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Bird Census News is the Journal of the European Bird Census Council or EBCC. The EBCC exists to promote the organisation and development of atlas, census work and population studies in all European countries; it promotes communication and arranges contacts between organisations and individuals interested in census and atlas work, primarily (but not exclusively) in Europe.

Bird Census News reports developments in census and atlas work in Europe, from the local to the continental scale, and provides a forum for discussion on methodological issues.

Cover illustration by Evgeniy Koblik

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EDITORIAL

This issue of Bird Census News is published shortly after a moment of transition for the European Bird Census Council. Following recent changes in the EBCC Board, our chair and long-standing Board member, Verena Keller, has stepped down from the Board. We would like to express our sincere thanks to Verena for her many years of dedicated leadership and her outstanding contribution to EBCC activities, from advancing large-scale monitoring initiatives to strengthening cooperation across Europe.

The articles in this issue once again highlight the diversity and relevance of bird monitoring across the EBCC network. The contribution from Denmark demonstrates the exceptional value of long-term data by documenting changes in the national bird fauna over the past century, combining historical sources with modern atlas and monitoring data. The paper from Belgium addresses the impact of Usutu virus on wild bird populations, using data from national bird monitoring schemes. From a different geographical context, the article from Armenia provides a detailed assessment of the status and conservation of the Cinereous Vulture.

We also continue our tradition of publishing interviews with EBCC Board members. In this issue, we feature an interview with Aleksi Lehikoinen, offering insights into his scientific background, motivation, and views on EBCC's role.

We hope this issue will both inform and inspire.

on behalf of the EBCC
Petr Voříšek, EBCC Office manager

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Development of the Danish bird fauna over the past 100 years

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Abstract. The Danish bird fauna has changed over the past 100 years. The breeding ranges of open land bird species have decreased drastically while species connected to forest and scrub have gained range. Further, the number of breeding species and their distribution has increased within the past 100 year. This paper aims to give an overview of the population changes within the last 100 years. This is carried out by comparing monitoring data from the three Danish Atlas projects with the descriptions by Skovgaard 1932, a compilation of all data on Danish breeding birds' distribution from the 19th century until 1932.

Introduction

Since 1975, voluntary birdwatchers have conducted bird counting in the Danish Point Count Census, along with three national Atlas projects in 1971–1974, 1993–1996 and 2014–2017, to map and monitor the distribution and populations of breeding birds in Denmark. This continuous data has provided a clear view of the populations of Danish breeding birds, but only very little continuous data exists from before 1900s.

In 1932, P. Skovgaard made a status on the number of bird species in Denmark, based on literature dating back to the late 19th century (Skovgaard 1933). By combing the status made by Skovgaard with data from the three Danish Atlas, this short note investigates the changes of the Danish bird fauna over the past 100 years.

Methods

The compilation by Skovgaard

In 1932, P. Skovgaard made a status on the number of bird species in Denmark based on literature dating back to the late 19th century. Skovgaard used the 53 topographical-botanical districts used by botanists and faunists in that period to make a status on more than 200 bird species. The status by Skovgaard consists only of a list of the species with the districts mentioned. Combining these lists with manually digitalized shapefiles of each district, species distribution maps were produced in QGIS and R. Additionally, a species richness map was produced, showing the number of species in each district.

Atlas III

For the Atlas III project Denmark has been divided into 2256 squares, each square measuring 5 km × 5 km. Volunteers have been registering all bird species found within the squares over a 4-year period (2014–2017). All data have been entered into an online atlas database http://dofbasen.dk/atlas/. Filters have been added to the database in order to secure high quality data. In order to calculate population estimates, the participants have carried out line transects with density bands. Participants recorded the number of species within 25, 50 and 100 meters along the one-kilometre line transect.

Results

Atlas III has resulted in 398,679 observations being entered into the atlas database. From Skovgaard's description in 1932, to Atlas III the number of species has increased. Skovgaard's collection shows that within a district the highest number of species was found to be between 140–149. Such high species numbers was only found in a few districts (Fig. 1). The data from Atlas III shows a high number of species within the squares (76 to 120 species). The high number of species per square is distributed throughout all of Denmark, with few squares containing only few species.

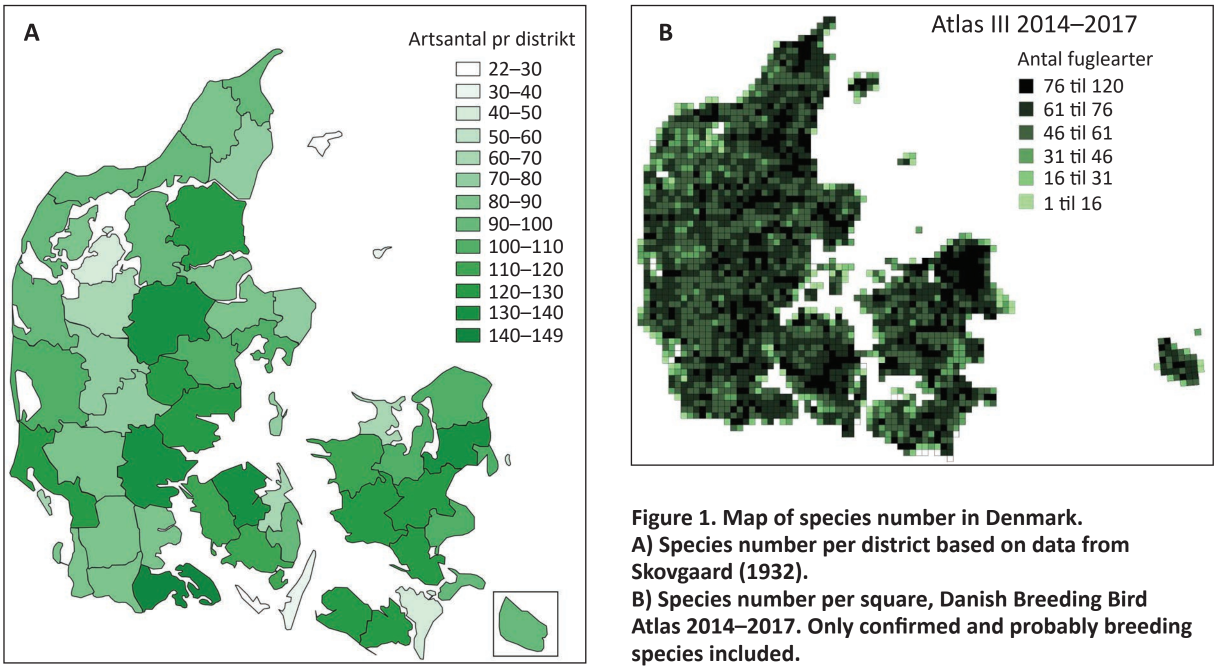

Figure 1. Map of species number in Denmark.
A) Species number per district based on data from Skovgaard (1932).
B) Species number per square, Danish Breeding Bird Atlas 2014–2017. Only confirmed and probably breeding species included.

