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Population trends in boreal birds: Continuing declines in agricultural, northern, and long-distance migrant species

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ABSTRACT

When many environmental changes take place simultaneously, one of the first challenges for conservation efforts is to identify the species and environments that are in the most need of conservation measures. We studied whether there are differences in the population growth trends of 94 boreal bird species according to their migration strategies, breeding distributions (northern or southern), or breeding habitats. To this end, we examined recent trends in bird census data covering >1000 km along a north–south transect in Finland, from the deciduous forests on the southern coast through the boreal taiga forest to the alpine fell area in the north. Our results show that long-distance migrants (species wintering in western or eastern Africa or Asia), northern species, and species living in agricultural environments are in decline in north-eastern Europe. The results were the same for both the long-term (27 years; 1986–2012) and the short-term (12 years, the most recent reporting period of the EU bird directive; 2001–2012) data set. Additionally, species breeding mainly in urban/sub-urban environments, coniferous forests, or wetlands showed negative growth trends, especially over the short-term. These results provide updated information that can be used to determine the targets of conservation efforts focused on Northern Palaearctic birds. Several different conservation measures may be needed to help these populations, ranging from protecting habitat in the migration and wintering grounds to changing climate and agricultural policies at a national and/or international level. In addition, further research is needed to identify the particular mechanisms underlying the population trends.

1. Introduction

Environments around the world are changing at an unprecedented pace due to changes in climate and land use, leading to declines in several taxa (Butchart et al., 2010; Fahrig, 2003; Hanski et al., 1995; Jetz et al., 2007; Stuart et al., 2004; Thomas et al., 2004). Because a number of these changes are taking place simultaneously across different areas and environments, one of the first challenges in designing conservation programs is to identify the populations and environments that are most in need of conservation measures.

In birds, habitat reduction and change have resulted in population declines in many species (Birdlife International, 2010). This is particularly true for tropical species that are predicted to face further dramatic population declines and extinctions in the near future (reviewed by Sekercioglu et al., 2012; Sodhi et al., 2004). However, species outside the tropics have also been experiencing continuous habitat change. For example, in Europe, a widespread decline in farmland birds has been documented as a result of increasingly intensive agricultural practices (e.g., Butler et al., 2010; Donald et al., 2001, 2006), and a number of studies have raised concerns over the effects of forest management on birds (e.g., Angelstam et al., 2004; Gregory et al., 2007).

Climate change is also affecting bird populations in many different ways (Sæther and Engen, 2010). In the temperate and boreal zones, climate change may be disproportionately threatening species with northern distributions, which appear to be in decline, while the populations of those with primarily southern distributions seem to be increasing (Virkkala and Rajasärkkä, 2011a,b). These findings concur with the observation that northern species are retracting the southern limit of their ranges at the same time as southern species appear to be expanding their distributions northwards (Brommer et al., 2012; Kujala et al., 2013, 2011; Virkkala and Rajasärkkä, 2011b). These changes may be due to differences in the thermal tolerances of species (Jiguet et al., 2010), and they are predicted to continue (Barbet-Massin et al., 2012).

A number of recent studies have indicated that particularly the breeding populations of long-distance migrant birds are in decline

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(Böhning-Gaese and Bauer, 1996; Both et al., 2010; Gregory et al., 2007; Heldbjerg and Fox, 2008; Hewson et al., 2007; Holmes and Sherry, 2001; Ockendon et al., 2012; Reif et al., 2011; Sanderson et al., 2006). The causes of these recent declines are likely to be found either along their migration routes or on their wintering grounds; recent evidence indicates that, in particular, mortality during migration may be a major demographic factor affecting population dynamics (reviewed by Faaborg et al., 2010; Holmes, 2007; Newton, 2008).

We analyzed whether there are differences in the population growth trends of common boreal birds that are due to differences in their wintering areas, breeding distributions (northern or southern), or breeding habitats. The studies cited above have mainly focused on western and central European bird populations, while the population trends in the boreal zone of northern Europe have been examined in less detail. Our study, focusing on the whole of Finland, aims to increase the depth of current scientific knowledge in this area. The region studied here extends more than 1000 km in a north–south direction, from the deciduous/mixed forest belt on the southern coast through the boreal taiga forest to the alpine fell area in the north (Fig. 1). This area has undergone major habitat changes due to intensive forestry operations (Kuuluvainen, 2009) and agricultural use (Pitkänen and Tiainen, 2001), both of which are ongoing processes affecting birds in Finland (Pitkänen and Tiainen, 2001; Virkkala, 1991, 2004). The area includes species specific to the north and the south, respectively, as well as widespread species that occur throughout the entire area. The breeding fauna of this area is furthermore a mixture of western and eastern fauna; it includes several species that migrate to southern Asia or follow an eastern route to eastern Africa, as well as species that migrate to Africa through western Europe.

