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Population trends for Swedish breeding birds

Populationstrender för fåglar som häckar i Sverige

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Abstract

We have assessed the population trends for the 255 bird species breeding in Sweden (including distinct subspecies), based on data for the last 30 and 10 years, respectively. Over the past 30 years more species have decreased (38%) than increased (32%) in numbers. In particular, formerly common farmland species have fared poorly but this is also true for some forest species. Over the past 10 years there are more species with increasing trends (29%) than there are species with decreasing trends (19%). Trends for several species in long-term decline have levelled off and have in some cases even started to increase. It is not known whether this recent change is a result of conservation efforts or simply that population numbers have stabilised at lower levels now permitted by the environment. It is therefore essential to initiate research devoted to finding factors directly linked to ongoing population changes, particularly for species in long-term decline. To cover population trends for all Swedish species additional monitoring programmes are needed, in particular on owls and in mountain habitats.

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Introduction

Biodiversity has been on the international political agenda for some time. The UN has adopted an important goal, that is, to clearly reduce the loss of biodiversity by 2010 at the latest. The same goal was also adopted by the EU member states in Gothenburg in 2001. For Sweden's part, the goal has been expressed as: "the loss of biodiversity should have been halted by 2010 at the latest".

We know that biodiversity is declining in Sweden, but there is no quantitative information on the trends for many species. In many ways birds are suitable indicators of the state of the environment, since they are better known and have been studied in greater detail than most other groups of organisms. Many bird species are at the upper end of the food chain and so may be sensitive to the status of other organisms at lower levels in food webs. Birds are found in all our ecosystems and they are relatively easy to study and identify by their appearance, song or call. They are also fairly well known to the general public and decision makers, and often possess symbolic value in relation to nature conservation.

Bird population trends have been one of the EU's official environmental indicators for some years (Gregory et al. 2005). These indicators show quite clearly that European farmland birds (particularly in Western Europe) are doing badly, but that many forest species have also declined drastically in recent decades (Gregory et al. 2005, 2007). Since summer 2007 bird trends have also been official indicators of biodiversity in relation to some of the Swedish Environmental Objectives (www.miljomal.nu).

The situation for many bird species in Sweden is neither particularly bright. According to the Environmental Objectives Council report de *Facto 2007*, the 2010 goal will be very difficult to achieve. It has been suggested that biodiversity is being lost at a slower rate than previously, but that the number of threatened species will not have been reduced since 2000. The Swedish Species Information Centre red list of threatened species in Sweden has actually continued to grow, albeit marginally, since the latest list in 2000 (Gärdenfors 2005).

A much-discussed article in the journal Vår Fågelvärld reported that 46 per cent of Swedish bird species declined in number during the period 1990–2000 (Ullman 2006). That article was based on figures published in "*Birds in Europe: population estimates, trends and conservation status*" (BirdLife International 2004), to which the Swedish Ornithological Society contributed trend estimates for Sweden. The trend estimates for common species were mainly based on an interpretation of results from the Swedish Bird Survey, which primarily covered parts of southern and central Sweden. For a few species, data from species-specific projects were used, and in the case of a few other species data came mainly from spontaneous bird observations reported to regional ornithological societies around the country. The assessment of status and trends for various species were based on various data sources, of which some, but not all, consisted of systematic surveys.

Aims

Because of the seemingly alarming situation we were appointed by the Swedish Environmental Protection Agency (EPA) to provide a coherent picture of population changes over the last few decades for all bird species nesting in Sweden, by collating the best possible available data in a systematic and consistent way. Our task was also to collate and evaluate existing knowledge and explanatory models on the causes of these trends, and, if possible, to suggest alternative and additional explanations. In particular, we set out to evaluate how trends relate to the target on sustainable use of biodiversity and biological resources as stated in the Swedish Government's Environmental Objective no. 16 "A Rich Diversity of Plant and Animal Life". There are 16 Environmental Objectives that set out specific goals for various natural habitats and human environments, to be achieved in the future (www.miljomal.nu). Finally, we were to identify gaps in present knowledge and propose action to fill them. The present paper is a condensed translation of our full report published 2008 in Swedish (Ottvall et al. 2008).

We used monitoring data and other available information as a basis for describing population and distribution trends for Swedish nesting birds over the past 30 years, focusing on common and fairly common species, and in some cases subspecies. We have proposed actions to improve the conservation status of vulnerable species or groups of species. Much less effort was put into looking for changes in the geographical range of various species. This is mainly because of a lack of robust data.

Methods

Time periods studied

In addition to describing population trends[1] for breeding birds in Sweden over the past 30 years, we have also chosen to describe developments over the last 10 years. This is because we consider it important to address the question of how Swedish birds are faring at the moment. For many species, the three generations period used as a reference for the National Red List when assessing the degree to which a species is threatened corresponds to approximately 10 years. When evaluating the progress of national efforts being made to achieve the environmental quality objectives, it is also essential to analyse bird data from the last 10-year period separately. Moreover, the last decade roughly coincides with a number of major changes in agriculture and forestry, such as Sweden joining the EU (1995) and the resulting impact of the Common Agricultural Policy (CAP), as well as the new Swedish Forestry Act (1993) and the introduction of forest certification. Economical support for the creation of wetlands and stricter regulations governing land drainage were also introduced in the latter part of the 30-year period. In short, a fair number of recent large-scale policy changes have taken place, which may have effects on bird populations. In addition, during the last decade a new bird monitoring scheme, the "Fixed routes" (see below), has added new and better data on breeding bird trends in Sweden.

This means that the main periods dealt with in

[1] *Unless otherwise specified, the term "population" here means the Swedish breeding population of the species/subspecies in question.*

this study are 1977–2006 (the 30-year period) and 1997–2006 (the 10-year period). We have not adhered rigidly to these years, since some key data refer both to the years immediately preceding, and to the years immediately following these periods. For instance, the national system of point counts (see below) began in 1975, and in a few cases census data from 2007 have also been included (for example, for wet meadows in Skåne, southern Sweden, and for a few coastal bird censuses). Population changes occurring before the mid-1970s are not dealt with separately and are not included in any of the trends described, but are mentioned when relevant. The study period largely coincides with the period for which we have data of acceptable quality on a substantial number of species. An analysis of a longer period than 30 years would in essential respects have to be based on data of anecdotal, regional or local nature, except for a small number of species.

Species and subspecies selection

In Appendix 2 we have used English and scientific names recommended by Gill & Wright (2006) on bird species dealt with in this study. In the text itself we have only used English names of bird species included in Appendix 2, but scientific names as well in the few cases when discussing bird species not included in Appendix 2.

In general, we present trends for species, having assessed a total of 248 species regularly breeding in Sweden over the past 30 years. In the case of a few species, where there are two distinct subspecies in different parts of Sweden, it was sometimes difficult or would even be misleading to state a common trend. In such cases we present trends for each of the two subspecies separately rather than presenting a trend for the species as whole. In all cases the birds in question are distinct subspecies, with largely separate ranges. The seven species thus split up into two subspecies each are Dunlin, Lesser Black-backed Gull, Yellow Wagtail, Chiffchaff, Willow Warbler, Nutcracker and Redpoll. The main exception with regard to separate ranges is the Willow Warbler, where there is an overlap zone of up to 350 km between the northern and southern subspecies in central Sweden (Bensch et al. 1999). In total, this study therefore presents trends for 255 species and subspecies.

In a few cases it was difficult to decide whether a species or a subspecies should be included in the analysis. Among species excluded from the study are those that have only recently begun to breed in small numbers and, where further colonisation is likely, such as Shag *Leucocarbo aristotelis* and Stonechat *Saxicola torquatus*. On the other hand, we have included species that have bred fairly regularly in Sweden over the last 30 years, but that no longer occur, or do so only sporadically, such as Kentish Plover, Barn Owl, Snowy Owl and Hoopoe.

Data sources

Most ornithological activity takes place in southern Sweden. Fewer ornithologists are active in the north of the country, which is fairly sparsely populated. This imbalance in the distribution of the country's ornithologists can also be clearly seen in the number of bird counts and general bird monitoring projects carried out and we have tried to take this geographic bias in the quality of data into account when discussing the observed trends.

Data that can be used to estimate the size of, and trends for, Swedish bird populations are produced in many ways, from spontaneous local counts and bird reports to long-term national programmes. Much of this data is published continuously, regionally and nationally. Data sources used in this report are presented in detail in Appendix 1. The Swedish EPA and the Swedish Ornithological Society play a central role in the production of national data. Regionally, many county administrative boards are involved in bird monitoring. A substantial number of regional coast and coastal meadow censuses have recently been carried out by courtesy of the latter and we here present a first summary of their findings. Moreover, reporting of bird observations by the public has increased dramatically over the last few years thanks to the online service offered by the Species Gateway (www.artportalen.se), which further adds to our knowledge of less common species in particular, that is species that are too rare to be covered by the general monitoring programmes, but not rare enough to have their own monitoring programme.

The basis for our trend assessments are data collected each year under the monitoring programmes funded by the Swedish EPA (the Swedish Bird Survey (SBS), the migration counts at Falsterbo, bird ringing at Ottenby and the Waterbird censuses). Additional data come from other continuous monitoring in the form of bird ringing, censuses and species-specific projects.

The most important national bird monitoring data for many of the more common species occurring in habitats covering much of Sweden (mainly forest and agricultural land) were gathered under SBS. This is because these data are gathered systematically during the breeding season in order to reflect population trends throughout the country. Nevertheless, we have also taken the data available from other sources into account to get an as well-balanced trend as possible for each species, since different survey methods each have their advantages and drawbacks. This approach seldom led to conflicting results, since the trends are often very similar. SBS reflects the national breeding population of songbirds, whereas autumn data from the bird observatories and migration counts provide a picture of breeding from a (frequently) larger catchment area. In the case of some species, this means that the assessment to some extent reflects population trends beyond Sweden's borders as well. However, the trends in neighbouring countries are often similar to those in Sweden, but exceptions exists (Lindström & Svensson 2006b).

There are hardly any long-term studies of breeding birds in northern Sweden. However, the avifauna of mountain birch forests and mountain heaths at Ammarnäs in Lapland has been studied under the LUVRE Project since 1963. Other specific sources from northern Sweden are nestbox studies of the Siberian Tit (Grey-headed Chickadee) in a large and remote area of northern Swedish spruce forest (studies since 1999), and also the bird observatories at Ånnsjön in Jämtland in central Sweden (studies during the breeding season since 1989) and at Stora Fjäderägg in Västerbotten (autumn ringing of migrants since 1984).

In the case of species occurring in more specific habitats such as wet meadows, seashores, and archipelagos, we have based our assessments almost entirely on the specific local or regional censuses made in such habitats and areas. Here, SBS data merely serve as a complement, since numbers of individuals counted per species and year under SBS are often low and from few localities of these types. Data on species covered by species-specific projects have of course been obtained from those projects.

There is doubtless a large quantity of relevant data that has not been included in our analysis. Some of the data have been published, but most remain unpublished in the possession of private individuals and institutions. We know that there are many long, good-quality data series, but it has not been possible within the scope of this study to find and analyse them. Nor have we been able to include published local repeated censuses.

