ruiz et al., 2014).

One of the French birds made two stopovers in Niger, and in Algeria, whilst another one stayed in northern Angola, or in the western Central African Republic for 61 days (Emmenegger et al., 2013).

The spring migration takes only about two months, being shorter than the autumn one (Catry et al., 2014).

Table 2. Migration route and wintering places of the South-Western breeding population of the European Roller

Country	Autumn migration	Stopover site (autumn)	Wintering area	Spring migration	Stopover site (spring)
Algeria	X	X		X	X
Angola	X	X	X		
Benin	?				
Botswana			X		
Burkina Faso	X	X			
Cameroon	X	X		X	X
Central African Republic				X	X
Chad	X	X		X	X
Congo, Republic of the			X	X	X
Cote d'Ivoire	X			X	X
Equatorial Guinea	?				
Gabon	X	X			
The Gambia	?				
Ghana	X	X		X	X
Guinea	X	X		X	X
Guinea-Bissau	?				
Liberia	X			X	X
Libya	X	X			
Mali	X	X			
Mauritania	X	X			
Morocco	X	X			
Namibia			X		
Niger	X	X		X	X
Nigeria	X	X			
Senegal	X	X			
Sierra Leone					
Spain	X	X		X	X
Togo	?				
Tunisia	X	X			
Western-Sahara	?				
Zambia			X		

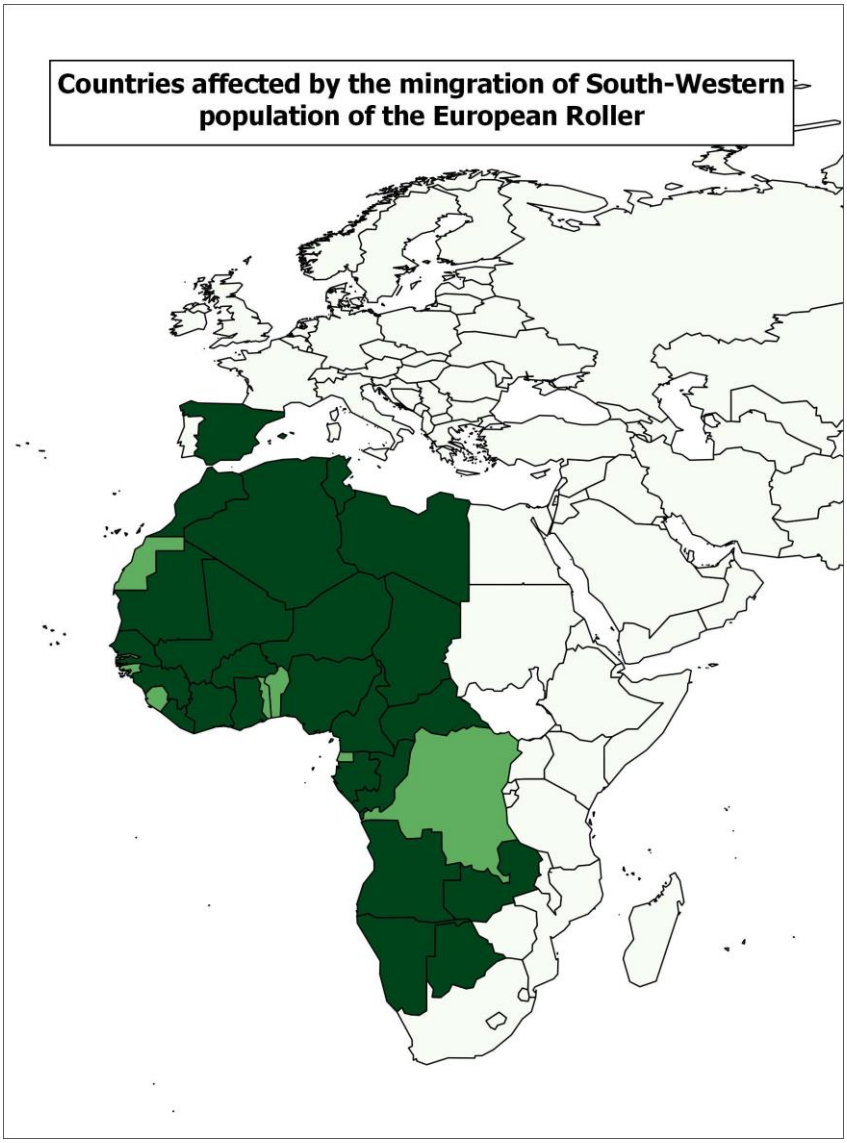


Figure 1. Countries affected (dark green) or potentially affected (light green) (see Table 2) by the migration of the South-Western population of the European Roller

3.2. Migration routes, stopover sites, and wintering sites of the Eastern , Central and Northern European breeding populations of European Roller (*Coracias garrulus garrulus*)

The European Roller population of this region consist of several subpopulations showing differences in size and trend. Northern populations (Poland, Lithuania, and Latvia) are highly threatened because of their small size, and decreasing population trend. In the central-eastern region, Austria has recorded the same trend as the northern countries. However, in Hungary, Romania, Bulgaria, and Cyprus the Rollers are numerous, and the number of breeding pairs is probably stable. Several migration studies have been conducted lately (Finch et al., 2015; Finch et al., 2017), and preliminary results of an ongoing project are also available about the migration routes and wintering areas of the eastern part of the European population. According to these studies, there are three different migration routes with overlapping or partially overlapping wintering grounds.

a) Autumn migration

Finch et al. (2015) found that the median departure date from the breeding site was 21 August for the whole European population (IQR (interquartile range): 3 August-6 September). However, in Hungary a later departure date was found, birds left the Carpathian basin between 30 August – 19 September. Ring recoveries, geolocator and satellite tracking data (Finch et al., 2015; Finch et al., 2017; and ROLLERPROJECT, LIFE/13/NAT/HU/000081) suggested the Balkan Peninsula as a stopover site in the Mediterranean region, and autumn migration through Turkey was also shown. Crossing the Mediterranean Sea can be fast, less than one day. North Libya and Egypt were not obviously confirmed as stopover sites after the crossing. Data from PTT devices showed broad-fronted migration across the Sahara Desert. Sub-Saharan stopover sites were found in Chad, and Sudan. In Chad, areas used by this Roller population were located eastward compared to those used by south-western populations. Wadi Fira Region (Chad) has been used by four rollers out of six for more than one week. Although, geolocator-derived locations are more imprecise, the Cypriot population might use the Nile Valley during autumn migration. European Rollers usually reach their sub-Saharan stopover sites in late September, and head further south in the beginning of November.