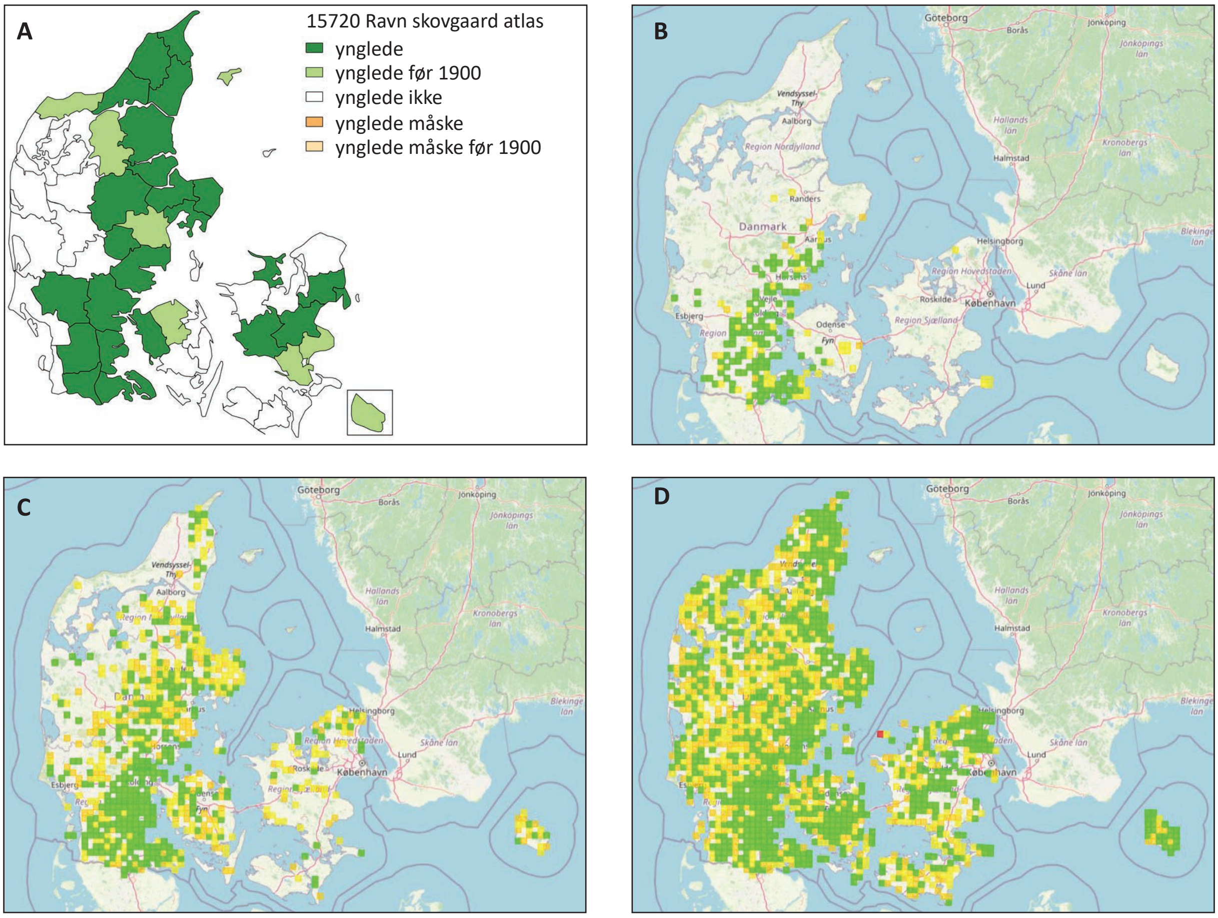

Figure 2. Distribution of the Common Raven (*Corvus corax*) in Denmark.
A) Map based on the description by Skovgaard 1932. Dark green is breeding, light green is breeding before 1900 and white is not breeding.
B) Atlas I, 1971–1974.
C) Atlas II, 1993–1996.
D) Atlas III, 2014–2017. Green is certanly breeding, orange and yellow is likely breeding, and red is searched for but not found.

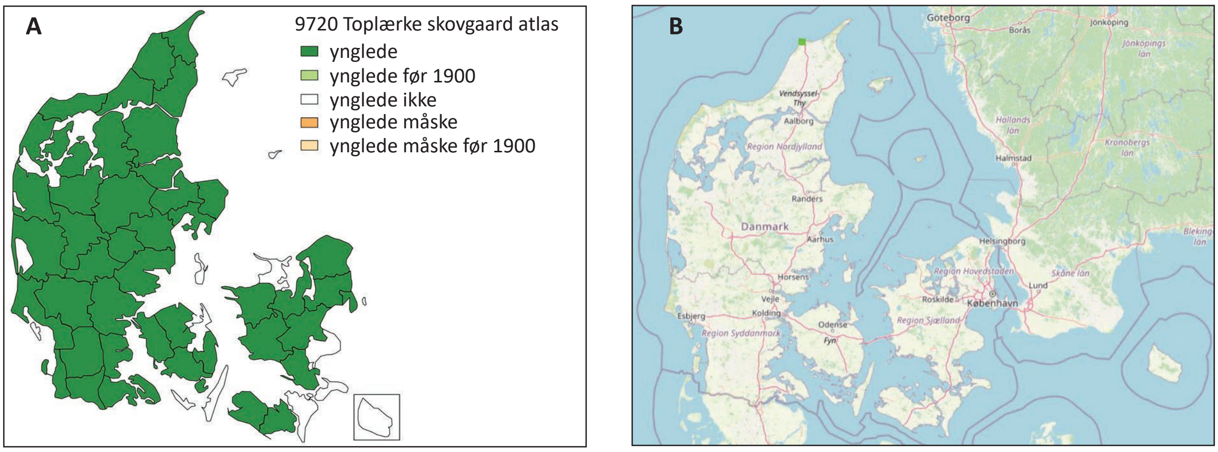

Figure 3. Distribution of the Crested Lark (*Galerida cristata*).
A) Map based on the description by Skovgaard (1932). Dark green is breeding, light green is breeding before 1900 and white is not breeding.
B) Map from Atlas III, 2014–2017. Green is certanly breeding.

As a species-specific example of changes, the Common Raven (*Corvus corax*) was found breeding in half of Denmark in the Skovgaard's compilation, mostly in eastern Jutland, western Funen and the southern part of Zealand (Fig. 2A). During Atlas I the Common Raven was only found breeding in south-eastern Jutland (Fig. 2B). Through Atlas II and III the distribution of the Common Raven has expanded to all of Denmark with a total expansion of 79% (Fig. 2C and 2D). The expansion of the Common Raven is one of the most positive results from Atlas III.

A species that has decreased dramatically since Skovgaard's compilation is the Crested Lark (*Galerida cristata*). Before 1932, the Crested Lark was found in almost all of Denmark (Fig. 3A). In the Atlas III period Crested Lark was only found breeding in one square in the northern part of Jutland (Fig. 3B).

Generally, species that are connected to open areas, especially semi-desert habitats, have decreased since the 1800s (Fig. 4).

Discussion

The development of breeding bird species in Denmark has greatly changed since the 1800s, and generally the number of breeding birds is increasing (Ejrnæs *et al.* 2011). This increase is thought to a result of the many landscape changes in Denmark in the last 100 years; an expansion of the Danish forests has created new habitats for many species. Furthermore, increased protection of certain species is believed to have contributed to the increased species number (Miljøministeriet 2005). One of the biggest winners during the Atlas III period is the Common Raven. Where many open land birds have decreased over the last decades, the Common Raven has increased its population with 800% since 1984 (Eskildsen *et al* 2020). In the 1960s it was restricted to the southern part of Jutland due to superstition and intensive persecution. The considerable increase in the population is a result of protection of the species in 1967. Where many bird species connected to forest and scrub have increased, open land species, especially dry open land species, have decreased dramatically. Nyegaard *et al.* (2014) describe how rare breeding birds associated with semi-desert habitats, i.e. dry, sandy soil with limited vegetation cover like the Crested Lark have shown a marked decline in their populations. Their habitats have changed, disfavoring the species as a result of increasing nitrogen supply deriving especially from agricultural livestock production. These findings correspond to the general tendencies found in the Atlas III project. Despite the decline of open area bird species, the overall Danish breeding bird population has increased over the last 100 years, but is now more dominated by forest/scrub species rather than open land species.

Acknowledgements

We would like to thank all the 1468 participants in the Atlas III project for all their work. Without

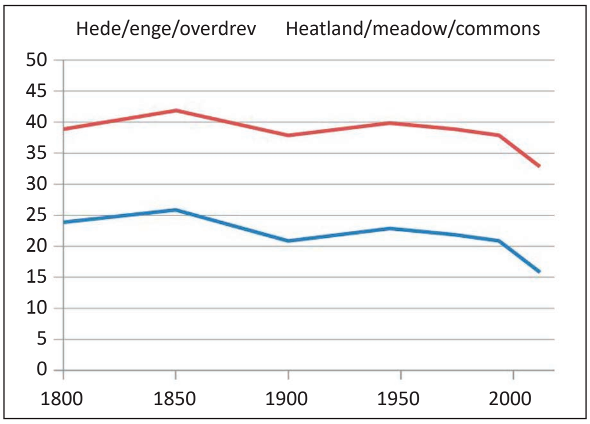

Figure 4. Development of breeding birds in open land 1800–2012 (from Romdal et al. 2013).
Red curve: Species in both their primary and secondary habitat.
Blue curve: Species in their primary habitat.

their effort it would never have been possible to carry out this project. We would also like to thank Daniel Palm Eskildsen for creating the maps based on Skovgaard's data. Lastly thanks to Aage V. Jensen Naturfond for funding the Atlas III project.