Data quality

Available data were assessed for certainty and quality on a four-point scale (0–3), where:
3 – a high degree of certainty (good quantitative and qualitative data are available);
2 – some degree of uncertainty (less good quantitative data are available);
1 – a high degree of uncertainty (few quantitative data are available);
0 – large uncertainty (no quantitative data are available).

Data were classified as high quality (3) where good data were available from SBS, with a sufficient number of individuals counted annually, or if repeated censuses of specific important habitats had been made (for example wet meadows and archipelagos). Less good long-term data from SBS or regional/local inventories were classified as (2). Data that did in fact exhibit temporal resolution sufficient to discern a trend, but not with sufficient resolution to estimate the trend in numbers were classified as (1). The latter classification was also given to data obtained solely from ringing/migration counts with a high degree of uncertainty as to whether the birds counted/caught are Swedish breeding birds. Finally, class 0 was reserved for the species where there was essentially no information on the national population trend.

Data of acceptable standard (data quality 3 and 2, Table 1) were available for approximately 80% of the species. On average, data quality was somewhat better for the last 10 years, but there are still 18 species about which we know virtually nothing with regard to changes in their numbers. Practically all these species are found in northern Sweden, and no fewer than eight are owls.

Table 1. Number (and percentage) of all Swedish bird species (n=255 populations of 248 species) in different data quality categories over the last 30 and 10 years.
Antal (och andel) fågelarter (n=255 populationer av 248 arter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.

Data quality *Datakvalitet*	30 years (n=255) *30 år*	10 years (n=251) *10 år*
0	21 (8 %)	18 (7 %)
1	32 (12 %)	21 (9 %)
2	50 (20 %)	53 (21 %)
3	152 (60 %)	159 (63 %)

Trends and trend assessment

We have determined the direction and size of trends and population changes for Swedish breeding birds over the last 30 and 10 years, respectively. Appendix 2 gives details of trends for individual species, the data sources on which our trend estimates are based, wintering area, red listing, Annex 1 species (the EG Birds Directive), the occurrence of each species in various habitats and whether it is hunted.

Each trend estimate is normally based on several data sources, where we have first of all determined which data set(s) should be given greatest weight. Our basic premise was that where there was an SBS trend estimate and we considered that SBS accurately reflects the population trend for that species, the SBS trend estimate was given the most weight. For species that are not properly covered by SBS, because only a few individuals are counted annually or because they have specialised habitat requirements, other data sources were mainly used, and SBS data served merely as a complement. Obvious examples are species found in wet meadows and archipelagos, and those subject of a species-specific project.

Since the available background material was so heterogeneous, in practice it was not possible to adhere to a fixed model for all species when estimating or assessing trends. SBS trends were based on SBS data from the Fixed routes (9 years) and summer Point counts (32 and 9 years, respectively). Trends were also estimated for birds on wet meadows, along coasts and in archipelagos, based on repeated regional surveys (30 and 10 years, respectively). We used TRIM (TRends & Indices for Monitoring data) to estimate annual population indices and a trend (see Appendix 1 for details). The trend analysis involved calculating the average annual percentage change over the period studied.

The trend direction was determined for statistically significant trends, whereas non-significant trend were (usually) considered stable. The overall trend for the 10-year period was regarded as negative or positive if the SBS trend from fixed routes and free choice routes pointed in the same direction and one of the trends was statistically significant. In addition, the overall trend was considered stable if neither of the methods revealed any significant trend, or if the methods indicated trends pointing in different directions. In several cases, to reduce the risk of statistical Type II errors, that is assuming stability even though there is a true underlying trend, we chose to regard numerically strong trends as true, even though they did not attain statistical significance (more on this below). The guiding principle for the 30-year period was to use trends from the SBS summer point counts in the first place, but the winter point counts were at least as good for many of the resident species. In these cases we used an overall assessment of trends estimated using TRIM from the summer and winter point counts as described above. Trends estimated using TRIM were then compared with other data sources for a final assessment of the overall trend. As a rule, there was a high degree of correspondence between SBS data and other data sources, something that has also been found in previous comparisons (Svensson et al. 1986, Karlsson et al. 2005).

The size of population change was assessed in all cases where data were of good quality (category 3). Other trends were only assessed in terms of their direction. For TRIM-based trends the size of population changes was calculated as an annual trend raised to the number of years in question. For example, a positive trend of 3% per year translates into a 30% increase over 10 years (calculated as 1.03^9). In the same way, a falling trend of 3% corresponds to a 24% decline over 10 years (calculated as 0.97^9). When the size of population change could not be calculated using TRIM trends, a general assessment was made on the basis of available material. Direct use was made of population figures for species of which virtually the whole population has been monitored by way of specific projects.

Where the size of population change had been calculated or estimated, the figure was translated into numerical and semantical categories (Table 2). An overall assessment of several data sources was nonetheless made for all species for which the size of population change was calculated using TRIM trends. In some cases this resulted in an adjustment of the degree of a change. One example is the Tree Pipit, for which summer point counts indicated a population decline of 56% over 30 years, which would represent a large decline (Table 2). On the other hand, the material from Ammarnäs and migration counts at Falsterbo revealed no significant trend for the Tree Pipit over the same period. The overall assessment of this species was therefore a decrease of 30–49% over 30 years, expressed in words as “a decline”.

The classification in Table 2 follows that used by BirdLife International (2004). This makes it possible to make comparisons with earlier assessments. Unlike the report by BirdLife International (2004), we chose to always classify the lowest level of population change, i.e. that in the range 0–9%, as “stable”. The limit for the most pronounced change

Table 2. Classification of population changes and translation of those changes to categories in words over 30 and 10 years. The size of population change was calculated only for trends based on data quality 3.
Indelning av populationsförändringar samt överföring av dessa till kategorier i ord över 30 respektive 10 år. Storleken på populationsförändring beräknades enbart för trender med datakvalitet 3.

Trend in words *Trend i ord*	30 years *30 år*	10 years *10 år*
Large decline *Stark minskning*	50–79% and >80% decrease	30–49%, 50–79% and >80% decrease
Decline *Minskning*	10–19%, 20–29% and 30–49% decrease	10–19% and 20–29% decrease
Stable *Stabil*	<10% increase and <10% decrease	<10% increase and <10% decrease
Increase *Ökning*	10–19%, 20–29% and 30–49% increase	10–19% and 20–29% increase
Large increase *Stark ökning*	50–79% and >80% increase	30–49%, 50–79% and >80% increase

over the 10-year period was set at a 30% increase or decrease, the same as that used in BirdLife International (2004). Note that this rate of population change over 10 years was used when assessing whether a species was sufficiently threatened to be red-listed. For the 30-year period we chose to use a 50% increase or decrease as the limit for "a large population change". This limit was chosen arbitrarily by us and does not adhere to any previous classification. However, we suggest that a halving of a population over 30 years can be seen as "a large decline". A decline of 30% over 10 years represents an average annual loss of just over 4%, compared with approximately 2.4% in the case of a 50% decline over 30 years.

Clarifications

All trends presented in Appendix 2 are national trends for Sweden for the species (or subspecies) in question. We are aware that there are sometimes geographical differences in population trends within the country. This inevitably means that the trends presented here sometimes differ from local and regional patterns. An increasing trend presented here does not in any way imply that we are disregarding the fact that a species may have declined, locally or regionally, merely that the overall trend for the country is increasing. Likewise, a species with a nationally declining trend may of course display an increasing trend locally or regionally.

In several cases there are large differences in geographical resolution between the long-term and short-term trends (30 and 10 years, respectively, Figure 1). Whereas we have had a national system giving good coverage of many species (the Fixed routes) over the last 10 years, in most cases such data are lacking over the longer time perspective. Many of the long-term trends are based on data mainly from the south of the country, which, in the absence of additional data, have then been extrapolated to apply to the whole of Sweden. Nor are long-term data evenly distributed over southern Sweden. Point count data from SBS originate mainly from areas where most people live, which means that Mälardalen (Stockholm region and westwards), the west coast (Gothenburg region) and the province of Skåne (Scania) in the south are over-represented in the material.

In several places in this study we use expressions such as "trend reversal" or "tendencies towards a trend reversal". In this context it is important to note that the study is based on separate analyses of two time series, in which the later 10-year period forms part of the longer 30-year one. Hence, data on the two periods are not independent of each other in a methodological or statistical sense, and thus, strictly speaking, cannot be tested against one another. Put simply, we use the term "trend reversal" to signify that the last 10 years of the 30-year period exhibit a different pattern from that shown by the first 20 years, but no formal statistical testing of this has been performed. This would in any case not be possible for the majority of species owing to the quality of the underlying data.

Interpreting observed trends

One important reason for describing trends is to be able to react in time when something is in the