Some individuals stopped south of the equator (Democratic Republic of the Congo, Angola, and Zambia), before reaching the wintering grounds (Finch et al., 2015; ROLLERPROJECT, LIFE/13/NAT/HU/000081).

b) Wintering area

PTT devices showed Botswana, Namibia, and Angola as wintering quarters for Hungarian Rollers, however, Zambia and Zimbabwe were found as wintering sites for Latvian Rollers (Finch et al., 2015). Individuals from the same population did not share the same wintering ground. The south-eastern population seems to use more eastern and northern areas such as Tanzania and Kenya for wintering. Del Hoyo et al. (2001) also mentioned these countries as wintering grounds.

c) Spring migration

Median spring departure date from the wintering sites was 5th March for the European population (Finch et al., 2015), while one Hungarian individual set off on the 17th March. Different migration strategies were revealed for south-eastern Roller populations. The Latvian, and Hungarian populations migrate through the Arabian Peninsula, however, Austrian, and Montenegrin populations exhibit a clockwise loop pattern. According to ring recoveries, the Hungarian population is also likely to migrate in a counter-clockwise loop direction. Turkey was found as an important stopover site during spring migration.

Table 3. Migration route and wintering places of East and Central and Northern-European breeding populations

Country	Autumn migration	Stopover site (autumn)	Wintering area	Spring migration	Stopover site (spring)
Angola	X	X	X	X	X
Botswana			X		
Bulgaria	X				
Burundi	?		?		
Central African Republic	X			?	
Chad	X	X		X	?
Dem. Rep. of the Congo	X	X		X	X
Djibouti				?	
Egypt	X			?	
Eritrea				?	
Ethiopia	X			X	
Greece	x	X			
Hungary	X				
Iraq				X	
Israel				X	
Italy	X			X	
Jordan				X	
Kenya			X	X	
Kosovo (UN Res 1244)	X				
Lebanon				X	
Libya	X			X	
Macedonia	X				
Oman				?	
Namibia			X		
Republic of the Congo	X	?			
Rwanda			?	?	
Saudi-Arabia				X	X
Serbia	X				
Somalia				?	
South Sudan	X				
Sudan	X	X		?	
Syria				X	
Tanzania			X	X	X
Turkey	X	X		X	?
Uganda				X	
Yemen				X	
Zambia	X	X	X		
Zimbabwe			X		

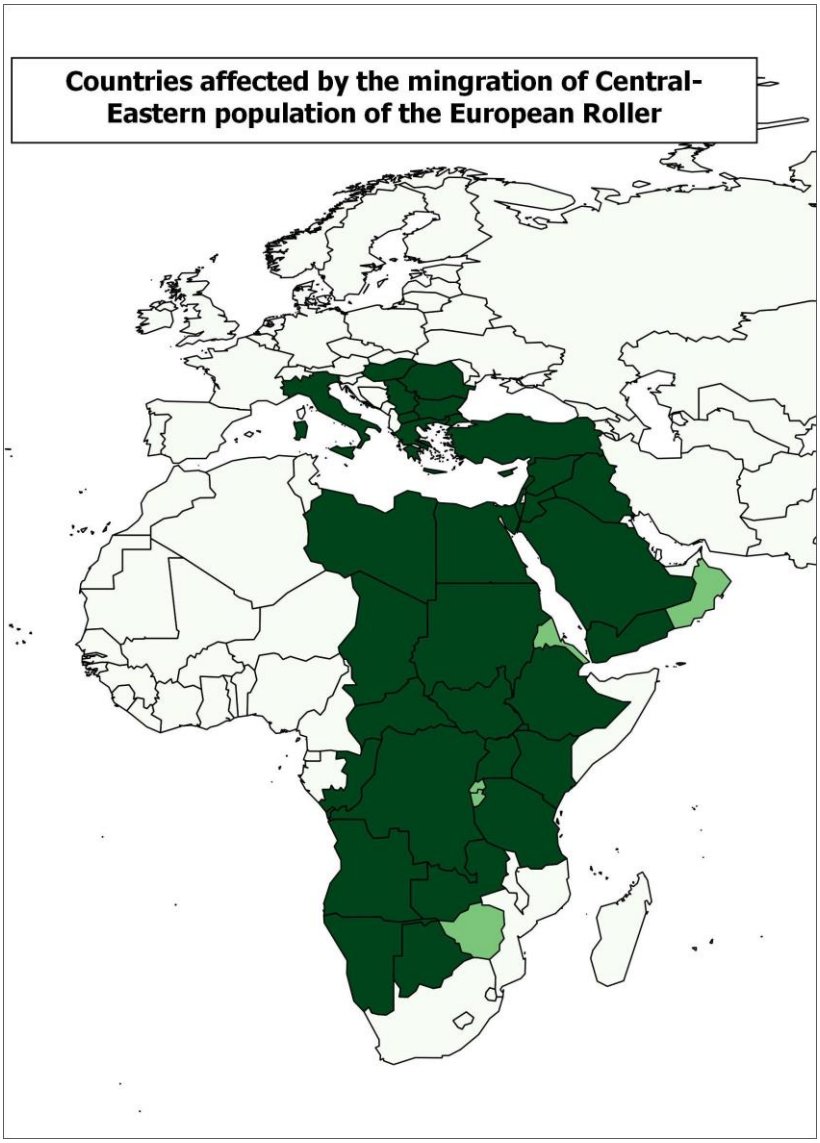


Figure 2. Countries affected (dark green) or potentially affected (light green) (see Table 3) by the migration of the Eastern-, Central-, and Northern-European breeding populations of the European Roller