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Impact of Usutu virus (USUV) on bird populations in Belgium

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Abstract. Usutu virus (Usuv) was first diagnosed in two corpses in Belgium in 2012. The first widespread outbreak affected NE Flanders in late summer 2016. A much larger outbreak followed in summer 2017, and again in summer 2018, each year expanding further west. Many sick and dead Eurasian Blackbirds *Turdus merula* were reported by the public to the data portal www.waarnemingen.be / www.observations.be.

We evaluated the impact of Usuv at population level using data from Common Bird Monitoring (CBM). We looked for contrasting changes in abundance from areas inside/since the outbreaks with outside/before the outbreak. In Flanders, of 60 species, Eurasian Tree Sparrow *Passer montanus* (–85% inside/+38% outside), Common Moorhen *Gallinula chloropus* (–60%/+57%), Song Thrush *T. philomelos* (–19%/+16%), Eurasian Blackbird (–11%/+24%), Northern Wren *Troglodytes troglodytes* (–13%/+22%), Dunnock *Prunella modularis* (–13%/+28%) and Mistle Thrush *Turdus viscivorus* (–62%, –20%) fitted the expected contrasting patterns of different dynamics between affected and unaffected areas exactly. Overall, in 31 of the 60 species annual changes were >20% worse inside than outside affected areas (11 species were >50% worse). Only 17 species were >20% better inside.

Declines were habitat specific: more marked in areas dominated by (sub)urban, agriculture or wetlands, but not in woodland. This pattern fits the ecology of Usuv: thermophilic, faster mosquito (vector) cycles in small water bodies on artificial substrates, and density dependent risks of outbreaks. In the less urbanized, more wooded and hilly parts of Wallonia, no strong declines fitting Usuv were found, despite the virus being widespread.

Evidence indicates that:

- Usuv is more widespread than mass mortality in birds indicates.
- mortality outbreaks happen under specific, local (micro)climatic conditions; particularly urban areas, agriculture habitats and wetlands are at risk.
- USUV affects many bird species at population level, some worse than Eurasian Blackbird.
- mortality of other sensitive species does not necessarily coincide with mortality of Blackbirds, and may happen unnoticed.

Introduction

Usutu virus (Usuv) is an encephalitic flavivirus transferred by mosquitos (Weissenböck et al. 2002, Nikolay 2015, Engel et al. 2016, Benzarti et al. 2019b). It originated in Africa and different strains reached Europe independently many times during the last 50 years, possibly imported by migratory birds (Engel et al. 2016). The first epozootic outbreak killing birds in Europe was documented in 1996 in Italy (Weissenböck et al. 1996); later in 2001 in Austria (Weissenböck et al. 2002, Rubel et al. 2008, Steiner & Holzer 2008) and in 2005 in Hungary (Bakonyi et al. 2007). Usuv was found in 93 bird species and was lethal to birds of 36 species, but Eurasian Blackbirds (*Turdus merula,* hereafter Blackbird) have suffered particularly high mortality (Chvala et al. 2007, Bosch et al. 2012, Tietze et al. 2014, Nicolay 2015, Lühken et al. 2017, Walter et al. 2018, Benzarti et al. 2019b). Meanwhile outbreaks have been documented from some 10 countries, mostly in southern and central Europe. Closest to Belgium, there was a large outbreak in the Rhine valley in southwestern Germany (Frankfurt-Karlsruhe) in 2011–2013 (Ziegler et al. 2015, 2016, Lühken et al. 2017) of the same strain as some ten years earlier in Italy, Austria and Hungary (Becker et al. 2012, Lühken et al. 2017). However, the major outbreak in Belgium and The Netherlands in 2016 (Rijks et al. 2016) followed an outbreak just across the border in Germany in 2014–2016, and was caused by a different virus strain (Cadar et al. 2017).

In Belgium, Usuv was first diagnosed in two corpses in 2012: a captive Bullfinch (*Pyrrhula pyrrhula*) and a Great Spotted Woodpecker (*Dendrocopos major*) (Garigliany et al. 2014). Judging by the many Blackbirds reported ill and dead by the public to the online portal www.waarnemingen.be/www.obervation.be in the summers of 2016, 2017 and 2018, a large outbreak spread from East to West across northern Belgium, but this was a different virus strain than the earlier two cases (Cadar et al. 2017, Garigliani et al. 2017).

In this paper we map the extent of the Usuv outbreak based on citizen science data of dead and ill Blackbirds. We screen the impact at population level of the Usuv outbreak on other common birds in Belgium and look at the particular climatic context of the outbreak.

Methods

Identification of affected areas

In the online portal www.waarnemingen.be/www.obervation.be, we routinely collect citizen science data from the public on biodiversity in general, including dead and ill birds (also road victims). When increased mortality of Blackbirds was reported (and Usuv suspected), we placed a call to the public through the press (in Flanders) in summer in each of the years 2016–2018 to report dead and ill birds. The areas heavily affected by Usuv in Flanders (northern part of Belgium) clearly stood out on maps of Blackbirds reported ill or dead. From this, we mapped the areas of virus outbreak in 2016 and 2017 (Fig. 1). The first outbreak in 2016 encompassed some 6,000 km^2 in the northeast of the country (Fig. 1A). In the next summer heavy mortality of Blackbirds was reported from a much larger area (12,000 km^2), moving further west. The remaining 3,000 km^2 of Flanders further west up to the coast were affected in summer 2018. The Brussels capital region was just at the edge of the outbreak in 2016, but became affected in 2017. No increased mortality of Blackbirds was reported from Wallonia (except for some cities) and it appears that it was spared from widespread Usuv mortality.

Because mortality occurs in summer (July-September), the effects of the outbreak in 2016 on breeding bird surveys could only be detected for the first time in spring 2017. This nevertheless results in a pattern of three areas consecutively affected from different years onwards, giving the opportunity of a clear comparison of areas before *versus* after and inside *versus* outside the virus outbreak (Fig. 2). If Usuv mortality affects bird populations, the hypothesis is that species sensitive to Usuv will have declined in the year(s) after the outbreak compared to before or to unaffected areas (Fig. 2).

Bird monitoring data

We used data from the Common Bird Monitoring (CBM) in Flanders (Vermeersch et al. 2007, 2019), Brussels (Weiserbs & Paquet 2010) and Wallonia (Derouaux & Paquet 2018) to screen as many species as possible for impact at population level. In the end 60 species were sufficiently abundant (with enough data available from theCBM) to be evaluated. For Flanders, we lumped the CBM counts in different 'Usuv areas' (Fig. 1) by year and calculated changes in abundance between years. Sample size varied between 184–197 counted grid-cells (km-square) annually in 2016–2018, and 25–94 grid-cells per area per year. We conducted two analyses: (1) identifying those species that fitted exactly the pattern of systematically declining in each of the three affected areas compared to each of the three unaffected areas (before or elsewhere) (see Fig. 2), and (2) comparing the population changes between affected and unaffected areas for all areas lumped. We calculated changes from the breeding season before the outbreak (2016) to the first (2017) and second (2018) year of the outbreak and averaged