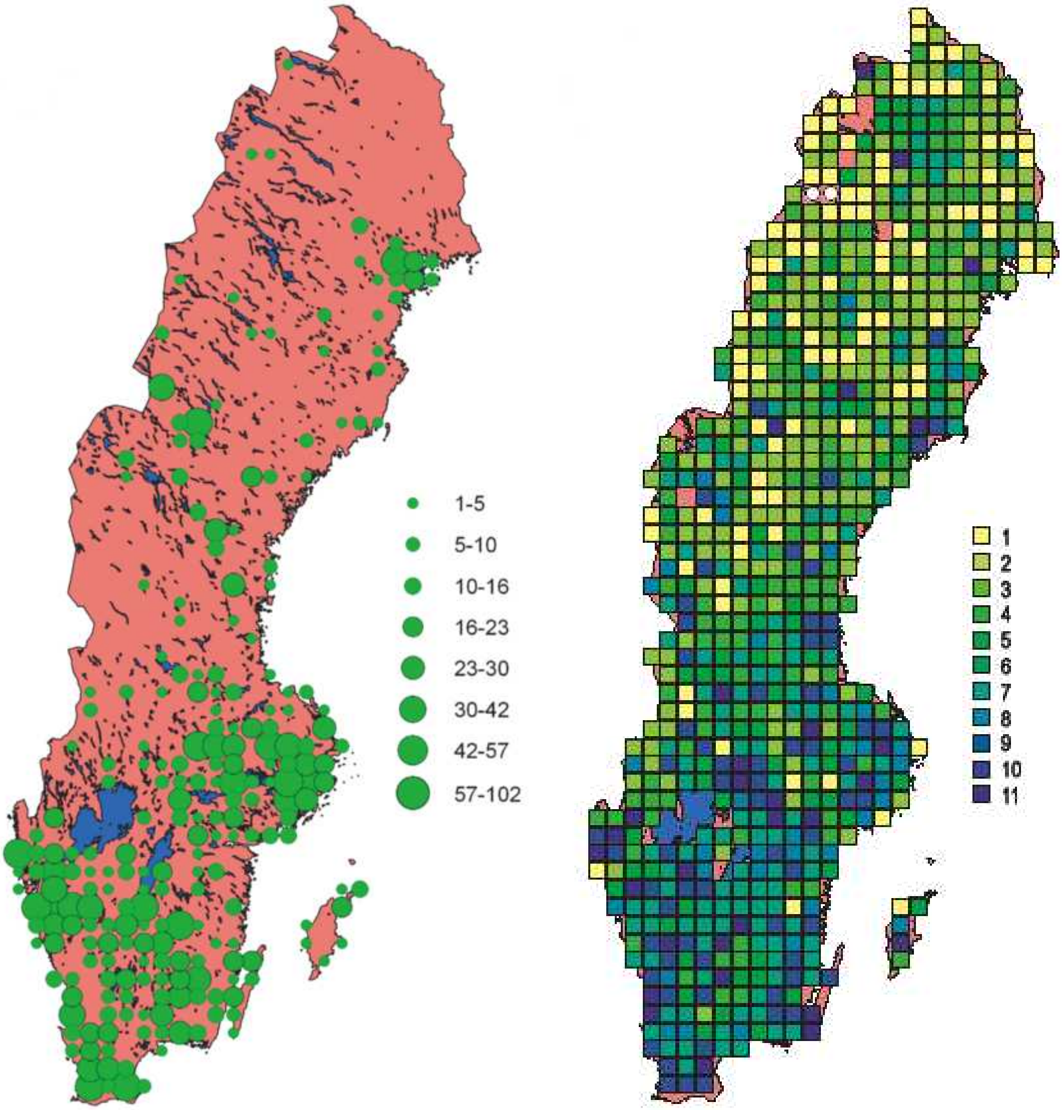

Figure 1. Geographical distribution of breeding bird censuses performed under the Swedish Bird Survey 1996–2006. The left-hand map shows the location of free-choice routes, based on the number of individual censuses per topographical map sheet (25×25 km). The right-hand map shows how many times a census was performed along each Fixed route (each square is a topographical map sheet containing one route). Even though fewer censuses have been performed in northern Sweden, the fixed routes in northern Sweden give much better coverage than do the free-choice routes.

Geografisk fördelning av häckfågelinventeringar gjorda inom Svensk Fågeltaxering det senaste dryga decenniet. Till vänster visas var de fritt valda punktrutterna gjorts, summerade på antalet enskilda inventeringar per topografiskt kartblad (25×25 km). Kartan till höger visar hur många gånger var standardrutt inventerats (varje ruta är ett topografiskt kartblad och innehåller en rutt). Även om det i båda programmen gjorts färre inventeringar i Norrland, täcker standardrutterna in norra Sverige betydligt bättre än vad punktrutterna gör.

process of changing. The rationale for this is that a numerical trend is normally caused by specific changes in ecological variables of importance to the birds. Well-known examples are the decline in White-tailed Eagle numbers due to rising levels of organic toxins (Helander 1983), and that farmland birds are now on the decline, partly because of increasingly intensive farming of fertile plains and reduced intensity or abandonment of farming in less fertile upland forest areas (Wretenberg et al. 2006). Before a trend is confirmed and alarm bells are rung, it is important to make possible to discriminate an actual and disturbing change from the natural fluctuations exhibited by many species.

There are several known examples of natural fluctuations due to the availability of an important resource, usually food. Numbers of crossbills and Greater Spotted Woodpeckers peak every other year or every three years when coniferous trees produce large numbers of seeds (Newton 2006). Perhaps the best known population fluctuations are those of owls and raptors, which fluctuate in three or four-year cycles in tandem with rodent numbers (Hörnfeldt et al. 2005). Even longer cycles are known for the Brambling, whose local population peaks occur about once per decade in correspondence to the population cycle of their favourite food – the autumnal moth *Epirrita autumnata* (Enemar et al. 2004, Lindström et al. 2005).

Apart from more regularly occurring population fluctuations, time series may also reveal individual

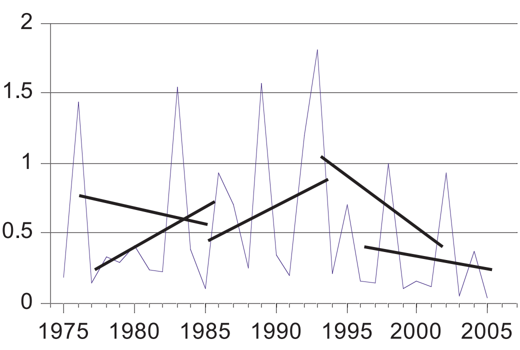

Figure 2. The blue line shows the occurrence of undetermined crossbills in Sweden around Christmas and the New Year during the winters 1975/1976–2005/2006, according to the Winter Bird Count. The unbroken lines show approximate trends for different 10-year periods.
Den blåa kurvan beskriver förekomsten av obestämda korsnäbbar i Sverige runt jul och nyår vintrarna 1975/1976−2005/2006, enligt Vinterfågelräkningen. De heldragna linjerna indikerar ungefärliga trender för olika 10-årsperioder.

years with very good, or very poor, numbers of a species. For instance, numbers of species susceptible to cold winters, such as Grey Heron, Winter Wren and Kingfisher plummeted during a series of cold winters in the mid-1980s, but their populations quickly recovered (Lindström & Svensson 2006a).

It is obvious that the shorter the period for which a trend is described, the greater the risk that the trend has not been caused by any fundamental changes in the environment, but instead merely reflects natural population fluctuations or a year of temporary change. If one or two initial or concluding years in a short time series coincide with a sharp population peak, this may be a decisive factor for the statistical interpretation of the trend for that period. In the case of long-term stable but short-term sharply fluctuating species, such as crossbills, adjacent 10-year trends differ greatly both in terms of direction and strength, sometimes depending on which individual years are included (see example Figure 2).

With a time period of "only" 10 years, the risk of natural population fluctuations or individual deviating years affecting the observed trends increases markedly. On the other hand, we also know that actual changes in a given direction take place over shorter periods, as when agricultural land was taken out of use in the late 1980s, resulting in large areas of fertile land lying fallow. This positively affected population trends of both Skylarks and Linnets for a few years (Wretenberg et al. 2007), but not in the long term. In our analyses we have therefore not hesitated to describe 10-year trends as increasing or decreasing, particularly not for species with little natural variation from one year to another. A general comment is that the 10-year trends should be treated with a degree of caution.

All Swedish breeding birds

Trends for all species

The number and proportion of species in various trend classes are shown in Figure 3. We have included all species, regardless of data quality. Over the last 30 years there were more species declining than increasing, whereas the opposite applies over the last 10 years. The proportion of species declining (decline or large decline) was considerably lower (19%) during the last 10 years of the period than over the 30-year period as a whole (38%). At the same time, the proportion of stable species was almost twice as high during the final 10 years (50%) as during the whole period (27%). This may be partly because it is harder to demon-

All species / *Alla arter*

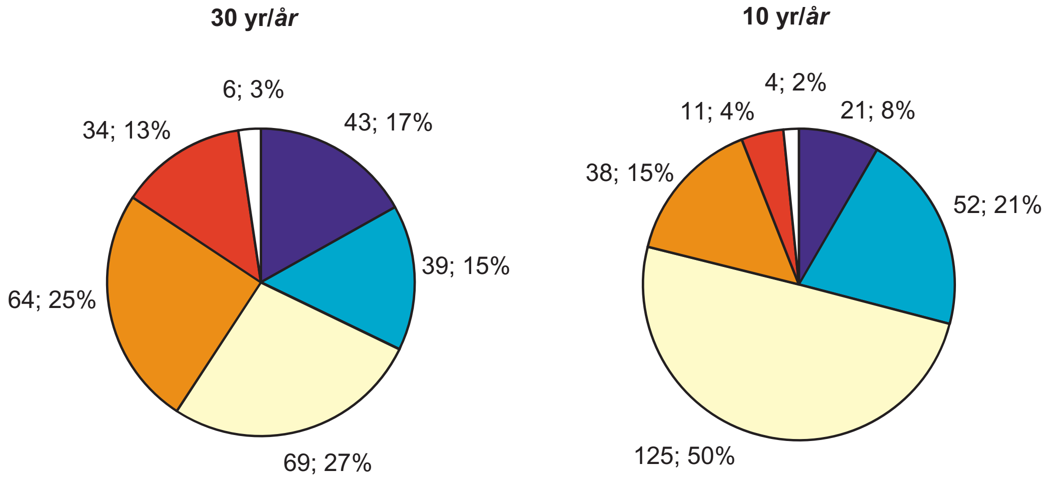

Figure 3. Number and percentage of bird species in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). The trend categories have the following colours: large increase (dark blue), increase (pale blue), stable (yellow), decline (orange), large decline (red), unknown (white) and not regular breeder (black). The text outside each part of a chart shows number of species and percentage of all species. For example, "34; 13%" means that a large decline was found in 34 species, which is 13% of all species.
Antal och andel fågelarter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). Trendkategorierna har följande färger: stark ökning (mörkblå), ökning (ljusblå), stabil (gul), minskning (orange), stark minskning (röd), okänd (vit) och ej regelbunden (svart). Texten utanför varje tårtbit av diagrammet visar hur många arter respektive vilken proportion av arter som ingår i denna kategori.

strate a trend over a shorter period, particularly if data quality is poor. The proportion of species increasing in number (increase or large increase) was marginally lower (29%) during the final 10-year period than during the whole 30-year period (32%). Please note that it is not possible simply to compare the distribution in groups with differing degrees of increase or decrease. For instance, a large increase during the 10-year period will on average be more pronounced (as an annual percentage) than a large increase over 30 years.

Trends for species with differing data quality

The estimates for about one fifth of species are uncertain; that is, one or both of the trends have data quality classified as 0 or 1. A clear majority of these species displayed stable trends, which suggests that it is difficult to determine trends for this group of species. Over the 30-year period declines were more common compared with increases (30% of species declined and 15% increased). Over the final 10 years increases were more common compared with declines (15% of species increased and 10% declined). When restricting the same analysis to species for which the data was more reliable (data quality 2 and 3, Figure 4), the pattern was similar to that for all species. However, declines were only slightly more common over the 30-year period (40% of species decreased and 37% increased), and increases were clearly more common over the final 10 years (31% of species increased and 21% declined). The proportion of stable species doubled during the last 10-year period, as compared with the whole 30 years.