3.3. Migration route, stopover sites, and wintering sites of the Asian breeding population of European Roller (*Coracias garrulus semenowi*)

The migration of *Coracias garrulus semenowi* has not been studied yet in detail. Only field observation data is available to describe migration pathways, and wintering areas of its populations – no tracking data or ring recoveries can confirm these and more data are required to clarify migration routes. According to the literature, the autumn migration route probably goes across the Arabian-Peninsula, with birds reaching South Africa via the eastern part of central Africa (Somalia, Kenya and Tanzania). The regular observations of this subspecies in South Africa suggest this country as a main wintering area. However, Zambia, Zimbabwe, and Botswana might also be part of the wintering quarter. Strong migration is recorded in a narrow corridor along coastal lowlands to north-east Somalia (del Hoyo et al., 2001), therefore this region might be the most important pathway during the spring migration. From Somalia birds move through Cape Gardafu (del Hoyo et al., 2001) to Oman, where large flocks are also observed.

Table 4. Migration route and wintering places of *Coracias garrulus semenowi*

Country	Autumn migration	Stopover site (autumn)	Wintering area	Spring migration	Stopover site (spring)
Botswana			?		
Burundi	?				
Djibouti	?			?	
Eritrea	?			?	
Ethiopia	?			?	
Kenya	X			X	
Lesotho			X		
Malawi	X			X	
Mozambique	X		?	X	
Rwanda	?				
Somalia	X			X	
South Africa			X		
Swaziland			X		
United Republic of Tanzania	X			X	
Uganda	?			?	
Zambia	X			X	
Zimbabwe	X		?	X	
Kuwait	?			X	
Oman	X	X		X	X
Saudi-Arabia	X			X	
United Arab Emirates	X			X	

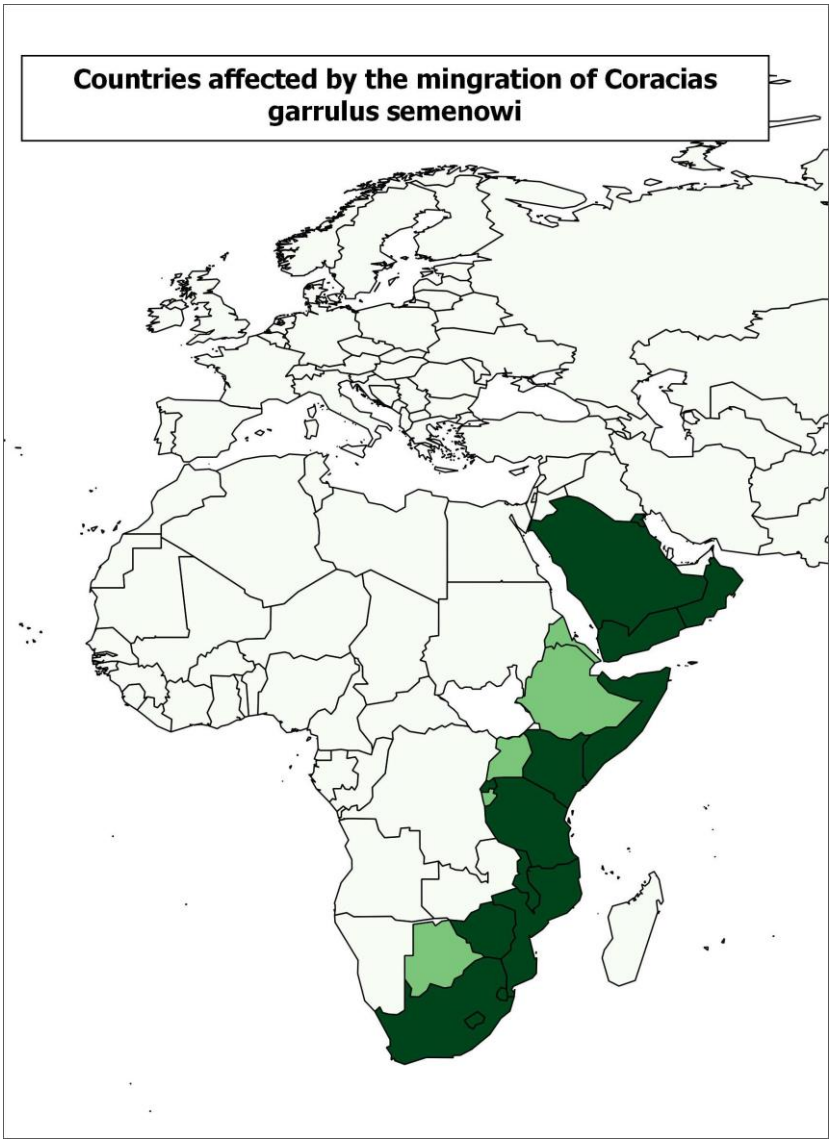


Figure 3. Countries affected (dark green) or potentially affected (light green) (see Table 4) by the migration *Coracias garrulus semenowi*

3.4. Priority countries for European Roller (*Coracias garrulus*)

To secure European Rollers on their non-breeding grounds extensive direct and indirect actions need to take place within short, medium and long period. To make the conservation work more effective, it is necessary to distinguish priority areas. The territories of almost all African countries are used by migrating, or wintering European Rollers. However, certain countries have higher importance for the species than others, due to higher population numbers and longer duration of stay. As detailed information is not available about the threat affecting Rollers for all countries concerned, three main criteria are therefore used to distinguish priority areas. Firstly, the eastern and western population of *C. g. garrulus* and *C.g. semenowi* follow mostly different pathways during autumn and spring migration, although they share several stopover sites and wintering areas. Regions used by two or three populations have higher priority. Spending more time in a particular area means higher risk to be affected by any risks, and therefore stopover sites and wintering areas get higher priority. Lastly, regions used in spring and autumn migration or wintering sites also get the highest ranking. Actions are being organized in specific countries based on the following priority system.