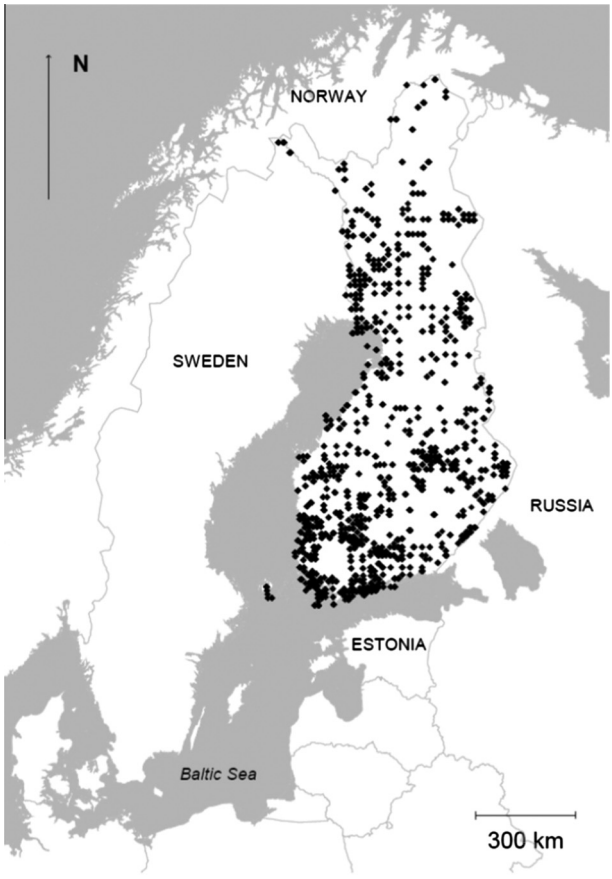

Fig. 1. Map showing the study area (Finland) in north-eastern Europe. The symbols show the locations of the point count routes and transect lines where counts took place from 1986 to 2012.

By simultaneously analyzing variation in population trends associated with breeding habitat, latitudinal distribution, and wintering area, we were able to identify potential targets for current conservation efforts. Furthermore, we examined whether there have been recent changes in these trends by examining both long-term (27 years) and short-term data sets (12 years, the most recent reporting period of the European Union bird directive). We wish to note that our main aim was not to identify conservation needs at the level of individual species but to identify breeding habitats or wintering/migration areas in need of particular attention because of alarming trends seen in the general bird populations found in those areas.

2. Methods

2.1. Census data

The data were collected from 1986 to 2012 using single-visit line transects and point-count routes that were conducted during the breeding season. Line-transect counts were performed from June 1 to 17 in south-central Finland and from June 10 to 30 in northern Finland; point counts were performed from May 20 to June 20 in south-central Finland and from May 30 to June 30 in northern Finland. Only routes surveyed at least twice were included in the study. Surveys were conducted from 04:00 to 09:00, which is when the birds were most active, and on days when weather conditions were not windy or rainy (see http://www.luomus.fi/seurannat/methods.htm for details of the survey methodology). During line-transect surveys, birds were counted along line transects that were up to 6 km long; we employed an average walking speed of 45–60 min per km depending on bird density (Koskimies and Väisänen, 1991; Lehikoinen, 2013). The distance to each observed bird was estimated to be in one of two distance belts: birds were either within 25 m of the transect or outside of that range. During point counts, birds were counted for 5 min from predetermined fixed stations that were located in uniform habitats within 50 m of the station. Birds were recorded as being either within or outside a 50-m-radius circle from the station. Each point-count route consisted of 20 stations, and stations were at least 250 m apart in forested habitats and 350 m apart in open habitats. In both census types, all land bird species known to be in Finland were surveyed.

Annually, an average of 135 (min. 59; max. 249) line transects and 53 (min. 33; max. 116) point-count routes were counted. The transects covered most of the country (Fig. 1), and there have been no long-term changes in either the annual latitude coordinates of the line-transect sites or in the annual mean census date (Lehikoinen, 2013). The data were converted to numbers of breeding pairs (as explained in detail in Koskimies and Väisänen, 1991; Lehikoinen, 2013).

The raw data set included observations from 221 species. We decided *a priori* to consider in the analyses only species for which there were on average five or more observations each year, in order to avoid potentially spurious results resulting from observations of species that were rarely observed in the censuses (not only rare species but species with low abundance or detectability, such as birds of prey). The decision to set the limit to five observations was arbitrary, but as it was made *a priori*, it was thus blind to the results. Moreover, it was a requirement of the time-dependent statistical model (see below) that each species included in the analysis be observed at least once each year. As a result of these restrictions, our analysis of population trends was limited to 94 land bird species (no waterbirds were included; see appendix for the species list).