Recent trend shifts

What changes have there been within various species over 30 and 10 years, respectively? In order to make trends within the respective periods more comparable, we have combined large increase and increase to form a single class, and done the same with the corresponding two decline classes. Trends based on data quality 2 or 3 for both periods are available for 198 species/subspecies. We made a general examination of whether the trend over the last 10 years displayed a pattern differing from that

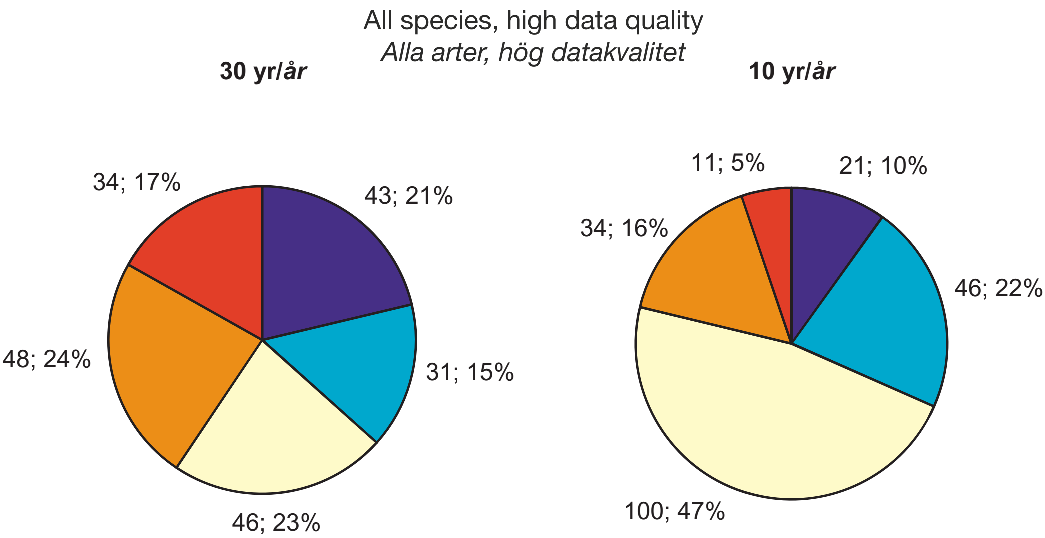

Figure 4. Number and percentage of bird species in various trend categories over the last 30 years (left-hand diagram) and the last 10 years (right-hand diagram). Only species having data quality 2 or 3 are included. For further information on how to read the graphs, see Figure 3.
Antal och andel fågelarter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). Inkluderade är bara de arter som har datakvalitet 2 eller 3. För ytterligare information om tolkning av diagrammen, se Figur 3.

Table 3. Number of species in various trend combinations over the last 30 years and 10 years. From the table it can be seen that there were 29 species that declined over 30 years and also over 10 years, 4 species that were stable over 30 years but declined over the last 10 years, and so on. Only species having data quality 2 or 3 are included.
Antal arter i olika kombinationer av trender för de senaste 30 åren respektive 10 åren. Tabellen läses så att 29 arter som minskade över 30 år även minskade över 10 år, 4 arter som var stabila över 30 år minskade de senaste 10 åren, osv. Inkluderade är bara de arter som har datakvalitet 2 eller 3.

	Trend 30 years *Trend 30 år*			
Trend 10 years *Trend 10 år*	Decreasing *Minskande*	Stable *Stabil*	Increasing *Ökande*	Total *Summa*
Decreasing *Minskande*	29	4	10	43
Stable *Stabil*	38	30	22	90
Increasing *Ökande*	11	12	42	65
Total *Summa*	78	46	74	198

for the 30-year period as a whole (Table 3). This was done purely as an assessment without any formal statistical testing. In practice, an observed difference between the periods means that the trend over the last 10 years is considered to deviate from that over the preceding 20 years.

The most alarming pattern is that 29 species in long-term decline have also decreased over the last 10 years (15% of all species; 37% of the species in long-term decline). The most striking and positive change is that a large number of species have shifted from a long-term declining trend to a stable one, albeit at a lower population size level (38 species; 48% of those in long-term decline). Some long-term declines have even been reversed to an increase (11 species; 14% of those in long-term decline). Out of 74 species showing a long-term increase, 57% continue to increase, whereas the positive trend has levelled out or been reversed for 43%. All in all, there are 101 species (51% of all species) whose short-term trend is the same as the long-term one. The short-term trend for 61 species (31%) is more favourable than the long-term one; the short-term trend for 36 species (18%) is less favourable than that for the long period.

Thus far, the analysis reflects the numerical changes in the Swedish avifauna as a whole. A more detailed analysis is made below, in which specific groups of birds are dealt with according to their systematic classification (raptors, waders and owls), winter quarters or preferred breeding habitat (representing different Environmental Objectives).

As regards the selection of systematic groups in the following analyses, we have chosen to highlight raptors as the group that has generally done well over the last 30 years. This group is interesting by virtue of its position at the top of the food chain. Top predators are expected to react quickly to ecosystem disturbances. We have also chosen a group that we already know has not done well: waders. In this group populations of species breeding in wet meadows have suffered a particularly severe decline. Here may be found some of the species or subspecies that may become extinct as Swedish breeding birds in the near future. Focus is also put on a group about which our knowledge is unsatisfactory, namely owls. Although there is detailed local or regional data on owls from several places in Sweden, in the case of most species there is no national assessment of population trends. We consider the remaining systematic groups to be covered by other chapters on the importance of winter quarters and preferred breeding habitats. We have also chosen to analyse species hunted in Sweden as a group (game birds), and finally we discuss the effects of climate change on the Swedish avifauna.

Raptors

Trends

In general, birds of prey have done very well in Sweden over the last 30 years (Figure 5), and data quality is generally good (Table 4). Eight of the 17 species breeding regularly in the country have increased, five have remained stable and four have declined over the last 30 years. Species on the increase include several very well-known birds, such as the Peregrine Falcon, White-tailed Eagle and Red Kite. Of the four species in long-term decline, Honey Buzzard is the only in long-term large decline while the other three show lower long-term rates of decline. Looking solely at the last decade, the situation has further improved somewhat for raptors in general, with only one species still in decline: Montagu's Harrier. A long-term increase in numbers of Osprey and Marsh Harrier has levelled off.

Causes

The increases in raptor numbers should mainly be seen as the beginnings of a recovery from the dire situation resulting from persecution and pollution for much of the 20th century. The population curves of several raptors bottomed out in the mid-1970s. Recovery has occurred thanks to a successful combination of many different targeted efforts by man. Persecution and illegal hunting have been reduced by information and by guarding nests, in which the voluntary efforts of ornithologists and conservationists have played a key role. Pollution has decreased as a result of national and international bans. Several species have recovered more quickly than would otherwise have been possible thanks to captive-breeding programmes and supplemental feeding in the wild.

The four species in long-term decline are the Honey Buzzard, Montagu's Harrier, Hen Harrier and Rough-legged Buzzard. The last two breed mainly in northern Sweden, where their breeding success is heavily dependent on rodent numbers. Their long-term decline is most likely mainly due to a general fall in rodent numbers in the north in the 1980s and 1990s. Rodent numbers are being monitored by Umeå University in a project funded by the Swedish EPA (www.emg.umu.se/personal/lankar/hornfeldt/index3.html). Over the past decade it appears that lemming numbers have recovered somewhat, which ought to have slowed the decline. But the rodent population in forested areas seems to continue to decline, possibly as an effect of warmer winters (Hörnfeldt et al. 2005).

The Honey Buzzard is essentially an insect-eater and its decline is probably due to a number of factors working in concert. Sweden probably now has fewer insect-rich habitats during the breeding season, partly because of farm closures in forested areas. Increasingly dense forests (more trees per unit area), with a lower proportion of broadleaf trees and fewer flowering plants, may also have acted to the detriment of the species. Beyond Swe-

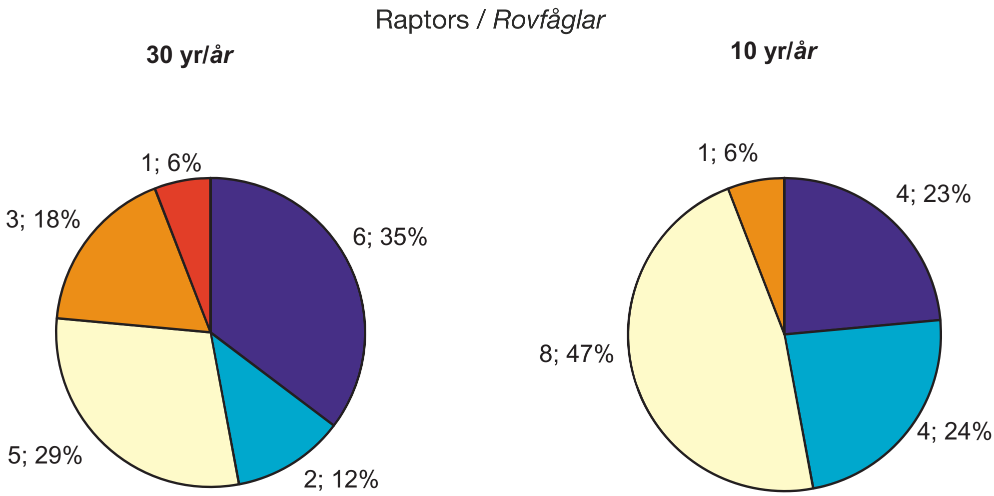

Figure 5. Number and percentage of raptor species in various trend categories over the last 30 years (left) and 10 years (right). For further information on how to read the graphs, see Figure 3.
Antal och andel rovfågelarter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

Table 4. Number (and percentage) of all raptors (n=17 species*) in different data quality categories over the last 30 and 10 years.
Antal (och andel) rovfågelarter (n=17 arter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.*

Data quality *Datakvalitet*	30 years (n=17) *30 år*	10 years (n=17) *10 år*
0	0 (0 %)	0 (0 %)
1	3 (18 %)	3 (18 %)
2	3 (18 %)	3 (18 %)
3	11 (64 %)	11 (64 %)

* Honey Buzzard, Red Kite, White-tailed Eagle, Marsh Harrier, Hen Harrier, Montagu's Harrier, Goshawk, Sparrowhawk, Buzzard, Rough-legged Buzzard, Golden Eagle, Osprey, Kestrel, Merlin, Hobby, Gyrfalcon, Peregrine Falcon.

den's borders extensive shooting of birds still takes place at some points along their migration routes (in Malta, for example), and there have been major land-use changes in the birds' winter quarters. Montagu's Harrier is under threat from land clearance for grazing purposes at nesting sites, predation by Goshawks, overgrowth of nesting sites and recurrent disturbance by man (Tjernberg & Svensson 2007).

Knowledge gaps

In general, our knowledge of trends and actual numbers of Swedish raptors is good, mainly thanks to individual species-specific projects, but also as a result of the migration counts made at Falsterbo. The main reasons for changes are fairly well known. There are few obvious gaps in our knowledge, although we do not know a great deal about the winter ecology of species migrating south of the Sahara (Honey Buzzard, Marsh Harrier, Montagu's Harrier, Osprey and Hobby).