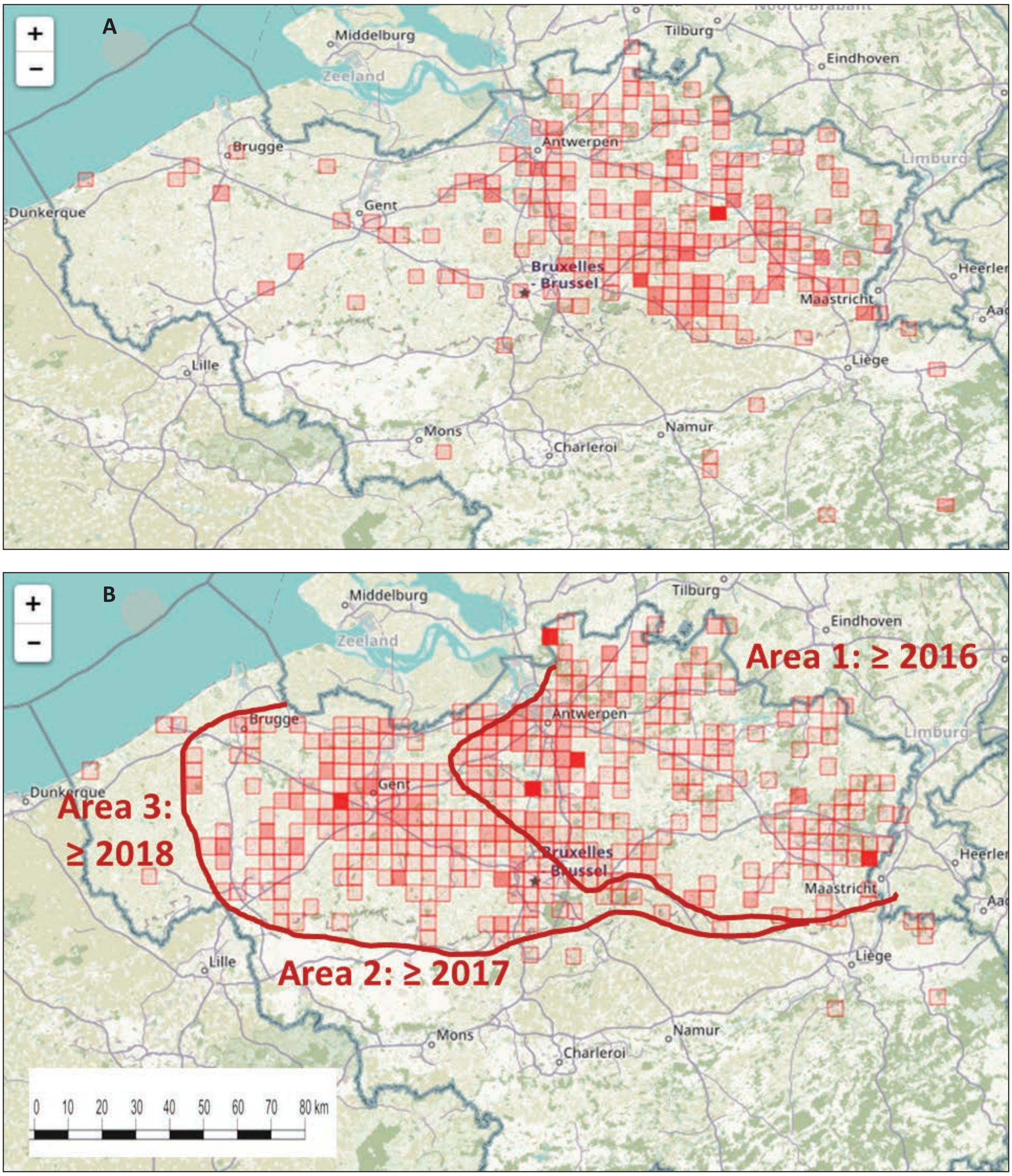

Figure 1. (A) Map of ill and dead Eurasian Blackbirds (*Turdus merula*) reported to the online portal www.waarnemingen.be/www.obervation.be between July and September 2016.
(B) Delineation of the spread of Usuv outbreaks over the years in Flanders based on maps of ill and dead Eurasian Blackbirds (*Turdus merula*) reported to the online portal www.waarnemingen.be/www.obervation.be between July and September each summer. Area 1 affected from 2016 onwards, area 2 from 2017 onwards and area 3 from 2018 onwards.

the values for areas outside and inside the outbreak (Fig. 3). The total difference between the average population change in affected and unaffected areas was added to calculate the "population change contrast": e.g. an average increase of +12% outside and +26% inside results in a contrast of +14, but an increase of +28% outside and a decrease of –64% inside results in a contrast of –92. When populations inside affected areas fared better, the contrast is positive, when they do worse than outside, the contrast is negative.
The CBM surveys in Flanders are randomly stratified for the habitat that is dominant in the km-square grid cell. Habitat of the surveyed cells

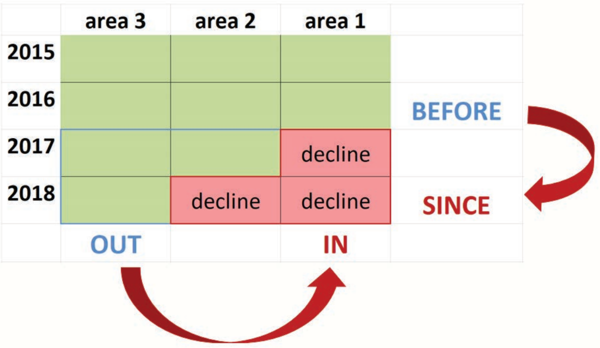

Figure 2. Schematic pattern of outbreak areas and expected effects (if any) on breeding birds compared to years before the outbreaks and areas outside of it. Green=breeding birds unaffected, Red=breeding season following Blackbird mortality in the previous summer.

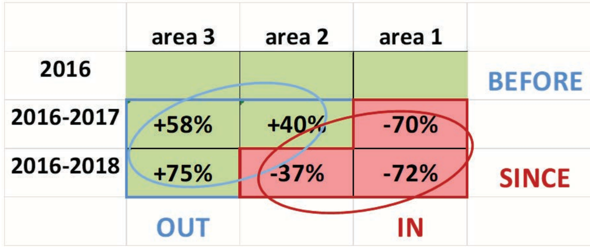

Figure 3. Example for Common Moorhen (*Gallinula chloropus*) of calculation of contrast between the average population change in affected and unaffected areas: first calculation of average population change outside (+57%) and inside (–60%) affected areas, then distance between these two changes (–117).

Table 1. Average population changes (%) outside and inside areas affected by Usutu virus in Flanders (Belgium) 2016–2018 for seven species fitting the pattern in Figure 2.

	outside	inside
Tree Sparrow (*Passer montanus*)	+38%	–85%
Moorhen (*Gallinula chloropus*)	+57%	–60%
Dunnock (*Prunella modularis*)	+28%	–13%
Songthrush (*Turdus philomelos*)	+16%	–19%
Eurasian Blackbird (*Turdus merula*)	+24%	–11%
Northern Wren (*Troglodytes troglodytes*)	+22%	–13%
Mistle Thrush (*Turdus viscivorus*)	–20%	–62%

were selected to belong to one of the six categories: forest, agriculture, suburban, urban, heathland or wetland. Hence, for common species trends can be calculated and compared by habitat (for methods and results about multimput in R, see Onkelinx et al. 2017, Onkelinx & Vermeersch 2019).

Results

Victims reported

The number of dead or ill Blackbirds (excluding road victims) reported to the online portal increased sharply in Flanders from summer 2016 onwards: from an average of 8 (max 11) during July-September each year between 2009–2015 to 396 in 2016, 1202 in 2017 and 397 in 2018. Calls to the public made reports the following week double to quadruple.

Impact on bird populations

Six species out of 60 (see supporting information Table S1 for species list) fitted exactly the expected pattern (Fig. 2), i.e. strongly declining in areas with important mortality of Blackbirds and doing much better in (as yet) unaffected areas (Table 1): Tree Sparrow *(Passer montanus),* Common Moorhen *(Gallinula chloropus),* Dunnock *(Prunella modularis),* Song Thrush *(Turdus philomelos),* Blackbird and Wren *(Troglodytes troglodytes)* (in order of decreasing contrast between affected and unaffected areas). Mistle Thrush *(Turdus viscivorus)* also fitted the pattern, except that it was also declining in unaffected areas, but much less so than in affected ones (Table 1). Not a single species showed the reverse pattern, i.e. consistently doing better in each of the three affected areas of Fig. 2 than in each of the three outside. Other common "species to watch", which showed large negative overall contrasts between affected and unaffected areas and almost fitting the pattern of Fig. 2 (at most one of the six cells at odds) are Northern House Martin (*Delichon urbicum*) (total contrast –68), Grey Partridge (*Perdix perdix*) (–47), Stock Dove (*Columba oenas*) (–41), Common Pheasant (*Phasianus colchicus*) (–37), Eurasian Magpie (*Pica pica*) (–34), Common Kestrel (*Falco tinnunculus*) (–29) and Common Starling (*Sturnus vulgaris*) (–25).

When we plot the total contrast between the average population changes outside and inside affected areas for all 60 species (irrespective whether or not they fit the pattern in Fig. 2), the distribution is shifted to negative values (Fig. 4). 31 species had a total contrast >20 units worse inside than outside (11 species even >50 units worse). Only 17 species did >20 units better inside (8 species >50 units better) than outside affected areas.