Criteria:

a) How many populations are using the area?

b) How much time do the birds spend there?

c) Autumn/spring migration route, or wintering area?

Priority 1 1.1. Many populations are affected.

1.2. Birds spend a minimum of 30 days in the area.

1.3. Birds use the area during both spring and autumn migration, or it is a wintering site.

Priority 2 2.1. One or more populations are affected.

2.2. Birds spend between 7-30 days in the area.

2.3. Birds only use the area during spring or autumn migration.

Priority 3 3.1. Birds spend less than 7 days in the area.

Priority 4 4.1. Migration routes can potentially cross the country, although there are no data available to prove this.

3.5. Map of priority countries

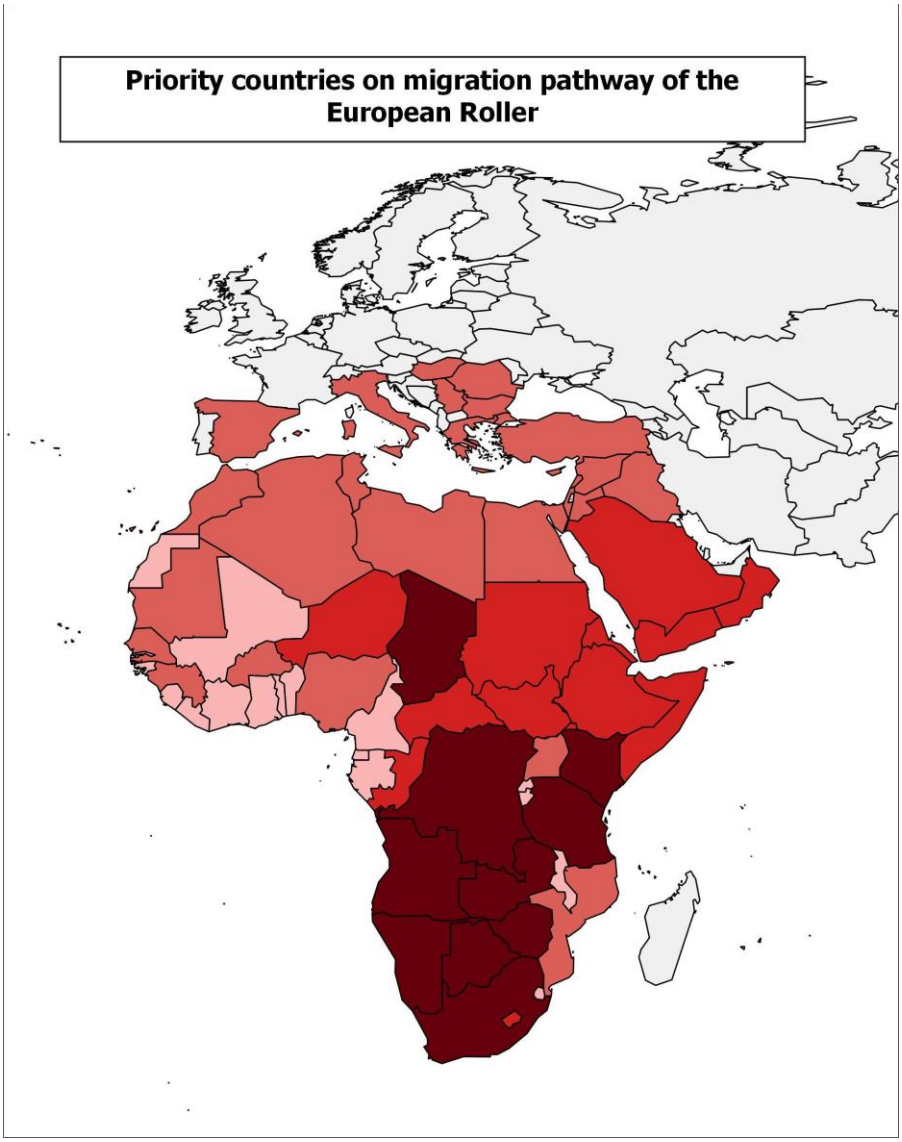


Figure 4. Priority countries on migration pathway of the European Rollers. Increasing intensity of red colour is in accordance with priority. Dark red = priority 1, dark medium=priority 2, light medium=priority 3, lightest red= priority 4.

4. Threats

The European population is still declining but at a less severe rate (c. 5-20 per cent over three generations (16.8 years)), and the Central Asian population is not thought to be declining significantly (BirdLife International, 2017). The migration strategy of the European Roller makes this species vulnerable as it uses different habitats during its annual cycle (Catry et al., 2014.) Most of the threats Rollers face during migration and wintering are not well known, some are even undiscovered, so further investigation is necessary. Although European Rollers spend only four months on their European breeding grounds, most research and conservation efforts are concentrated in these areas (del Hoyo et al., 2001).

The Action Plan is divided into the following thematic areas which identify key threats, and gaps in the conservation of this landbird species:

4.1. Habitat change

Agricultural intensification on breeding areas has a negative effect on European Rollers (Avilés & Parejo; 2004). Therefore, the conversion of foraging habitats, or the intensification of extensive agricultural areas might be a serious threat for Rollers during the migration period. The adoption of appropriate land-use policies and practices is required at international, national, and local levels to preserve suitable sites, habitats and landscapes on stopover sites and wintering grounds.