Proposed actions

- Further efforts should be made so that forestry practices promote more varied, multi-storied forests with a greater preponderance of deciduous trees and herbaceous plants, which will benefit the Honey Buzzard.
- More strenuous efforts to combat the hunting of raptors in Europe and Africa.
- Better protection of nest trees and protection zones around nest trees for large raptors, and good forestry planning to ensure nest tree continuity.
- Adapted farming practices so that land-use pressure is not too great in areas with breeding

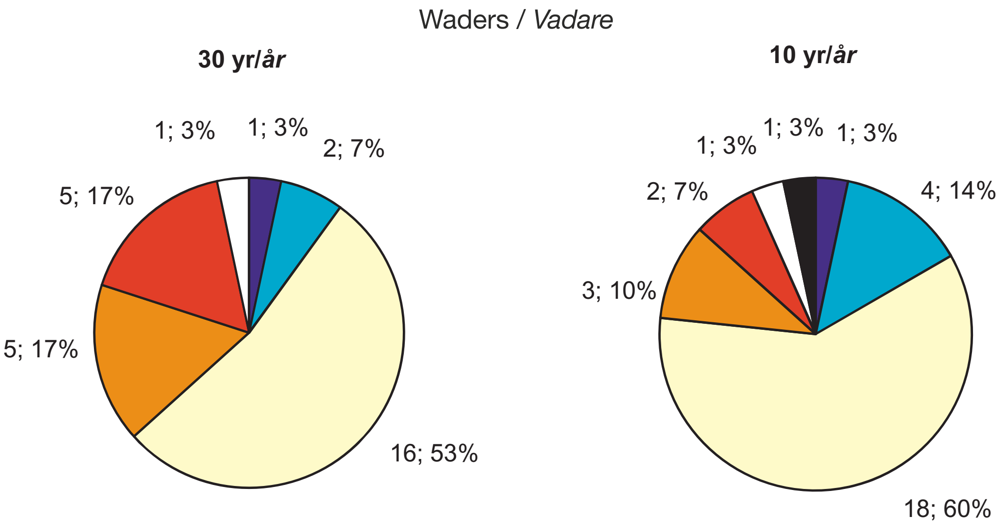

Figure 6. Number and percentage of species of waders in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to read the graphs, see Figure 3.
Antal och andel vadararter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

Montagu's Harriers. If possible, adjacent clumps of trees, where Goshawks and corvids can nest, should be cleared. This is also likely to benefit several species of waders.

- Adaptation of land management requirements for environmental subsidies so that a certain amount of shrubby vegetation can be left in areas where Montagu's Harrier is present.
- Reduce bird kills from power lines and railways (due to eagles and other species feeding on mammals killed by trains).
- Avoid locating wind turbines and wind farms close to eagle territories. In the absence of precise recommendations for Sweden the buffer zones proposed for Scotland should be applied.
- Illegal hunting of Golden Eagles must be stopped.

Waders

Trends

Of the 29 species of waders breeding regularly in Sweden over the last 30 years (including two subspecies of Dunlin), the Kentish plover no longer regularly breeds in the country. The Marsh Sandpiper *Tringa stagnatilis* has bred on at least two occasions in the last 10 years, but is not dealt with here. As a group, waders have not done well. Over the last 30 years three species have increased, sixteen have been stable, ten have declined and the trend is unclear for one species (Figure 6). Five of the species in decline have suffered a large decline (>50%): Kentish Plover, Southern Dunlin, Common Snipe, Black-tailed Godwit and Turnstone. It is worrying that three of these have continued to decline in the last 10 years, and the Kentish Plover has even ceased to breed regularly. The situation over the last decade is generally somewhat better than for the period as a whole, with five species increasing, eighteen stable, five declining and one no longer regularly breeding in Sweden. The trend for the Purple Sandpiper is completely unknown, and data on a further five species are poor (Table 5). All species for which the data are poor breed mainly in northern Sweden.

Several species breeding in mountainous areas (eleven species) are doing well, as are six species breeding on northern Swedish bogs. However, waders whose breeding habitat is associated with grazed wet meadows in southern Sweden are doing badly. In addition, southern populations of Golden Plover, Jack Snipe and Wood Sandpiper, which breed on bogs, have declined. Even though waders frequenting coastal and archipelago habitats in northern Sweden have generally done well, it appears that Temminck's Stint no longer breeds

Table 5. Number (and percentage) of all waders (n=29 species*, including one species with two subspecies) in different data quality categories over the last 30 and 10 years.
Antal (och andel) vadare (n=29 arter, inklusive en art med två underarter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.*

Data quality *Datakvalitet*	30 years (n=30) *30 år*	10 years (n=29) *10 år*
0	4 (13 %)	3 (10 %)
1	7 (23 %)	3 (10 %)
2	7 (23 %)	8 (28 %)
3	12 (40 %)	15 (52 %)

* Oystercatcher, Avocet, Little Ringed Plover, Ringed Plover, Kentish Plover, Dotterel, Golden Plover, Lapwing, Temminck's Stint, Purple Sandpiper, Dunlin (*alpina*), Dunlin (*schinzii*), Broad-billed Sandpiper, Ruff, Jack Snipe, Common Snipe, Great Snipe, Woodcock, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Whimbrel, Spotted Redshank, Redshank, Greenshank, Green Sandpiper, Wood Sandpiper, Common Sandpiper, Turnstone, Red-necked Phalarope.

along the coast of Västerbotten (Sundström & Olsson 2005). Wader populations on grazed wet meadows in southern Sweden are in large-scale decline; apart from the disappearance of the Kentish Plover as a regular breeding bird, the Southern Dunlin and the southern population of Ruff are going the same way (Johansson et al. 2007). Furthermore, there are signs that the Black-tailed Godwit has declined dramatically in the last 10 years (Johansson et al. 2007, Cronert 2008). A more positive development is that populations of Common Snipe, Oystercatcher, Lapwing, Curlew and Redshank remain unchanged or have increased over the last decade after a lengthy period of decline. These species are not entirely dependent on grazed grassland; their main habitats are elsewhere. The Avocet is a species that has undergone a sharp long-term increase, one that is now beginning to level off. This species has seen a fivefold increase in Western Europe since the Second World War, expanding its range from Central Europe northwards to southern Sweden (Hötker & West 2005). Two species whose main habitat is forest, Woodcock and Green Sandpiper, both have an increasing trend over the last 10 years; the Green Sandpiper has been stable over 30 years. However, the Common Sandpiper, which inhabits the shores of lakes and rivers, has declined throughout the entire 30-year period.

Causes

Wader numbers in southern Sweden have suffered greatly as the area suitable for breeding shrank dramatically throughout the 20th century owing to land drainage and land-use changes with resulting cultivation or overgrowth. The area of wet meadows is now only a fraction of what it used to be. Bird populations dependent on these habitats are therefore much smaller today than their historical levels. Habitat destruction of this kind mostly took place before the period concerned here. It may be suspected that the continuing negative trend being experienced by some species, which cannot be specifically linked to habitat loss, may be due to non-viable population levels, in the case of the Southern Dunlin with proven negative genetic consequences (Blomqvist & Pauliny 2007).

Six of the eight red-listed wader species breeding regularly in Sweden occur to varying degrees in grazed wet meadows. Over the last 20 years extensive restoration work and various kinds of agricultural subsidies have increased the area of semi-natural grassland. Despite these measures, several species now found only on grazed or mown meadows have continued to decline (Ottvall & Smith 2006, Johansson et al. 2007, Flodin et al. 2008). This applies particularly to species whose populations were already at worryingly low levels even before the beginning of the period, such as Southern Dunlin, Black-tailed Godwit and Ruff. The reasons for this continuing decline are only partly known, and probably include excessively uniform local farming practices (Widemo 2007), high predation on eggs and chicks (Jönsson 1990, Blomqvist & Johansson 1991, Grönstöl et al. 2003, Ottvall 2005), and inbreeding in the case of Southern Dunlins (Blomqvist & Pauliny 2007). A key factor may be that the surrounding countryside has changed dramatically since the first half of the 20th century. The spread of shrubs and trees in the surrounding landscape has reduced the availability of suitable habitats and may have favoured various predators in the vicinity of the wet meadows. The often small remnants of habitat available nowadays may not be sufficient for the less abundant species, which are susceptible to various random events (predation, weather conditions etc.). The role of hunting is not known, but several species (such as the Black-tailed Godwit) are hunted at some point along their migration routes and in their winter quarters (BirdLife International – Species Fact sheet Black-tailed Godwit: www.birdlife.eu/datazone/species/index.html?action=SpcHTMDetails.

asp&sid=3003&m=0). A sign that Ruff are experiencing problems in their winter quarters is that the species is the only wader bird breeding in mountainous areas of Sweden that is thought to be declining in number (see section on Mountain birds).

Four species (Lapwing, Common Snipe, Curlew and Redshank), which have declined over the long term, have shown signs of stabilising, or even a slight increase over the last 10 years of the period. This may partly be the result of successful habitat restoration and various environmental subsidies. However, follow-up surveys of wet meadows suggest disturbing and similar declines (approximately 30% over five years) in the majority of species, including the more numerous ones (Johansson et al. 2007, Flodin et al. 2008). The status of the four species mentioned seems mainly to have improved in habitats other than wet meadows, so for these species there is no direct causal link between action taken and trend reversals.

Species dependent on bogs in southern Sweden have declined sharply, mainly because many of these habitats have become overgrown. The reasons for overgrowth are probably complex, involving factors such as land drainage, increased use of fertilisers and possibly climate change.

Knowledge gaps

There are large gaps in the knowledge about several species breeding in mountainous parts of the country, although the use of Fixed routes (SBS) is improving our knowledge of population sizes and trends (and to some extent also range). Nevertheless, our knowledge of both population size and trends remains unsatisfactory for species such as Dotterel, Purple Sandpiper, Jack Snipe and Bar-tailed Godwit. Additional surveys in mountain regions are needed to improve the data on range, population sizes and trends for several northern species, particularly bearing in mind that these species are most likely to be among the first victims of ongoing climate change (Lindström & Agrell 1999).

One common factor for several of the declining species (e.g., Southern Dunlin, Ruff, Black-tailed Godwit and Turnstone) is that they migrate to West Africa. We know very little about the threats that may face these species in their winter quarters. One general problem is rapidly growing human populations, which threaten to have an adverse impact on many waterbirds, for example in the Niger delta (Olofsson & Strandberg 2008).

Although research has been conducted on waders breeding on wet meadows for several decades, the knowledge about management of meadows is unsatisfactory. County administrative boards have organized recurring surveys of a large proportion of coastal breeding waders. It is essential that this monitoring continues. A national action programme is being drawn up for the Southern Dunlin. For the sake of their continued survival in Sweden, it is urgent that similar conservation measures also be taken for the Black-tailed Godwit and the southern population of Ruff. In the first place, current management should be thoroughly reviewed. The controversial question of grazing pressure on pasture land is made more complicated by the fact that large numbers of geese graze on some wet meadows. It is quite clear that their effect on the vegetative cover is to make it too short, but the details of the impact of grazing geese on wader density and breeding success is still largely unknown (Cronert 2008 among others). Studies in the waders' winter quarters are also required.

Proposed actions

- Efforts should be made to create greater variation in grazing pressure within and between areas, as compared with current practice, where grazing of many areas is far too uniform, with either excessively heavy or too light grazing.
- Restoration of shallow pools in meadows should be encouraged. Several studies have found that very shallow small pools play an important role for chicks and young birds.
- Predation problems should also be further studied, and trials involving predator control should be considered in some places. Trials of this kind have recently begun on the Baltic island of Öland.
- Further restoration of wetlands and inland wet meadows should be encouraged.

