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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.

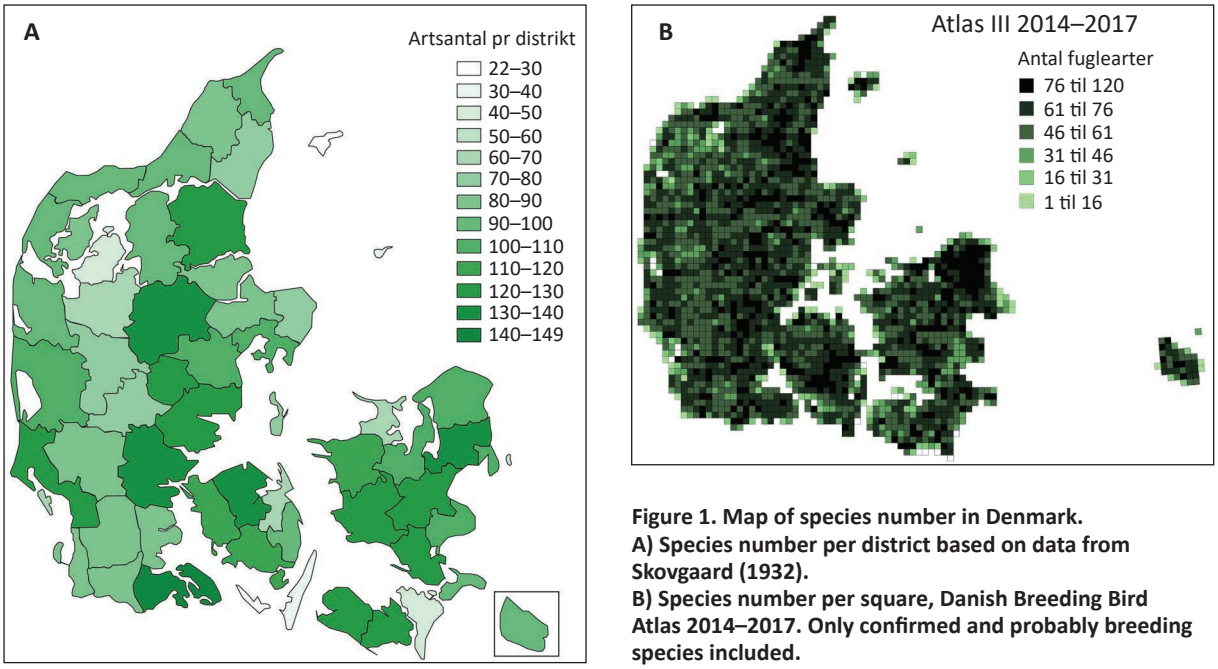

Figure 1. Map of species number in Denmark.
A) Species number per district based on data from Skovgaard (1932).
B) Species number per square, Danish Breeding Bird Atlas 2014–2017. Only confirmed and probably breeding species included.