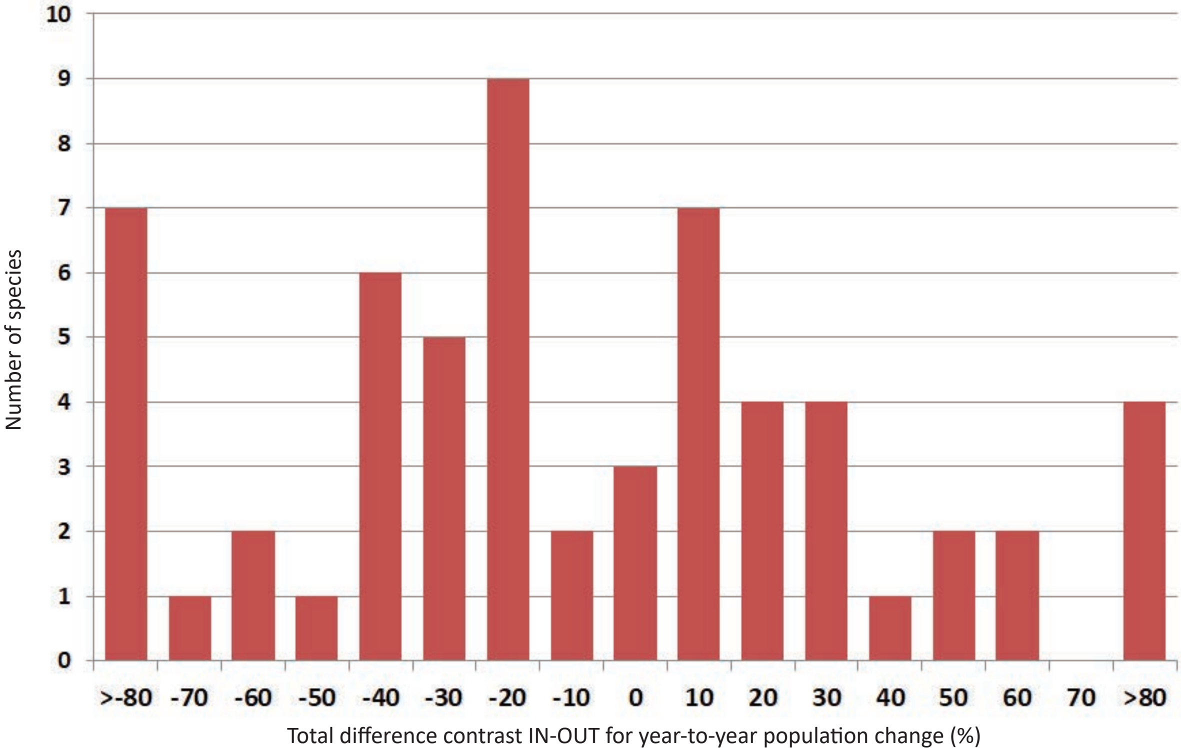

Figure 4. Distribution pattern for 60 species of total contrast between population changes outside *versus* inside areas affected by Usuv: negative values indicate that populations inside fared worse than outside, positive the reverse.

Habitat specific impact

Of the seven species considered very sensitive to Usuv (Table 1), all six with sufficient data showed significantly different trends according to habitat in Flanders, with strong declines recently in squares dominated by (sub)urban, agriculture or wetland, but stable or increasing populations in forest or heathland. Population models for Blackbird e.g. showed significant trends in three habitats, with increases over the last decade of +28% in squares dominated by forest, but declines by –23% in agriculture and –30% in squares dominated by urban areas (Onkelinx & Vermeersch 2019).

Discussion

Virological evidence

When the Usuv epidemy became obvious, virological screening of corpses was undertaken in Belgium by the University of Liège. Analyses of 131 birds of 40 species found dead in 2017–2018 showed 37 birds of 11 species to be positive for Usuv, originating from a wide area of southern Belgium (Benzarti et al. 2019a, Benzarti et al. 2019c), raising fears for impact on bird populations (Garigliany et al. 2017).

Identification of affected areas by citizen science

The density of citizen science bird data is high in Belgium: for Flanders (13,522 square-km), the online portal www.waarnemingen.be received 4.6 million bird records for the years 2016–2018 from ca. 7,000 persons annually. The data flow from Wallonia is about half of that in Flanders — substantially less, but not so low to account on its own for the virtual absence of reported Blackbird mortality. Therefore, the increase in dead and ill Blackbirds reported to the portal during the epizootic emergence of Usuv allowed us to map the boundaries of the outbreak using citizen science reports of dead birds. The same approach has already been used to map an outbreak of the closely related West Nile virus in the US (Eidson et al. 2001).

Impact on bird populations

The seven species listed in Table 1 may be particularly sensitive to Usuv. It is interesting that Blackbird, which has widely been reported as highly sensitive to Usuv, is by far not the worst affected species in this list. Furthermore, the shift towards more negative population changes inside affected areas in more than halve the species suggests that Usuv might have more widespread negative effects on bird populations, well beyond Blackbirds and a handful of other very sensitive species.

Owls, some songbirds (e.g. Turdidae, Corvidae) and woodpeckers have been found to be particularly affected by Usuv (Becker et al. 2012, Bosch et al. 2012, Nikolay 2015, Rijks et al. 2016, Benzarti et al. 2019b). We did not include any owls in this screening, and none of the three woodpeckers investigated had population trends worse inside than outside affected areas, but Eurasian Magpie declined inside while increasing outside. Among small passerines, House Sparrow (*Passer domesticus*) and Blackcap (*Sylvia atricapilla*) were reported to have a high percentage of positive cases for Usuv (Bosch et al. 2012, Nikolay 2015, Benzarti et al. 2019b). Population changes in both species were indeed also far worse inside affected areas in our study than outside, but the patterns of decline were not consistent with the advancing Usuv-front according to Blackbird mortality.

That raises the question, however, whether or not all species are necessarily affected in the same way and synchronously with Blackbirds? There may be different scenarios for an epizootic outbreak of Usuv, simplified: (1) when Usuv arrives in an area, it may affect all the sensitive species synchronously, as exemplified by mass mortality of Blackbirds, or (2) when Usuv arrives in an area, it may mostly remain unnoticed and may or may not affect individuals and populations depending on many local conditions (habitat, vectors, temperature, rainfall, host density, direct transmission?). Mortality of several species can be local and undiscovered until at some moment conditions are right for a large scale epizootic outbreak in a more common species like Blackbird. Blackbirds are so common in most parts of Europe and live so conspicuously close to people that mass mortality becomes a prominent and easily noted event when it happens in this species.

There is evidence that the second scenario applies more than the first. In Germany, Italy and Belgium, Usuv was already diagnosed before a large epizootic emergence occurred, or outside regions where elevated mortality was recorded (Jöst et al. 2011, Salvini et al. 2011, Garigliany et al. 2014). Many healthy birds (including Blackbirds) have been found carrying Usuv (Benzarti et al. 2019b, de Jong 2019). Outbreaks seem to coincide with particularly wet and warm conditions in spring and summer: enhanced mosquito (vector) and virus cycles under these conditions increase the risk for an outbreak (Rubel et al. 2008, Becker et al. 2012, Rijks et al. 2016). This also means that climate disruption (particularly warming (Brugger & Rubel 2009), but also excessive rainfall) constitutes an extra risk for Usuv outbreaks.

Usuv was first discovered in Belgium in 2012, but a large scale outbreak only happened from 2016 onwards. What was peculiar then in 2016 and afterwards? Rainfall in June was more than two times higher than the average value in the north-eastern part of Flanders (KMI url 1), closely coinciding with the area of mortality of Blackbirds later that summer. Rainfall remained high in that area throughout summer (KMI url 2). September 2016 was the hottest in Belgium since 2006 (KMI url 3) and the summers of 2017 and 2018 were both exceptionally hot (KMI url 4). The habitat specific trends in Blackbird further indicate that particular conditions in (sub)urban areas and in the agricultural landscape were favourable for the local outbreak. The urban heat effect and the larger areas of artificial substrates retaining shallow and fast warming water in these habitats may have played a key role. Blackbird population trends in cooler forested areas are not affected. This is supported by the records from the Netherlands, where survival rates of urban Blackbirds have become lower than in the countryside since the outbreak of Usuv (de Jong 2019).

Usuv risks can quite well be modelled, and unusually warm temperatures are an important predictor (Brugger & Rubel 2009, Cadar et al. 2016, Lühken et al. 2017, Walter et al. 2018). In all these models, the cooler, more forested higher areas in southern Belgium (most of Wallonia), which are also less suitable for mosquitoes (Versteirt et al. 2009), have a much lower risk for Usuv. The patterns of the recent outbreaks in Belgium fit these risk models very well, with no mass mortality reported from these areas so far and no detectable impact on bird populations.