4.1.1. Habitat loss and degradation

The loss and degradation of natural habitats, such as the conversion of floodplain woodlands and wooded savannah into agricultural land, are widely reported from Africa (Vickery et al. 2014). Crop expansion is a severe threat to biodiversity in tropical countries (BirdLife International, 2013 b). Sudan, Nigeria and Ethiopia established the greatest area of new cropland, whilst also being important stopover sites for Rollers (Phalan et al., 2013). Large parts of the African savannas are already utilized for cropland (Phalan et al., 2013). The conversion of natural grasslands to other land use reduces the size and quality of suitable feeding sites, meaning that important areas are being degraded along the migration routes and on wintering sites.

4.1.2. Desertification and drought

One of the most important African stopover sites for the *Coracias garrulus garrulous* subspecies is in the Sahel Region. Birds spend many weeks there on both the autumn and spring migration, thus drought in the Sahel can have a significant impact on the species. The four main causes of the Sahelian droughts are as follows: sea surface temperature changes; vegetation and land degradation; dust feedbacks; and human-induced climate change (Epule, 2012).

Most long-distance migratory species rely on considerable fuelling at stopover sites before they embark on migratory flight, particularly if they need to cross oceans or deserts with no, or limited feeding opportunities. Consequently, migrants must accumulate enormous amounts of fat before migratory flights, some doubling their body mass within just a few weeks. To achieve that timed fuelling, suitable habitats and food must be available at stopover sites (Bairlein, 2016). Fuelling has not yet been studied in the European Roller, but as the tagged individuals flew relatively fast (crossing the Mediterranean Sea in a day), the quality of stopover sites before and after passing great barriers (Mediterranean Sea, Sahara Desert, rain forest zone) might have a significant effect on the survival rate.

Future studies are needed to clarify the effect of desertification, and habitat degradation on migrating Rollers.

4.1.3. Climate change

Since the European Roller is a long-distance migratory species, it has a special annual cycle. Its populations may be affected by habitat changes on passage, and on non-breeding areas by changes in the phenology of vegetation and food sources; by potential expansion of barriers such as deserts; and by changes in the weather systems affecting migratory flights (AEMLAP, 2014).

The effect of climate change to this species is unknown yet. Future studies are needed.

4.2. Taking[1] and trade

Illegal killing/taking of birds is a growing concern across the Mediterranean, and the Middle East for numerous bird species including the European Roller.

Overexploitation is one of the main drivers of bird extinctions globally (BirdLife International, 2013a), and is the second most significant threat (after habitat loss/degradation driven primarily by unsustainable agriculture) to migratory birds (Kirby et al., 2008).

Birds are taken for use as pets, or display, or hunted for food and sport (Butchart, 2008), with much unsustainable use being illegal (BirdLife International, 2013a).

European Roller populations can be affected by numerous forms of taking, which is one of the most important conservation issues for this species (See below).

4.2.1. Lack of regulation

The European Roller is a protected species in many Range States, particularly in the western parts of its range and is also listed in the Red Data Book of Ukraine and Belarus (Red Data Book of Ukraine, 2009; Red Data Book of Republic Belarus, 2015) but unfortunately, its protection status outside the European Union is otherwise poorly known. Beyond the protection status, the vindication of local jurisdiction might be a very important factor.

4.2.2. Illegal killing

The European Roller suffers severe mortality throughout its migration routes. Legal or illegal shooting has been reported from Serbia, Croatia, Cyprus, Saudi Arabia, and Libya. Hundreds, perhaps thousands, are shot for food in Oman every spring (del Hoyo et al., 2001), and in Gujarat, India. Almost 500 European Rollers are captured by nets and killed in Egypt, on the Sinai Peninsula every year (Eason et al., 2016 http://husrb.mme.hu/en/content/tragical-roller-recapture-or-threats-middle-east-our-migrating-birds)

1. Taking: means taking, hunting, fishing, capturing, harassing, deliberate killing, or attempting to engage in any such conduct – CMS Convention Text, 1979.

One of the proposed conservation actions by IUCN and BirdLife International is to "tackle specific threats such as hunting." (http://www.iucnredlist.org/details/22682860/0).

Hunter bag in Oman, 2015 Source: www.twitter.com

4.2.3. Illegal trapping, and catching for keeping as pet

The European Roller is an attractive and exotic-looking bird. It is therefore a desired species as pet for private collectors**.** Illegal collecting could be a serious danger for Rollers. A case of smuggling live birds was reported at the Serbian-Hungarian border in 2008. (Kiskunsag National Park's Webpage: http://knp.nemzetipark.gov.hu/index.php?pg=news_35_1282). One report about of selling of European Rollers is also known from Ukraine: in autumn 2016, a case of internet trade of one adult bird for pet keeping was reported.

Juvenile European Rollers found at the Serbian-Hungarian border (photo: Kiskunsag National Park Directorate)

The only confirmed data about trapping Rollers on their migration route originate from the Democratic Republic of the Congo, where a Hungarian ringed bird was accidently trapped in 2016 (ROLLERPROJECT (LIFE/13/NAT/HU/000081) http://rollerproject.eu/en/content/extraordinary-recapture-data-africa).

4.3. Other threats

4.3.1. Indirect poisoning

The European Roller is a predominantly insectivorous species, and as such is possibly exposed to secondary poisoning by a wide selection of pesticides used in the agricultural sector. Poisoning may happen when the chemicals are accumulated through the food chain. As Rollers winter in sub-Saharan Africa – where chemical usage regulations are more permissive compared with the European Union - they are presumably exposed to dangerous pesticides banned from the EU breeding range.