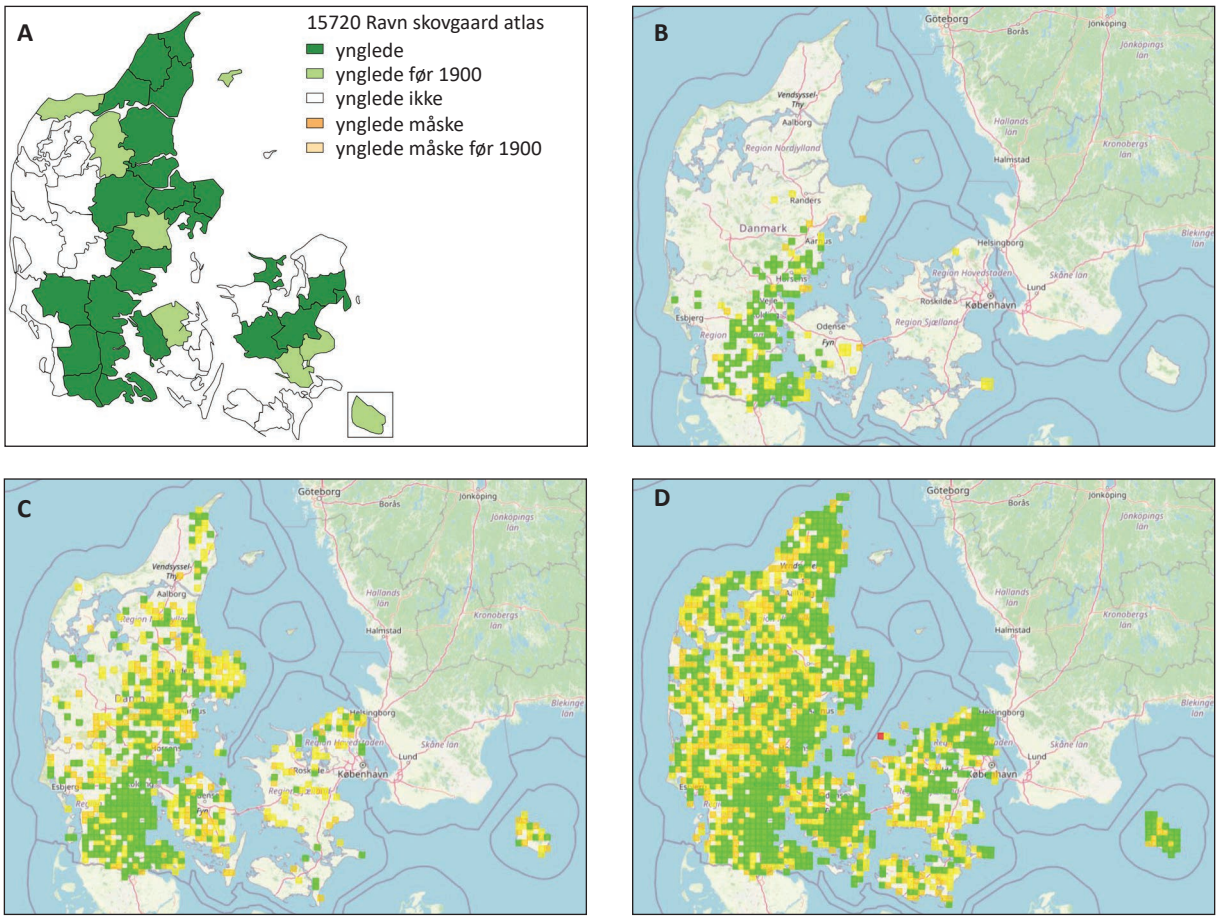

Figure 2. Distribution of the Common Raven (*Corvus corax*) in Denmark.
A) Map based on the description by Skovgaard 1932. Dark green is breeding, light green is breeding before 1900 and white is not breeding.
B) Atlas I, 1971–1974.
C) Atlas II, 1993–1996.
D) Atlas III, 2014–2017. Green is certainly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

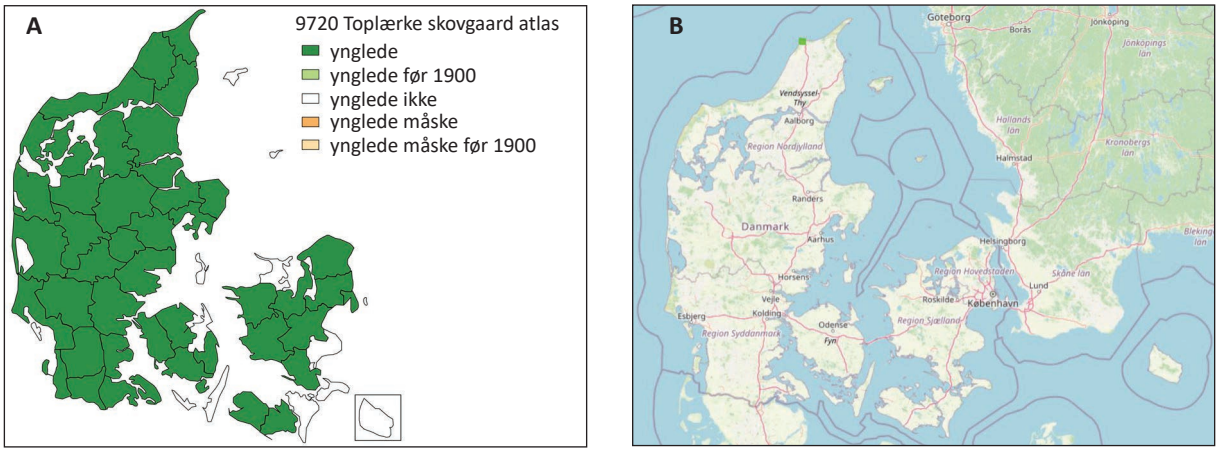

Figure 3. Distribution of the Crested Lark (*Galerida cristata*).
A) Map based on the description by Skovgaard (1932). Dark green is breeding, light green is breeding before 1900 and white is not breeding.
B) Map from Atlas III, 2014–2017. Green is certanly breeding.

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

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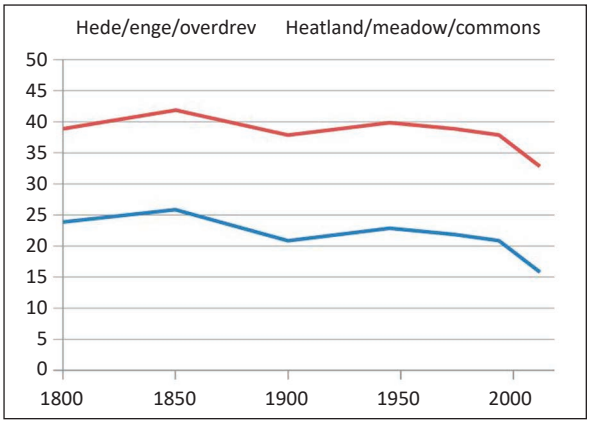

Figure 4. Development of breeding birds in open land 1800–2012 (from Romdal et al. 2013).
Red curve: Species in both their primary and secondary habitat.
Blue curve: Species in their primary habitat.

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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