Available evidence therefore indicates that:

- Usuv is more widespread in Europe than epizootic emergences and documented mass mortality in birds indicate
- Usuv does not primarily affect Blackbirds; it affects many species, also at population level, and some do far worse than Blackbirds
- massive outbreaks in Blackbirds happen under specific, local (micro)climatic conditions,

where particularly urban and agriculture areas and wetlands are at risk.
- mortality of other sensitive species does therefore not necessarily coincide with mortality of Blackbirds. Mass mortality may also happen unnoticed.

With this paper and the formulated hypotheses, we want to stimulate more detailed research on the impact of Usuv on bird populations (also beyond Blackbirds).

Acknowledgements

We are particularly grateful to all the volunteers that conduct the common bird monitoring and to the public for helping to map Blackbird mortality.

Supporting information

Table S1. List of all 60 screened species with sufficient data (names follow Handbook of the Birds of the World).

Grey Partridge	*Perdix perdix*	Common Chiffchaff	*Phylloscopus collybita*
Common Pheasant	*Phasianus colchicus*	Long-tailed Tit	*Aegithalos caudatus*
Canada goose	*Branta canadensis*	Eurasian Blackcap	*Sylvia atricapilla*
Egyptian goose	*Alopochen aegyptiaca*	Garden Warbler	*Sylvia borin*
Mallard	*Anas platyrhynchos*	Common Whitethroat	*Sylvia communis*
Stock Dove	*Columba oenas*	Short-toed Treecreeper	*Certhia brachydactyla*
Common Wood-Pigeon	*Columba palumbus*	Eurasian Nuthatch	*Sitta europaea*
Eurasian Collared-Dove	*Streptopelia decaocto*	Northern Wren	*Troglodytes troglodytes*
Common Moorhen	*Gallinula chloropus*	Common Starling	*Sturnus vulgaris*
Common Coot	*Fulica atra*	Mistle Thrush	*Turdus viscivorus*
Northern Lapwing	*Vanellus vanellus*	Songthrush	*Turdus philomelos*
Eurasian Buzzard	*Buteo buteo*	Eurasian Blackbird	*Turdus merula*
Great Spotted Woodpecker	*Dendrocopos major*	European Robin	*Erithacus rubecula*
Eurasian Green Woodpecker	*Picus viridis*	Bluethroat	*Luscinia svecica*
Black Woodpecker	*Driocopus martius*	Black Redstart	*Phoenicurus ochruros*
Common Kestrel	*Falco tinnunculus*	Common Stonechat	*Saxicola torquatus*
Eurasian Magpie	*Pica pica*	Goldcrest	*Regulus regulus*
Eurasian Jay	*Garrulus glandarius*	Dunnock	*Prunella modularis*
Eurasian Jackdaw	*Corvus monedula*	House Sparrow	*Passer domesticus*
Carrion Crow	*Corvus corone*	Eurasian Tree Sparrow	*Passer montanus*
Coal Tit	*Peripatus ater*	Tree Pipit	*Anthus trivialis*
Crested Tit	*Lophophanes cristatus*	Meadow Pipit	*Anthus pratensis*
Eurasian Blue Tit	*Cyanistes caeruleus*	Western Yellow Wagtail	*Motacilla flava*
Great Tit	*Parus major*	White Wagtail	*Motacilla alba*
Wood Lark	*Lullula arborea*	Common Chaffinch	*Frincilla coelebs*
Eurasian Skylark	*Alauda arvensis*	European Greenfinch	*Chloris chloris*
Common Reed Warbler	*Acrocephalus scirpaceus*	Common Linnet	*Linaria canabina*
Northern House Martin	*Delichon urbicum*	European Goldfinch	*Carduelis carduelis*
Barn Swallow	*Hirundo rustica*	Yellowhammer	*Emberiza citrinella*
Willow Warbler	*Phylloscopus trochilus*	Reed bunting	*Emberiza schoeniclus*

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The State and Conservation of Cinereous Vulture, *Aegypius monachus* (Linnaeus, 1766) in Armenia

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Abstract. The study of Cinereous Vulture *Aegypius monachus* in Armenia implemented in 2003–2019 showed that the species breeds mainly in the Khosrov Forest State Reserve. Its breeding population was between 12 to 14 breeding pairs, and the number of non-breeding individuals was estimated as 3–7 occurring in the country per year. The Area of Occupancy for the species was 456 km^2, and the Extent of Occurrence was 15,695 km^2. The population trend has shown a moderate increase (*Additive* = 0.0465 ± 0.0164, *Multiplicative* = 1.0476 ± 0.0172, $p < 0.01$). The overall increase of the population was 110% from 2003 to 2019 (16 years), averaging 6.45% per year. The threats for the species are poaching, shortage of food supply, poisoning by heavy metals at municipal dumps, lead poisoning from the bullets, poisoning by non-steroidal anti-inflammatory drugs (NSAIDs) which come from livestock husbandry, and forest fire. The proposed conservation measures include: (1) review of the policy of punishments for poaching the species and strengthening inspection; (2) increasing the network of the citizen scientists, who can advocate against poaching; (3) study of the potential poisoning of the species by heavy metals and NSAIDs; (4) development of sustainable artificial feeding stations; (5) strengthening capacity of Khosrov Reserve by setting up the fire early warning and fighting systems; (6) continuous monitoring of the species and reassessment of its conservation status in 2025.

Introduction

There are four species of Old World Vultures inhabiting Armenia (Adamyan and Klem 1999, Cramp and Perrins 1993). Among them is the Cinereous Vulture *Aegypius monachus*, which is currently listed in the IUCN Red List as Near Threatened. This monotypic species breeds in Spain, Bulgaria, Greece, Turkey, Armenia, Azerbaijan, Georgia, Ukraine, Russia, Uzbekistan, Kazakhstan, Tajikistan, Turkmenistan, Kyrgyzstan, Iran, Afghanistan, north India, northern Pakistan, Mongolia and mainland China, with a small reintroduced population in France (BirdLife International 2018, Cramp and Perrins 1993, Meyburg *et al*. 2020). In Armenia the Cinereous Vulture is a year-round resident, although it conducts some local movements in winter. This largest raptor of Armenia makes its huge nests (1.5–2 meters across) mainly on Juniper *Juniperus* spp. trees (Adamian and Klem 1999). The incubation period begins in late February to March, when the female lays one egg. The nestlings hatch in April to May and stay in the nest throughout the hot summer; that is why the adult often protects the nestling from overheating by creating shade with its open wings. The fledglings leave the nest in late August – early September (Adamian and Klem 1999, Geilikman 1965). The Cinereous Vulture was identified as the most vulnerable vulture species in Armenia, as its breeding population was significantly reduced after collapse of Soviet Union, due to the decline in its food supply and the poaching of adult birds for trophy hunting and nestlings for a wildlife trade (Aghababian *et al*. 2004). Several projects of various State and Non-governmental organizations were aimed at the conservation of the Cinereous Vulture's population in Armenia (IUCN 2013); however, publications on a current state of the species in Armenia are scarce. This paper is aimed at describing the modern conditions of the Cinereous Vulture in the country, including threats and existing and needed conservation measures, which can be a foundation for assessment of its conservation status.

Figure 1. The breeding habitat of the Cinereous Vulture *Aegypius monachus* in the Khosrov Forest State Reserve. Photo by Karen Aghababyan

Materials and methods

The systematic data collection on the species started in 2003. Monitoring was implemented by absolute counts of breeding pairs through locating occupied nests annually over the period from 2003 to 2019. Nests were searched for in the period of late March to early May, when one of the adults is permanently incubating or guarding the downy nestling. After the first inventory, conducted in 2003, 8–12 days per annum were spent monitoring known nests and searching for possible new ones. In addition, road-side vehicular surveys were implemented aimed at identification of number of non-breeding individuals.