Owls

Trends

Little is known about owl population size and trends (Table 6). Many species are retiring and occur sparsely over large areas. This makes them difficult to count. Sweden has eleven species of owl breeding more or less regularly. Two of them, the Snowy Owl and the Barn Owl, probably no longer breed every year, or are only represented by one or two pairs. Our analysis shows that the available data are unsatisfactory (data quality 0 or 1) for as many as eight of the species, and our comments be-

Table 6. Number (and percentage) of all owls (n=11 species*) in different data quality categories over the last 30 and 10 years.
Antal (och andel) ugglearter (n=11 arter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.*

Data quality *Datakvalitet*	30 years (n=11) *30 år*	10 years (n=9) *10 år*
0	8 (73 %)	8 (89 %)
1	0 (0 %)	0 (0 %)
2	2 (18 %)	1 (11 %)
3	1 (9 %)	0 (0 %)

* Barn Owl, Eagle Owl, Snowy Owl, Hawk Owl, Pygmy Owl, Tawny Owl, Ural Owl, Great Grey Owl, Long-eared Owl, Short-eared Owl, Boreal Owl (Tengmalm's Owl).

low should therefore be treated with great caution. However, there is some good local, and in some cases regional, data on owl population trends.

In a 30-year perspective, it appears that four of the 11 species are declining, whereas four are stable and three are increasing (Figure 7). The Eagle Owl has definitely increased, dramatically in fact, from a decimated population in the middle of last century (Olsson & Philipsson 2000). Recent data indicate renewed local decreases (maybe severe in some cases) in the short term. The Ural Owl and Great Grey Owl also seem to have increased over the long term, at least in the south of their range, but the trends appear to have levelled off in recent years. Species in long-term decline include the Barn Owl, Snowy Owl and Short-eared Owl, although the two former species have never included other than small numbers. Moreover, the decline of the Short-eared Owl seems to have continued over the last 10 years. Recent data suggest a slight increase for two of the species: the Hawk Owl and Pygmy Owl, whose long-term trends are stable. The Hawk Owl exhibits huge natural fluctuations in its population. In addition, its habitats are extensive northern coniferous forests and mountain birch forests, which are insufficiently surveyed.

Causes

The majority of owls are specialised hunters, feeding mainly on small rodents, and their numbers therefore vary greatly for entirely natural reasons, depending on the availability of rodents. Studies suggest that rodents in several areas of Sweden are in long-term decline and that the regularity of recurring peaks in their numbers is no longer as stable: (www.emg.umu.se/personal/lankar/hornfeldt/index3.html). This has probably had a negative impact on several owl species.

One example of this is that the last time a sizeable number of Snowy Owls bred successfully in Sweden was 1982, when there were at least 17 pairs. This was followed by a long period without any real "lemming years", so essentially this species did not breed at all. Only a few pairs were recorded as breeding successfully during a number of good lemming years in the 2000s. Snowy Owls breeding in Europe and Asia make up the same population and regularly change their nesting localities, depending on where rodents are numerous. The long period without a plentiful supply of lemmings in the Swedish mountains may have caused the region to (temporarily) lose its appeal to breeding Snowy Owls. The Short-eared Owl has probably also suffered from the decline in rodent availability, but other factors, such as overgrowth of previously open habitats and a less varied farmland landscape may have exacerbated their decline. Species with a more varied diet, such as the Eagle Owl, Tawny Owl and Pygmy Owl, are probably less affected when rodent fail to peak.

Many Ural Owls and Great Grey Owls nest in nest boxes or artificial nests. Hence, the erection of large numbers of these in many areas has to some extent compensated for the loss of natural nest trees in the forest landscape. It is likely that the populations of both species would be considerably smaller without this help. Paradoxically, clear cutting of forest has probably locally benefited the Ural Owl in particular, since there are then more open areas suitable for hunting, and clear cutting may boost numbers of small rodents in the short term. However, the owls must also be provided with nesting boxes (Mikkola 1983, Svensson et al. 1999). But this theory has been challenged, and there may be regional differences in how these species are affected by forest felling (O. Stefansson, pers. comm.). The Great Grey Owl has shown a tendency to be extending its range southwards since the 1960s. This may be partly due to the use of artificial nests, but may also be because more nesting pairs have been discovered. Nor can entirely natural causes be ruled out. The Great Grey Owl often uses Goshawk nests for nesting purposes in old forests (Cramp 1985). Locally, felling of old forest in northern Sweden has had a severe impact on the Great Grey Owl (O. Stefansson, pers. comm.).

Five species require cavities, mainly in trees, to nest. Modern forestry practices do not leave many old trees, nor are new suitable trees produced. This

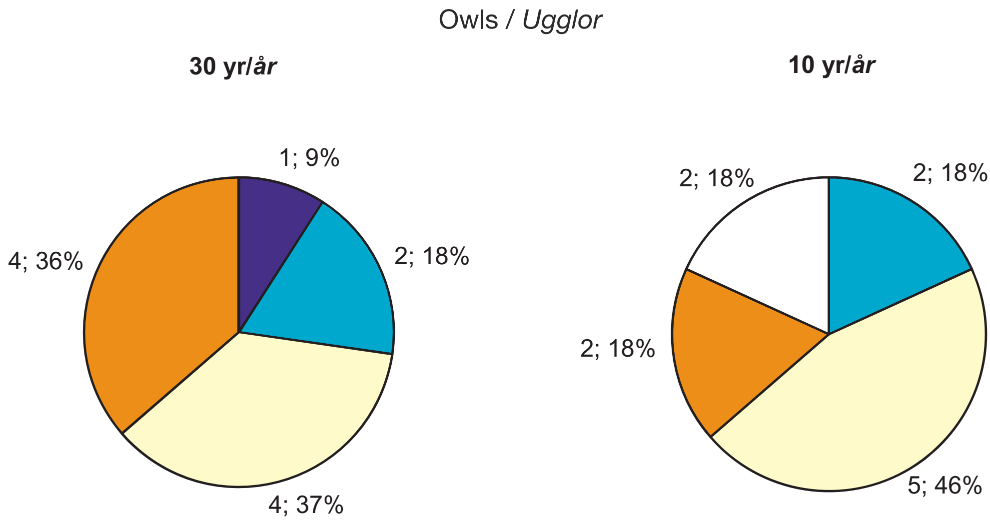

Figure 7. Number and percentage of owl species in various trend categories over the last 30 years (left) and 10 years (right). For further information on how to read the graphs, see Figure 3.
Antal och andel ugglearter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

reduces the availability of natural cavities and hence nesting opportunities for owls. As far as we know, the effects of the statutory duty of consideration for nature conservation by forestry to leave tall tree stumps and dead trees has not been studied systematically, but it is essential that a study of this kind is carried out. A study should also be made of how well forest owners plan to allow nest tree continuity.

Several of the larger owls were formerly persecuted, sometimes systematically. In particular, the Eagle Owl (which also suffered the effects of biocides) was on the verge of extinction in Sweden. Thanks to extensive conservation measures involving nest guarding and captive breeding, their number gradually began to rise, and for a time the Eagle Owl had virtually recolonised its former range. There is evidence that numbers have fallen once again in recent years, although there is no obvious explanation for this. Mortality is high close to power lines and transformer stations. It is thought that 10–14% of Eagle Owl mortality is due to this factor alone (Fransson 2008). In northern Sweden the percentage may be as high as 42% (Abel & Stenman 1997). It is possible that Eagle Owls in Sweden, like their counterparts in Finland, have "suffered" from the covering of open dumps, where rats were a major source of food.

Knowledge gaps

The lack of good monitoring of the majority of owl species is a problem, and a national programme should be initiated. There is widespread interest among ornithologists in studying owls, which means that local knowledge of some species may be very good. Collection, collation and analysis of existing material currently in the possession of owl enthusiasts, as well as coordination of the efforts already being made, would substantially improve our knowledge of the national situation. It would be of particular interest to analyse the status of the Eagle Owl and the local declines reported in recent years. This should also be done in tandem with a comprehensive review and analysis of Eagle Owl projects and their beneficial effects. An analysis of the decline of the Short-eared Owl and its possible correlation with habitat loss is also a matter of urgency. Erection of Ural Owl nesting boxes seems to be a fairly common practice in many areas. It is known that the Ural Owl is very dominant at its nesting localities and scares off other species, even other raptors and owls (O. Stefansson, pers. comm.). There is no general information on the effects this may have on other species.

Proposed actions

- More stringent requirements that forestry operators leave older trees of all qualities, particularly those with cavities and standing dead trees, ensure that they are surrounded by buffer zones, and also plan for a continual succession of these trees.
- Work for sustainable use of non-protected forest land, with the presence of suitable trees, capable of sustaining viable populations of Swedish owl species.
- Work for the creation of more protected areas with suitable habitats for owl species whose populations have suffered. Designation of more reserves with structurally complex forests where many owls have their natural habitat.
- Work to ensure that power companies are obliged to insulate transformers to reduce the number of Eagle Owls electrocuted.
- Information to forest owners to routinely put up owl boxes (several per square kilometre) in their commercial forests until satisfactory continuity of nest trees is achieved. Erecting nesting boxes is one way of alleviating the symptoms of non-sustainable forestry and helps other organisms in need of structurally complex forest.

Birds in various habitats

A long list of external factors may affect the population trend for a given bird species. These include climate, weather, predators, hunting and persecution, pollutants, as well as the availability of suitable habitats for nest-building, rearing of young and foraging. These factors affect reproduction and survival, and thus population size to varying degrees. It would appear that the availability and quality of suitable habitats are factors of particular importance to many Swedish bird species (see, for example, Wretenberg et al. 2007 for farmland birds). Several habitats are the result of or heavily dependent on anthropogenic activities, not least farmland and forest, which are entirely or primarily shaped by agriculture and forestry. Since it is conceivable that whole groups of bird species that are typical of certain habitats may be similarly affected by human or other influences, we have chosen to analyse groups of birds dependent on various habitats. In so doing, we have found it appropriate essentially to follow the classification of habitats defined in the environmental objectives laid down by the Swedish Parliament, particularly since birds have been used as indicators of biodiversity under the environmental objectives since 2007 (Ottvall et al. 2006, www.miljomal.nu).

Out of the 16 National Environmental Objectives, we have found the following to be suitable for separate analysis with the official name followed by the chapter name we have used in parentheses: 8. Flourishing Lakes and Streams (Freshwater birds); 10. A Balanced Marine Environment (Coastal birds); 11. Thriving Wetlands (Freshwater birds); 12. Sustainable Forests (Forest birds); 13. A Varied Agricultural Landscape (Farmland birds); 14. A Magnificent Mountain Landscape (Mountain birds); and 16. A Rich Diversity of Plant and Animal Life (Red-listed species). In the case of Environmental Objectives 8 and 11 it was particularly difficult to allocate different species to a single habitat category, and we therefore chose to combine these under the heading "Freshwater birds". We have not made any analysis for Environmental Objective 15: A Good Built Environment. It is true that our urban areas are home to a sometimes fairly diverse avifauna in valuable habitats (Mörtberg 2004, Hedblom & Söderström 2008), but far too few species are heavily dependent on that habitat alone.

Each species has been allocated to one or more habitats according to where they breed. A species is dealt with under a certain habitat category if the majority of the population is considered to occur (breed) in that habitat. Some bird species specialise in habitats not dealt with here (for example the most urban species), and others are typical generalists, found in a wide diversity of habitats. Thus, not all Swedish species are represented in the habitat-specific analyses. On the other hand, since the habitat classification is sometimes difficult, overlaps are inevitable, so that some species are represented in more than one of the following habitat analyses. A further complication is the fact that a given species may be a specialist in different habitats in different parts of the country. For instance, the Wheatear is a typical bird of farmland in southern Sweden, but in the country as a whole it is most numerous in mountainous areas above the tree line (“alpine heath”). The species is therefore dealt with in both the mountain and the farmland sections.