4.3.2. Collisions with wind farm turbines

Advances in technology and engineering are enhancing the contribution that wind power makes to renewable energy generation. Wind farms, both operational, and in planning, can be expected to have a negative impact on wildlife, particularly birds (Masden et al., 2006). Several European field studies have shown that birds can collide with the turbines, or can become disturbed by them during seasonal migration (Everaert, 2006).

A European Roller was found dead at a Romanian wind farm because of the turbines (in letter by Tamás Papp, Milvus Group, Romania). An adult was identified on at Babadag, Tulcea County by SC EVIVA NALBANT SRL (owner of the wind farm) on 4 August 2016.

There is not enough information about the European Roller's migration route, but wind farms can potentially become a significant problem with the expansion of renewable energy use.

4.3.3. Electrocution

Hunting from perches is a well-known behaviour of the European Roller. This species has naturally used trees, bushes and fences as perching sites, but nowadays it shows a strong preference for electric wires. This behaviour increases the risk of electrocution at breeding places, and presumably means a very high mortality factor for migrating and wintering birds, too.

4.4. Lack of research and monitoring

There is a knowledge gap on habitat use of European Rollers along migration routes and on wintering grounds.
The foraging habitats of European Rollers are well studied on the breeding areas. However, there is no detailed information about the habitat preference of Rollers on the non-breeding range.

4.4.1. Knowledge gap of migration pattern of the European Roller

Although several studies have already been published about the migration, and wintering grounds of the European Roller, there is still a significant knowledge gap about the stopover sites, and migration strategy of the Eastern populations. A successful conservation programme should cover all the key sites for the species including the most significant stopover sites, and wintering grounds, to ensure proper conservation measures along the flyway.

4.4.2. Lack of monitoring on non-breeding areas

There is no extended monitoring scheme of European Rollers including stopovers sites, and all wintering grounds. Planning and prioritizing different actions is not possible without a basic knowledge of any changes in the migrating populations.

4.4.3. Unknown factors causing decline in certain breeding populations

An accurate diagnosis is needed to understand all the factors in non-breeding areas contributing to or driving the decline of certain breeding populations.

4.4.4. Lack of information and coordination between researchers, national agencies, and organizations

There is no significant connection between researchers, national agencies, and organizations.
There is no international working group for the European Roller that could help to coordinate and organize different measures throughout the species' migration route.

4.4.5. Lack of information on the effect of climate change on the European roller along the flyway

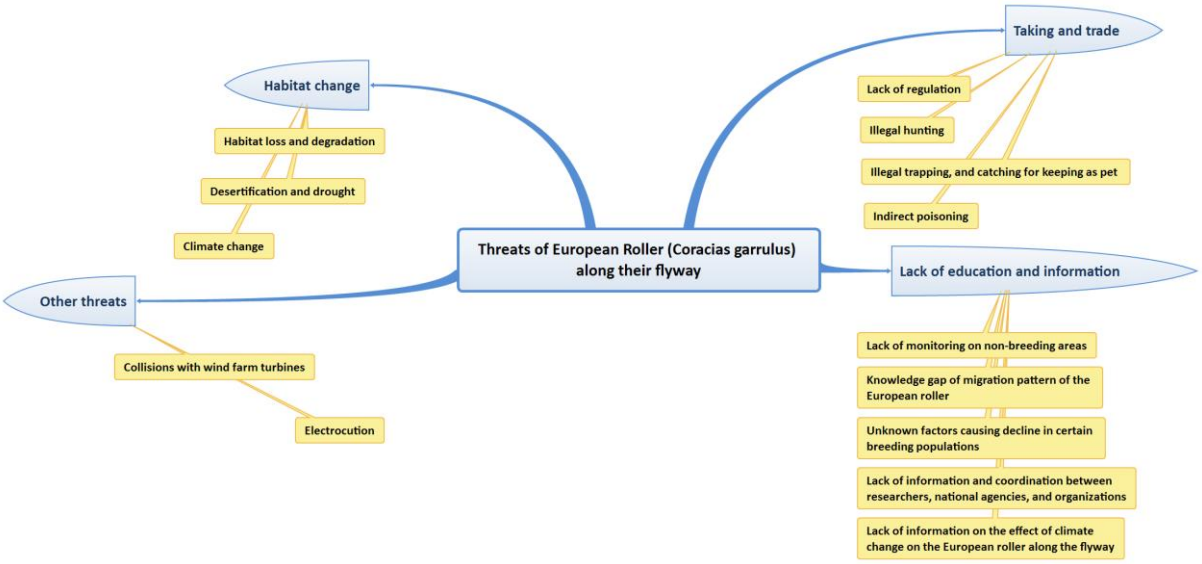
It is well known that climate change has various effects on migrating birds, such as changes in habitat and food availability on stopover and wintering sites, or changes in migration patterns and flyways. Nevertheless, there is no information about how the climate change is going to affect the European Roller on non-breeding areas.

4.5. Lack of education, and information

4.5.1. Lack of public awareness

The general public, local communities, stakeholders and decision makers are still not aware of migrating and wintering European Rollers.

4.6. Problem tree



5. Proposed strategic direction for conservation

5.1. Classification key for actions

Anticipating immediate or early commencement of all actions, each is classified according to when results are expected (reporting timeline), and the priority of the action is determined by its likely influence on the achievement of the overall goal of this Flyway Action Plan. The timeline and priority ranking has been assigned according to the scheme of categories provided in the African-Eurasian Migratory Landbirds Action Plan (AEMLAP) under specific consideration of the status of the European Roller as a species listed in CMS Appendix I and in Category A in Annex II of the AEMLAP.

5.1.1. **Timeline:**

S = results expected in the short term and actions that are already going on, (within one CMS COP intersessional period (i.e. three years) ;

M = results expected in the medium term, (within two COP intersessional periods (i.e. six years) ;

L = results expected in the long term, (within three or more COP intersessional periods (i.e. nine years or more).