To calculate population trends, we used multi-year data series and processed them using TRIM 3.0 software (Van Strien *et al*. 2004). For the purpose the Collated Index is calculated using log-linear poison regression; then the deviations are calculated and presented as a linear function, showing population growth or decline. Statistically significant change is stated on the $p < 0.05$ level, otherwise the population is considered stable. The mapping was implemented using QGIS 3.30.2 software. The Area of species occupancy (AOO) and the Extent of species occurrence (EOO) for the Cinereous Vulture were computed using the IUCN guidelines (IUCN Standards and Petitions Committee 2024). To calculate the AOO, we applied a national 2×2 km grid (BirdLinks 2019) and summed up all the 2×2 km cells where the adult birds were observed in the breeding season. To compute the EOO, the rule of minimum convex polygons (the smallest polygon in which no internal angle exceeds 180° and which contains all the sites of occurrence) was applied to the species' AOO, excluding discontinuities and disjunctions within the overall distribution inside the borders of the country. To assess threats, we conducted surveys of hunters, and of main online and offline market places where the mounted specimens of raptors are sold; also, we conducted questionnaires with farmers and veterinarians.

Results

Distribution and some biological peculiarities in Armenia

In Armenia Cinereous Vultures was found breeding mainly in Khosrov Forest State Reserve, occupying mainly juniper woodland (Figure 1 & 2) at an elevation range from 1,000 to about 2,000 m a.s.l. The species was recorded forming loose colonies, where the nests can be located as close to each other as 300–500 metres or even closer. The same nest was observed being used for several

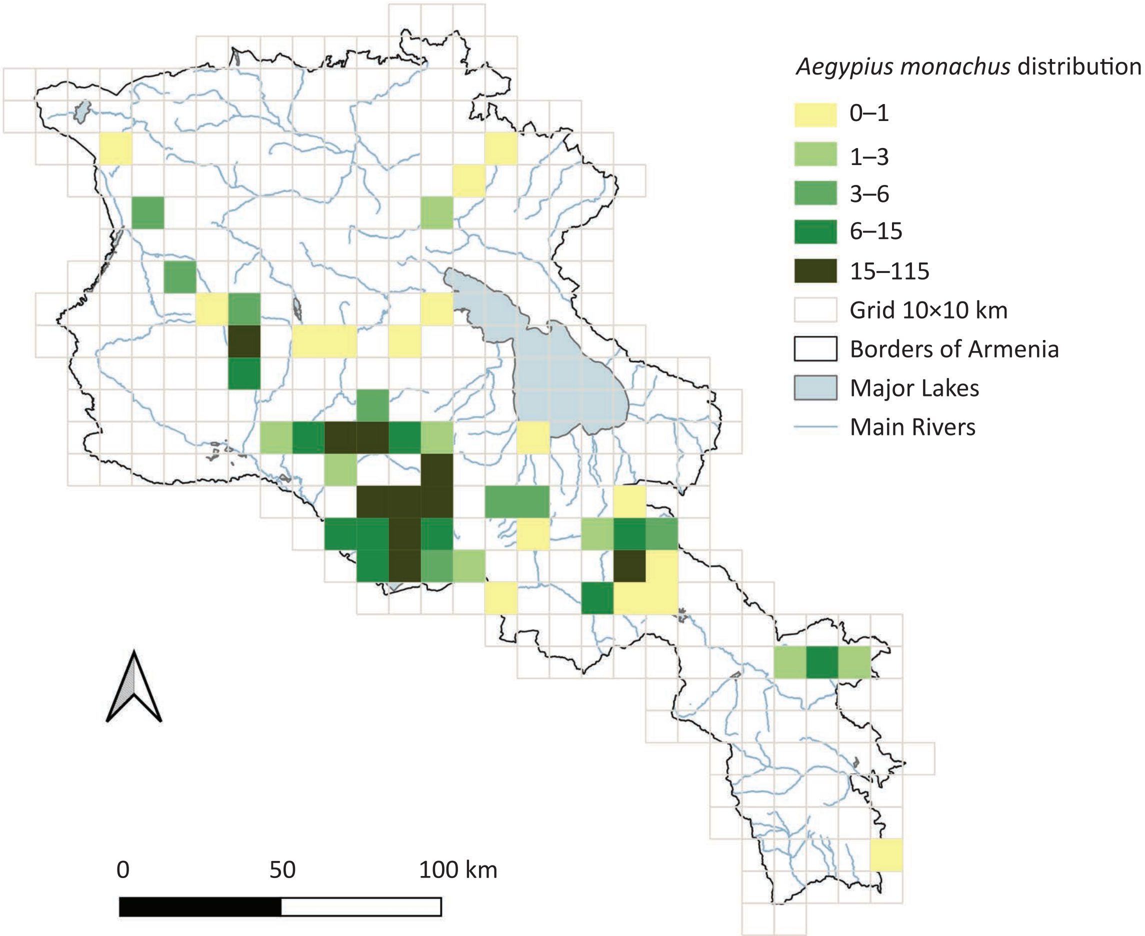

Figure 2. Breeding distribution of the Cinereous Vulture *Aegypius monachus* in Armenia. The standard European grid of 10×10 km (outlined with pale grey) is applied to Armenia. The filled squares indicate the records of the species summed from counts throughout the period of 2003–2019; darker colours indicate higher summed counts.

years in the absence of disturbance. In Armenia Cinereous Vultures were observed feeding on large-size carrion; also, the adult vultures were observed flying from Khosrov Reserve to Turkey in the morning, apparently searching for food. The AOO for the species was 456 km^2, and the EOO was 15,695 km^2.

Population dynamics

According to the most recent counts, the population of the species is between 12 to 14 breeding pairs; the number of non-breeding individuals observed in Armenia is 3–7 birds per year. The population trend during 2003–2019 demonstrated a moderate increase (*Additive* = 0.0465 ± 0.0164, *Multiplicative* = 1.0476 ± 0.0172, $p < 0.01$). The overall increase of the population computed from a linear trend (Figure 3) was 110% in 16 years, averaging 6.45% per year. In 2003–2005, there were 2–5 nestlings stolen from nests for sale per year, but no such cases were reported in 2016–2018. The recorded cases of poaching were 0–2 birds per year during 2016–2019.

Present conservation measures

At current the only breeding sites of the species that are covered by the National special protected area network are located in Khosrov Forest State Reserve, which is also a candidate Emerald Site. The species is included in IUCN Red List as Near Threatened (BirdLife International 2018), in Red Book of Animals of Armenia (Aghasyan & Kalashyan 2010) as Endangered (EN D), and in Annex II of the Bern Convention. The species is included in the Multi-species Action Plan to Conserve African-Eurasian Vultures, prepared under Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia of Convention on Migratory Species (Botha *et al*. 2017), and Armenia is a range state of that MoU.