Freshwater birds

This selection comprises 75 species, in practice most breeding birds that we associate mainly with fresh water of different types. Species not included are certain typical coastal birds that also frequent freshwater habitats to some extent. These fall instead under our analysis of "Coastal birds". Some

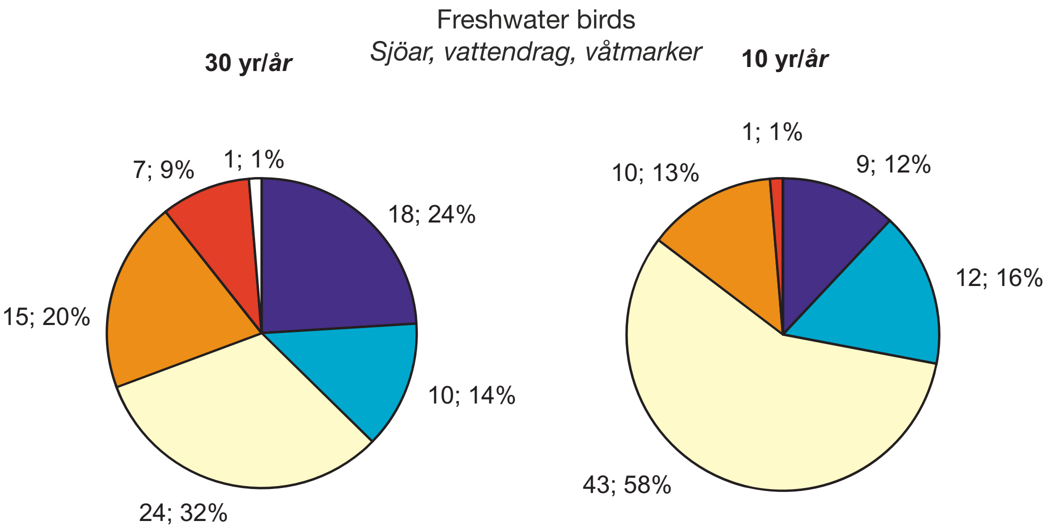

Figure 8. Number and percentage of freshwater species in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to read the graphs, see Figure 3.
Antal och andel arter vid sjöar, vattendrag och våtmarker i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

species have been found to have a sufficiently important presence in at least two habitats to be included in several habitat analyses. Six of the species under "Freshwater birds" are therefore also dealt with under "Coastal birds". These are Cormorant, Mute Swan, Velvet Scoter, Common Gull, Common Tern and Arctic Tern. More details about the trends for a number of waders are given in the section on waders.

Data on approximately 20% of the species are unsatisfactory (Table 7). Most of the species on which data are poor are either ducks (for example, Wigeon, Pintail, Long-tailed Duck and Common Scoter), of which several are hunted in Sweden or elsewhere, or birds breeding on bogs in northern Sweden (for example, Bean Goose, Broad-billed Sandpiper, Jack Snipe and Spotted Redshank).

The number and percentage of species in various trend categories are shown in Figure 8. If we include only species for which data quality is good (category 2 and 3), we find that there is a higher proportion of increasing species (47%) as compared with 37% for all species during the entire 30-year period. Conversely, the number of stable species is lower if only the group for which data quality is good is included (24%) as compared with 33% for all species. The proportion of declining species is almost the same, whatever selection is made.

Table 7. Number (and percentage) of all freshwater species (n=75 species*) in different data quality categories over the last 30 and 10 years.
Antal (och andel) arter vid sjöar, vattendrag och våtmarker (n=75 arter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.*

Data quality *Datakvalitet*	30 years (n=75) *30 år*	10 years (n=75) *10 år*
0	6 (8 %)	4 (5 %)
1	11 (15 %)	9 (12 %)
2	16 (21 %)	15 (20 %)
3	42 (56 %)	47 (63 %)

* Red-throated Loon, Black-throated Loon, Little Grebe, Great Crested Grebe, Red-necked Grebe, Horned Grebe, Black-necked Grebe, Cormorant, Bittern, Grey Heron, Mute Swan, Whooper Swan, Bean Goose, Greylag Goose, Canada Goose, Wigeon, Gadwall, Teal, Mallard, Pintail, Garganey, Shoveler, Pochard, Tufted Duck, Scaup, Long-tailed Duck, Common Scoter, Velvet Scoter, Goldeneye, Smew, Goosander, Marsh Harrier, Osprey, Water Rail, Spotted Crake, Moorhen, Coot, Crane, Little Ringed Plover, Ringed Plover, Golden Plover, Broad-billed Sandpiper, Jack Snipe, Common Snipe, Whimbrel, Spotted Redshank, Redshank, Greenshank, Green Sandpiper, Wood Sandpiper, Common Sandpiper, Red-necked Phalarope, Little Gull, Black-headed Gull, Common Gull, Common Tern, Arctic Tern, Black Tern, Short-eared Owl, Kingfisher, Sand Martin, Meadow Pipit, Yellow Wagtail (*thunbergi*), Grey Wagtail, Dipper, Thrush Nightingale, Grasshopper Warbler, River Warbler, Savi's Warbler, Sedge Warbler, Reed Warbler, Great Reed Warbler, Bearded Reedling, Penduline Tit, Reed Bunting.

Trends

A comparison between the whole 30-year period and the final 10 years indicates a general pattern, with a greater number of stable species over the last decade than during the period as a whole. As mentioned earlier, this may be partly because 10 years can be too short a period to identify trends. It is worth noting, however, that almost all species that had stable populations throughout the 30-year period have had the same trend over the last decade. The species with stable populations over both periods are found fairly evenly dispersed across the list of species. In other words, they are not concentrated in any particular family or order. It is notable that Garganey, Shoveler and Black Tern are among the group of birds that are stable in the long term. The common opinion has often been that they are on the decline (see, for example, Ahlén & Tjernberg 1996).

For both periods there are more species that have increased than have declined. Moreover, the ratio between the number of increasing and decreasing species during the two periods has increased from 1.3:1 to 2:1 over the last 10 years. One reason for this is a slower rate of decline over the last decade, or a levelling-out, for a considerable number of species that have long done badly. Thirteen species have moved from either the decline or the large decline category over the 30-year period to the stable category over the past decade.

Species in large long-term decline (>50%) for which the evidence is persuasive are Common Snipe, Black-headed Gull, Sand Martin, Thrush Nightingale and Grasshopper Warbler. However, the extent of decline in the Moorhen, Short-eared Owl and Yellow Wagtail (*thunbergi*) is uncertain due to poor data quality. The Short-eared Owl, Thrush Nightingale and Grasshopper Warbler have continued to decline over the last 10 years, whereas the Common Snipe has increased markedly during the same period. Overall, the numbers clearly show that bird populations in wet habitats in Sweden have generally done well during the period in question.

Causes

Taking the species that have increased the most throughout the 30-year period into account, we find certain general patterns. A majority of them have fairly northerly winter quarters. Several spend the winter in the agricultural landscape, and at least some of them are hunted. One striking observation, for instance, is how well swans, geese and some ducks have done. Naturally, there are both general and more species-specific reasons behind the observed changes. One important general factor is likely reduced winter mortality resulting from the near-absence of cold winters in the latter part of the 30-year period (Nilsson 1984, Koskinen et al. 2003). In addition, changes in agricultural practices have probably had a beneficial effect, particularly on winter survival rates. Agricultural factors mentioned as positive for several species are increased field size, greater use of artificial fertilisers (probably resulting in higher production and better food quality), as well as more widespread use of high-energy crops (Madsen et al. 1999, Dessborn & Elmberg 2007). Many species of swans, geese and ducks are also very quick to adapt to changes in their food supply, which goes for functional as well as numerical responses.

Mention should here be made of the large-scale shift among Whooper Swans from eating aquatic plants in winter to grazing on farmland, particularly fields of winter-green oilseed rape (Nilsson 1997), and the habit of several species of geese of feeding on spillage from the sugar beet harvest (Nilsson & Persson 2000). If it is indeed so that climate and farming methods are among the most important reasons for the relatively favourable trend seen for this group of species, this may be seen just as much as a warning signal as a sign of healthy environmental status. This is because neither of these two factors is related to Swedish freshwater habitats *per se*. There is no doubt that the species in question have also benefited from reduced hunting pressure in their winter quarters (Madsen et al. 1999).

The creation of small lakes and ponds in recent decades, as well as large-scale restoration of a number of bird lakes has probably been a factor in the positive trend for some species of grebe (Little Grebe, Red-necked Grebe and Black-necked Grebe), species that have also benefited from mild winters.

The increases seen in some other species are hard to relate to habitat changes; they are the result of recent colonisation of Sweden. Little Gull and Great Reed Warbler are among the species that have increased most. They have increased because the ongoing extension of their ranges has only recently reached Sweden, not because our lakes have changed in their favour in recent years. Their colonisation of Sweden coincides to some extent with increased eutrophication during the 20th century. The fact that eutrophication has lessened in many Swedish lakes is more likely to be positive in the long term for many species, particularly for fish-eating birds of oligotrophic “clear-water” lakes such as the Black-throated Loon, Common Merganser and Osprey.

There are species breeding both in freshwater and coastal habitats. Some of these have increased sharply at a national level mainly due to increases in coastal habitats (Mute Swan, Common Tern and Artic Tern). The reasons for their increase should therefore be sought there, rather than in any changes in freshwater habitats.

The Black-headed Gull has declined sharply, but has also largely changed habitat from lakes to coasts and archipelagos. However, this shift in habitat has not compensated for the large-scale fall in its numbers, the reasons for which have not been fully established. Suggested factors are changes in agriculture, increased predation, diseases and deterioration of winter habitats (Källander 1996). The sharp decline of the Sedge Warbler over the 30-year period is generally thought to be due to more adverse conditions during migration and in its winter quarters in Africa (Foppen et al. 1999).

The decreasing number of Golden Plover and Jack Snipe on bogs in southern Sweden is mainly due to overgrowth, which in turn follows from abandonment of traditional farming practices, land drainage and increased nitrogen deposition.

This study, like many previous ones on the same group of birds, focuses on lake habitats. Nonetheless, there are four species of Swedish birds that are closely associated with running water. Among these, the Grey Wagtail has increased sharply, not least geographically (it is expanding its range northwards), which is probably largely a direct result of the recent series of relatively mild winters (Ottvall & Holmqvist 1997). Kingfisher numbers are falling and the Dipper population is stable. The fourth species, the Sand Martin, deserves particular mention due to its dramatic decline, whose cause is more likely to be changes in the use of sandpits and gravel pits than in its original habitats (steep sandy river banks) (Lind et al. 2002). Natural gravel extraction has roughly halved over the last 30 years, and the number of gravel pits has fallen as they have been "restored" without any thought being given to Sand Martins and certain insect species that are numerous in these man-made habitats (www.scb.se/statistik/_publikationer/MI0803_2004A01_BR_03_MI03SA0401.pdf).