5.1.2. **Priority:**

1 = *high* (an activity needed to prevent the extinction of a migratory landbird species within the Action Plan area),

2 = *medium* (an activity needed to prevent, or reverse population declines in any globally threatened, or near threatened migratory landbird species, or in the majority of other migratory landbird species with a declining population trend within the Action Plan area),

3 = *low* (an activity needed to restore populations of a globally threatened or near threatened migratory landbird species, or to prevent population declines in any migratory landbird species).

(AEMLAP, 2014)

5.2. Proposed actions for the conservation of the European Roller along its flyway

5.2.1. **Habitat change**

5.2.1.1. Habitat loss, and degradation

Develop and implement new policies, or review existing policies that maintain, and manage natural and semi-natural habitats of value to the migratory European Roller within an otherwise wide-scale-, and/or intensively managed, cropped, or agricultural landscapes. Measures should include the promotion of agri-environment schemes, and where these exist, the removal of contradictory incentives and subsidies; biodiversity-friendly farming systems, and participatory sustainable resource and habitat management. (M/1)

5.2.1.2. Desertification and drought

Encourage planting of native trees and woodland conservation providing benefits for migrating bird species, including European Rollers, who use these areas as stopover sites in Sahel region. (L/1)

5.2.1.3. Climate change

Implement measures outlined in the UNEP/CMS Resolutions 9.7 (Climate Change Impacts on Migratory Species), 10.19 (Migratory Species Conservation in the Light of Climate Change) and 11.26 (Programme of Work on Climate Change and Migratory Species). (L/3)

5.2.2. **Taking and trade**

5.2.2.1. Lack of regulation

Ensure legal protection of European Roller of greatest local conservation concern in priority countries. (M/1)

5.2.2.2. Illegal killing

Promote international cooperation between enforcement authorities, and other stakeholders (S/1). Improvement of law enforcement is a prime task in most of the priority countries. (S/1)

5.2.2.3. Illegal trapping and catching for pet

Promote international cooperation between enforcement authorities, and other stakeholders in the regulation (S/2). Implement measures outlined in CMS Resolution 11.16 on Illegal Killing, Taking and Trade of Migratory Birds. (S/1). Promote awareness-raising campaigns in the priority countries. (S/2)

5.2.2.4. Indirect poisoning

Substitute, restrict, or ban substances of high risk to European Roller, including insecticides (pesticides) or probably second generation anticoagulant rodenticides (SGARs). Implement measures outlined in CMS Resolution 11.15 and its annexed Guidelines to Prevent the Risk of Poisoning to Migratory Birds. (M/1).

Encourage national legislative mechanisms to monitor the agricultural use of pesticide substances, and to adopt an integrated pest management that incorporates a certification scheme for farmers. (M/1).

5.2.3. **Other threats**

5.2.3.1. Collisions with wind farm turbines

Ensure that appropriate EIA (Environmental Impact Assessments) have assessed/are evaluating the risks to Rollers in projects along the well-known migration routes of the Roller. (S/3)

5.2.3.2. Electrocution

Encourage constructors and operators of new medium-voltage transmission lines to incorporate appropriate measures aimed at protecting migrating birds against electrocution. (L/2)

Encourage constructors and operators to cooperate with conservation organizations, competent authorities, and appropriate financial bodies in order to reduce the electrocution risk posed to birds from transmission lines. (M/2)

5.2.4. **Lack of research and monitoring**

5.2.4.1. Knowledge gap on the habitat use of European Rollers along migration routes and on wintering grounds.

Promote collaborative research programmes are needed along the flyway to identify key habitats for European Rollers during migration period. (S/1)

5.2.4.2. Knowledge gap on the migration pattern of European Rollers.

Promote to use advanced techniques, such as PTT transmitter or geolocators to identify the key sites for this subspecies. Moreover, promote international studies to describe factors affecting the migration of European Rollers throughout its entire breeding range. (S/1)

5.2.4.3. Lack of monitoring of non-breeding areas

Establish monitoring schemes both on stopover sites and on wintering grounds, especially in priority areas. (L/2)

5.2.4.4. Unknown factors causing decline in certain breeding populations

Develop common research programmes between African and European institutes, and conservation specialists to diagnose the demographic causes of population decline such as reduced productivity, survival or both and localize areas with high mortality risk for Rollers along the migration pathway. Reveal unknown factors behind population decline. (L/1)

5.2.4.5. Lack of information and coordination

Establish national and international Roller Working Groups to ensure connection between researchers, national agencies and organizations. (M/2)

Involve national agencies to collate data, and to develop, or revive national database(s).

Online resources/databases are proved to be an effective method to involve experts, and also the wider community in data collection, and provide fast feedback for all participants. (S/2)

5.2.4.6. Lack of information on the effect of climate change on the European Roller along the flyway

Promote research to predict the effect of climate change on European Rollers, and to design conservation actions to reduce its impact. (L/3)

5.2.5. **Lack of education and information**

5.2.5.1. Lack of public awareness

Although the European Roller is an easily recognizable species, there might be lack of awareness about its conservation status. Local communities in key areas, and decision-makers need to be aware of the value of taking care of Rollers, for their intrinsic conservation needs, and for cultural and economic reasons. Raise public awareness about the European Roller by targeted campaigns in key areas to raise public awareness about European Rollers among the relevant stakeholders and the wider public. (L/2)