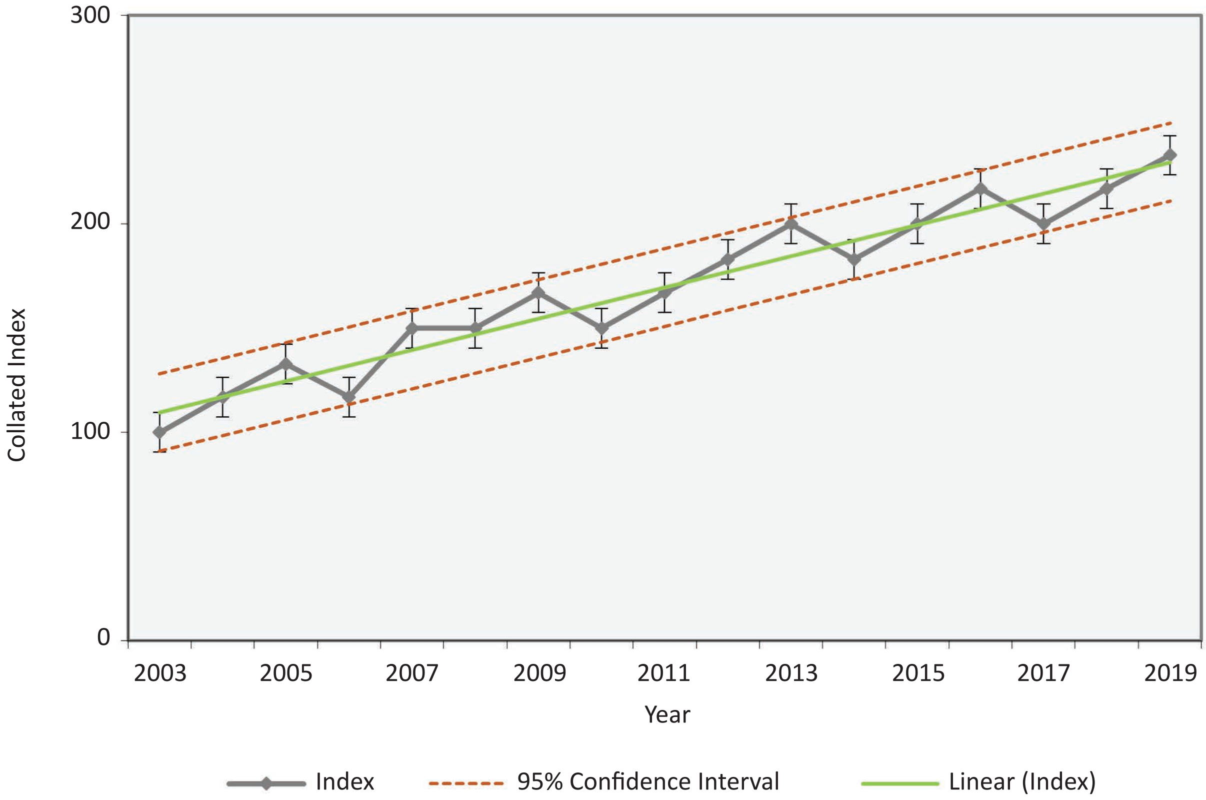

Figure 3. Population trend of the Cinereous Vulture *Aegypius monachus* in 2003–2019. The grey lines indicate observed population index throughout the years. The green line indicates a linear population trend. The orange dotted lines indicate a 95% confidence interval.

Discussions

Causes of observed population trend

The increasing population trend could be driven by several factors such as supplemental feeding by several conservation organizations and cessation of illegal nestling harvesting.

One of the most significant threats of early 2000s — the theft of nestlings from the nest for selling (Aghababian *et al.* 2004) — is over, mainly due to strengthening of protection regime in Khosrov Forest State Reserve. However, at present, the breeding and non-breeding individuals are still affected by direct persecution for trophies. The shortage of food was a critical issue and apparently affected the population of the species throughout 1980s to early 2000s. The species is known for its long-distance foraging areas (Moreno-Opo *et al*. 2010); thus, during breeding seasons of 2010–2019 the birds of Khosrov Reserve were observed flying to Turkey, most probably to search for food. This is likely to have caused the major population decline from about 50 pairs down to 7–8. Currently, the supplemental food that was coming from slaughter houses is still not available. There is a positive dynamic in population of some wild ungulates, e.g. the Bezoar Goat *Capra aegagrus aegagrus* (WWF Armenia, personal communication), and time to time the conservation organizations provide additional feeding, with the result that the food supply is improving.

Other possible threats come from potential poisoning by (1) heavy metals at municipal dumps, where batteries, mobile phones and other devises are disposed together with the food remains; (2) lead poisoning from the bullets; (3) poisoning by non-steroidal anti-inflammatory drugs (NSAIDs) which come from livestock husbandry. Recently, a new threat emerged — forest fire, which has not occurred in the Khosrov Reserve in past, happened in 2017 and destroyed over 3,000 hectares of habitats, including juniper woodland. Since the nestlings of the Cinereous Vulture fledge in August (the most dangerous period for fire), large-scale fires can affect the breeding success of the entire population.

Proposed conservation measures

The proposed conservation measures include: (1) reviewing the policy of punishments for poaching the species and strengthening inspection; (2) increasing the network of citizen scientists, who can advocate against poaching; (3) studying the potential poisoning of the species by heavy metals and NSAIDs; (4) development of sustainable artificial feeding stations; (5) strengthening the capacity of Khosrov Reserve with the establishment of fire early warning and fighting systems; and (6) continuous monitoring of the species for reassessment of its conservation status in 2025.

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Introducing the EBCC board: Aleksi Lehikoinen

Mark Eaton

What is your title and the current working position?

I am senior curator at the Finnish Museum of Natural History, University of Helsinki. My duties include coordination of the bird monitoring schemes in Finland and lead my own research group, the Helsinki Lab of Ornithology: https://www.helsinki.fi/en/researchgroups/helsinki-lab-of-ornithology I am also leading the national bird expert group which is doing e.g. the national red listing of birds and work as a member of the Finnish IBPES panel, which gathers research data on biodiversity for use by decision-makers, experts and citizens.

What are your main research interests and projects at the moment?

My main research interests are how anthropogenic changes, especially climate change and human land use, are affecting biodiversity using birds as a study taxon. I have used large-scale long-term monitoring data, including EBCC and EURING data, in many projects. The current research projects include European bird monitoring data to investigate e.g. the (i) avian responses on habitat loss and fragmentation, (ii) altitudinal shifts of bird populations in European mountain areas, (iii) role of survival and productivity on population dynamics of European passerines, (iv) how reliable the species distribution models are for predicting future population changes, (v) cumulative effects of climate change on bird populations, (vi) habitat selection of declining hunted bird species for restoration and (vii) how to do protected area prioritisation to meet the European Biodiversity Strategy targets.

What is your current role in the EBCC?

My main responsibility in the EBCC board is to advance the research related to EBCC projects. This includes creating connections with researchers and enhancing funding applications for research purposes. I am also leading the newly established EBCC acoustic monitoring group (AMOG) and chairing the scientific committee of the EBCC Bird Numbers conference in Riga.

Tell us a bit about your involvement at Hanko Bird Observatory, and what is so special about the place and the work there.

I was the manager of the Hanko Bird Observatory during 2000-2017. I started when I was a MSc student in biology at the University of Helsinki and used the long-term monitoring data started on 1979 in my MSc and PhD theses. Overall, I have spent over 1100 days at the observatory as a volunteer observer. The specialties of observatory are autumn irruptions of boreal species, such as woodpeckers, owls and tits. Some memorable moments include e.g. 58 migrating black woodpeckers (18 ringed), a night with 39 trapped owls (4 species) and over 26 000 migrating coal tits during a single morning. The activities of observatory have increased substantially during past years and currently in addition to the standardized monitoring routines (migration counts, breeding surveys and ringing), the observatory is also providing nature education, guided tours and works as an important site for training young birders on the national level. The collected data is freely available for research purposes through the web-page of the observatory (halias.fi). I also use regularly the data of the observatory with my MSc and PhD students.

Do you still manage to take part in fieldwork, and if so, what do you do?

I try to participate every year in surveys of the long-term monitoring schemes including four winter bird count routes and line transects and waterbird surveys during the breeding season. Regular fieldwork is stimulating and gives new ideas for research and it is great fun too!

Tell us something about your interests away from birds and ornithology… perhaps about your snow sculptures, which some attendees at the last EBCC conference will have seen?

I have had a hobby of making snow sculptures for more than ten years. It has been an interesting learning process of snow structure and different techniques, but I have also learned a lot about photographing and art in general. I use sometimes photos of the sculptures in science communication. Snow sculptures are visible at instagram account @marathanskat.

Your text in the next issue?

Bird Census News is meant as a forum for everybody involved in bird census, monitoring and atlas studies. Therefore we invite you to use it for publishing articles and short reviews on your own activities within this field such as (preliminary) results of a regional or national atlas or a monitoring scheme, species-specific inventories, reviews or activity news of your country (as a delegate: see also below).

Instructions to authors

– Text in MS-Word.
– Author name should be with full first name. Add address and email address.
– Add short abstract (max 100 words).
– Figures, pictures and tables should not be incorporated in the text but attached as separate files.
– Provide illustrations and figures both in colour.
– The length of the papers is not fixed but should preferably not exceed more than 15 pages A4 (including tables and figures), font size 12 pt, line spacing single (figures and tables included).
– Authors will receive proofs that must be corrected and returned as soon as possible.
– Authors will receive a pdf-file of their paper.
– References in the text: Aunins (2009), Barova (1990a, 2003), Gregory & Foppen (1999), Flade et al. (2006), (Chylarecki 2008), (Buckland, Anderson & Laake 2001).
– References in the list: Gregory, R.D. & Greenwood, J.J.D. (2008). Counting common birds. In: A Best Practice Guide for Wild Bird Monitoring Schemes (eds. P. Voříšek, A. Klvaňová, S. Wotton & R.D. Gregory), CSO/RSPB, Czech Republic; Herrando, S., Brotons, L., Estrada, J. & V, Pedrocchi, V. 2008. The Catalan Common bird survey (SOCC): a tool to estimate species population numbers. Revista Catalana d'Ornitología, 24: 138–146.

Send contributions in digital format by email to: dimitrije.radisic@dbe.uns.ac.rs