5.3. Action framework

Direct problem	Action	Priority	Time scale	Organisations responsible
1.Habitat change	**Objective 1. Maintain suitable habitats of European Rollers in non-breeding range**			
1.1. Habitat loss and deterioration	Encourage agri-environmental schemes, biodiversity-friendly farming systems, and participatory sustainable resource and habitat management schemes.	High (1)	Medium (M)	National governments, Relevant national authorities, Local stakeholders
1.2. Desertification and drought	Encourage woodland conservation and native tree replanting in deforested areas.	High (1)	Long (L)	Relevant national authorities, Local stakeholders, Conservation GOs and NGOs
1.3. Climate change	Implement measures outlined in CMS Resolution 9.7	Low (3)	Long (L)	Relevant national authorities
	Implement measures outlined in CMS Resolution 10.19	Low (3)	Long (L)	Relevant national authorities
	Implement measures outlined in UNEP/CMS/COP11/Doc 23.4.2. Programme of Work on Climate Change and Migratory Species	Low (3)	Long (L)	Relevant national authorities
2.Taking and trade	**Objective 2. Significant reduction in mortality due to illegal killing and trapping.**			
2.1. Lack of regulation	Ensure legal protection of European Roller of greatest conservation concern in priority countries.	High (1)	Medium (M)	Relevant national authorities, Conservation Government Organizations (GOs)
2.2. Illegal killing	Promote international cooperation between enforcement authorities, and other stakeholders.	High (1)	Short (S)	Relevant national authorities, Conservation GOs and NGOs, Local stakeholders
	Improve law enforcement.	High (1)	Short (S)	Relevant national authorities
	Promote sensitising campaigns in the priority countries.	Medium (2)	Short (S)	National governments, Relevant national authorities, Conservation GOs and NGOs

2.3. Illegal trapping and catching for pet	Promote international cooperation between enforcement authorities, and other stakeholders in the regulation.	Medium (2)	Short (S)	National governments, Relevant national authorities, Conservation GOs and NGOs, Local stakeholders
	Implement measures outlined in CMS Resolution 11.16 on The Prevention of Illegal Killing, Taking and Trade of Migratory Birds.	High (1)	Short (S)	National governments, International organizations, Relevant national authorities, Conservation GOs and NGOs
3.Other threats	**Objective 3. Significant reduction in mortality due to electrocution and collision with energy infrastructure**			
3.1. Indirect poisoning	Implement CMS Resolution 11.15 and measures outlined in the *CMS Guidelines to Prevent the Risk of Poisoning to Migratory Birds*, particularly the recommendations to prevent risk to birds from insecticides and rodenticides used to protect crops, with priority to substitution, restriction, or ban of substances of high risk to European Roller, such as harmful insecticides and second generation anticoagulant rodenticides (SGARs)	High (1)	Medium (M)	National governments, Relevant national authorities, Conservation GOs and NGOs,
3.1. Collisions with wind farm turbines	Ensure that appropriate EIA (Environmental Impact Assessment) have assessed/are assessing the risks to Rollers in projects along the well-known migration routes of European Roller.	Low (3)	Short (S)	National governments, International organizations, Relevant national authorities, Electric utility companies, Conservation GOs and NGOs
3.2. Electrocution	Encourage constructors and operators of new medium-voltage transmission lines and associated towers to incorporate appropriate measures aimed at protecting migrating birds against electrocution.	Medium (2)	Medium (M)	National governments, International organizations, Relevant national authorities, Electric utility companies, Conservation GOs and NGOs

	Encourage constructors and operators to cooperate with conservation organizations, competent authorities, and appropriate financial bodies in order to reduce the electrocution risk posed to birds from transmission lines.	Medium (2)	Medium (M)	National governments, International organizations, Relevant national authorities, Electric utility companies, Conservation GOs and NGOs
4. Lack of research and monitoring	**Objective 4: Increase efficiency of conservation measures**			
4.1. Knowledge gap on habitat use of European Rollers along the migration route and on wintering grounds	Promote research programs to identify key habitats for European Rollers along the flyway.	High (1)	Short(S)	Conservation GOs and NGOs, Research organizations, Universities, consultants, National governments
4.2. Knowledge gap on the migration pattern of the European roller	Deployment of more high precision tracking devices (e.g. PTT) to identify migration patterns, bottlenecks and stopover sites along the flyways.	High (1)	Short (S)	Conservation GOs and NGOs, Research organizations, Universities, consultants, National governments
4.3. Lack of monitoring on non-breeding areas	Develop common survey methods, and monitoring protocols on stopover sites and wintering areas.	Medium (2)	Long (L)	Conservation GOs and NGOs, Research organizations, Universities, consultants, National governments
4.4. Unknown factors causing decline in certain breeding populations	Develop common research programmes between African and European research institutes, and conservation specialists to reveal unknown factors behind population decline.	High (1)	Long (L)	Conservation GOs and NGOs, Research organizations, Universities, consultants, National governments
4.5. Lack of information exchange and coordination	Establishment of national and an International Roller Working Groups.	Medium (2)	Medium (M)	Conservation GOs and NGOs, Research organizations, Universities, consultants,
	Promote collaborative work with African organizations.	Medium (2)	Short (S)	Conservation GOs and NGOs, Research organizations, Universities, consultants,

				National governments
4.6. Lack of information on the effect of climate change on the European Rollers along the flyway	Promote research to predict the effect of climate change on European Rollers, and to design conservation actions to reduce its impact.	Low (3)	Long (L)	Research organizations, International organizations, Universities, consultants, National governments, Conservation GOs and NGOs
5. Lack of education and information	**Objective 5. Raise public awareness**			
5.1. Lack of public awareness	Promote a direct campaign to increase the awareness of local communities regarding the conservation status of the European Roller.	Medium (2)	Long (L)	Relevant national authorities, National governments, Conservation GOs and NGOs, International organizations
	Promote (social media) reporting tools to build citizen science datasets on distribution, movements and abundance.	Low (3)	Long (L)	Conservation GOs and NGOs, International organizations, Universities, consultants, Research organizations
	Capacity-building - promote scholarships etc. to bring students to European research institutes.	Medium (2)	Long (L)	Universities, consultants, Research organizations, International organizations

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