Knowledge gaps

Although counts have been made of staging and wintering waterbirds in Sweden and the rest of Western Europe for many years in succession (Wetlands International 2006), it is striking how little we know about long-term population changes and year-to-year variations in the breeding populations of the same species. In a Swedish context, we have a good idea of large-scale population changes for some species, but for most species except geese, we have no knowledge of the detailed causal relationship with the birds' breeding habitats. This is a serious failing, particularly bearing in mind that many of the species in question are hunted in many EU countries. For nature conservation as well as hunting purposes, it is obviously desirable to have good information on the geographical origin of the birds that are hunted, and also some measure of their annual breeding success, to which hunting quotas can be adjusted (Elmberg et al. 2006). This will also require cross-border cooperation, since migratory birds are the responsibility of administrative authorities in different countries. It is also striking that many of the species in this selection are scarcely covered by the Fixed routes used in SBS. The fact that some of them are carefully counted in infrequent coastal bird censuses is no compensation, particularly not as the trends for one and the same species may differ markedly between lakes and archipelagos (for example, in the case of the Black-headed Gull). Hence, we see a pressing need and several compelling reasons for initiating a long-term monitoring programme using standardised counts for mainland breeding populations of geese, ducks and waders, or at least for the species of most importance in conservation and hunting terms. A monitoring programme covering lakes and bogs during the breeding season would be particularly useful. Programmes monitoring species that are naturally rare and heavily dependent on a certain habitat, such as Kingfisher, Bearded Reedling and Dipper, are easy to design but expensive to carry out.

Proposed action

- Restore bird lakes and adjacent wet meadows, including regular mowing or grazing.
- Limit the introduction of fish in small lakes and ponds.
- Active management by draining small lakes and ponds to limit fish numbers.
- Recreate natural wetlands with flat shores in areas of arable farming.
- Limit leaching of nutrients from agriculture.
- Restore drained bogs to their former condition.
- Resume mowing of bogs that were previously mown.
- Clear overgrown bogs.

Coastal birds

The entire, or main part, of the Swedish population of the species treated in this selection are breeding in coastal habitats. There is some overlap with species breeding in freshwater habitats: six species are dealt with in both sections. Many species that are found predominantly in lakes, rivers and streams but that also are numerous along our coasts are not dealt with here, only in the section entitled "Freshwater birds". Waders frequenting wet meadows are dealt with in the section on waders, although three species occurring both in wet meadows and in archipelagos are included here. The species discussed here comprise one cormorant, five ducks, three waders, one skua, six gulls (five species), five terns, three auks and a passerine. Our knowledge of coastal birds is generally good: repeated surveys have been performed along most sections of Swedish coast over the last 30 years (Table 8). However, these are often carried out at lengthy intervals (10–20 years), so we usually do not have detailed knowledge of intermediate changes in population sizes.

Table 8. Number (and percentage) of all coastal birds (n=24 species*, including one species with two subspecies) in different data quality categories over the last 30 and 10 years.
Antal (och andel) kustfågelarter (n=24 arter*, inklusive en art med två underarter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.

Data quality *Datakvalitet*	30 years (n=25) *30 år*	10 years (n=25) *10 år*
0	0 (0 %)	0 (0 %)
1	1 (4 %)	0 (0 %)
2	1 (4 %)	2 (8 %)
3	23 (92 %)	23 (92 %)

* Cormorant, Mute Swan, Shelduck, Eider, Velvet Scoter, Red-breasted Merganser, Oystercatcher, Ringed Plover, Turnstone, Parasitic Jaeger, Common Gull, Herring Gull, Great Black-backed Gull, Lesser Black-backed Gull (*intermedius*), Lesser Black-backed Gull (*fuscus*), Kittiwake, Caspian Tern, Sandwich Tern, Common Tern, Arctic Tern, Little Tern, Guillemot (Common Murre), Razorbill, Black Guillemot, Rock Pipit.

Trends

In general, Swedish coastal birds have done well over the last 30 years, although there are large regional and local variations. Almost 70% of the species have either increased in number or remained stable (Figure 9). Eight species (populations) have declined, some of them dramatically. Those suffering the most large long-term declines are Velvet Scoter, Turnstone, Lesser Black-backed Gull (*fuscus*) and Sandwich Tern. The declines of Velvet Scoter and Turnstone seem to be continuing, whereas the trends for the Lesser Black-backed Gull (*fuscus*) and Sandwich Tern have levelled off, or even been slightly reversed in some regions (*fuscus*). One species perhaps somewhat surprisingly found among the stable species in a 30-year perspective is the Rock Pipit. There is no doubt that this species has declined sharply in the Baltic, but most of the decline occurred before the period covered here. The continuing decline in the Baltic area is instead counterbalanced by an increase on the west coast (and to some extent along the Bothnian Sea coast). The species in this group increasing most over the last 30 years are Cormorant, Mute Swan, Eider, Great Black-backed Gull, Common Tern, Arctic Tern and Guillemot (Common Murre). Over the last 10 years the populations of almost half of the species have been stable, one fifth has increased, and just under a third has declined in number. In other words, things are not quite so positive in the shorter term. Some species exhibit clear trend reversals over the 30-year period, where the last 10 years reveal a markedly different trend from the first twenty – one example is mentioned above (*fuscus* Lesser Black-backed Gulls in the Baltic). It should be mentioned that this population still remains far below its pre-decline level. Another case is the Eider, which has undergone a dramatic long-term increase, but which has declined sharply in the last 10 years. There are however still far more Eiders today than there were 30 years ago. It may also be noted that sharply rising trends for some species have continued over the last 10 years. Examples include Cormorant, Common Tern, Arctic Tern and Razorbill.

The overall trend for the avifauna of coastal habitats would have been more negative if some waders frequenting wet meadows had been included in the analysis. However, of the species excluded, only the Avocet, Kentish Plover, Southern Dunlin and to some extent Black-tailed Godwit are heavily dependent on coastal wet meadows. Even if these four species were included in the analysis, there would still have been more species increasing than decreasing in numbers over the 30-year period. On the other hand, the negative trend for coastal birds over 10 years would have become more pronounced if these species had been included.

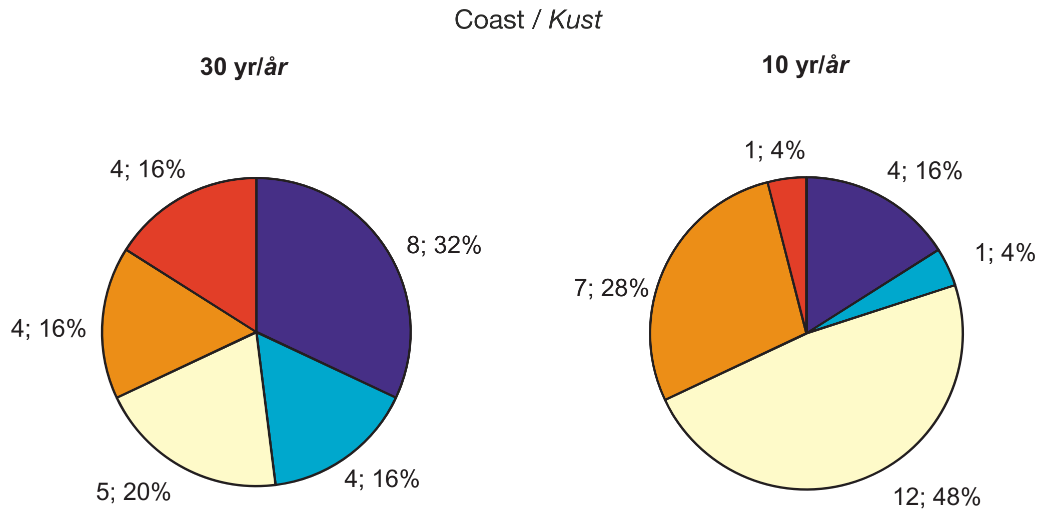

Figure 9. Number and percentage of coastal bird species in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to read the graphs, see Figure 3.
Antal och andel kustfågelarter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

A note of caution must be given with regard to the trends observed. Many surveys are biased towards the inner rather than the central and the outer parts of the archipelagos. If birds are tending to "move out" from the inner and central archipelago to the outer islands, the increases seen may actually be the result of this redistribution, rather than any real increase in total numbers. Although there are indications that this has in fact happened in a number of archipelagos (Åhlund 1996a, Aspenberg & Axbrink 1998), the instances where surveys have been performed in entire archipelagos (including inner and central areas) nonetheless suggest that several species at the same time have increased in number overall.

Geographical differences in trends

All in all, the overall trend in the Baltic Sea proper has not been as favourable as that in other coastal areas. The most positive general trend was found in Bothnian Sea and Bothnian Bay. Also worth noting is that species that are in general decline have exhibited a lower rate of decline or have even increased in number in the north, for example Velvet Scoter and Turnstone. In general, developments along the west coast have also been more favourable than in the Baltic proper, but here there are signs of a negative trend for several species in the last few years. A comparison between the surveys made in the 2000s with those from the 1960s and 1970s reveals that no less than 95% of the species dealt with here increased in number in Västerbotten, northern Sweden. In Stockholm county the corresponding figure was 59%, in Blekinge (southern Sweden) it was 47% and in Västra Götaland (western Sweden) 89%. These figures largely reflect the patterns noted in each region (Bothnian Sea – Bothnian Bay, northern Baltic, southern Baltic, West coast).

Causes

Possible factors behind the general population increases are well summarised in Åhlund (1996a), Aspenberg & Axbrink (1998) and Sundström & Olsson (2005). Paradoxically, the main reason for these population increases is probably the same factor that constitutes one of the greatest threats to marine systems across the globe (including birds of the Baltic Sea and Swedish West coast), that is, the influx of nutrients from human activities (Nixon 1990, HELCOM 1993, Rönkä et al. 2005). Eutrophication ultimately has a general negative impact on water quality and biodiversity (Rumohr et al. 1996, Bonsdorff et al. 1997), but in the short term the effects are probably mostly positive. Initially, there is greater availability of food for birds as a result of increased production by plants, invertebrates and fish (Beukema & Cadee 1991, Pitkänen 1994, Bonsdorff et al. 1997), which in turn enable bird populations to grow and may allow expansion into new habitats (Rönkä et al. 2005). This is probably exactly what has happened with our coastal birds. This may also be a factor that at least partly explains the differences between different parts of Sweden's coast, along with a population shift from inner to outer archipelagos. Another factor highlighted as positive, at least in the short term, is that of climate change. There has been a large proportion of mild winters over the last 30 years, which naturally favours species with northern wintering grounds (such as several species in this selection), as winter survival improves (Nilsson 1984, Koskinen et al. 2003). A third key factor in population increase is a decreased hunting pressure and persecution of some species. Hunting pressure on birds of the coast has generally decreased in recent decades (see the section on game species), as has egg collection and persecution of certain species (Aspenberg & Axbrink 1998, Engström & Pettersson 2002).

Even though the general situation described above is positive, there are a number of species that have declined, or even declined sharply. Bader et al. (2006) provide an excellent account of the factors that have affected, or may affect, coastal birds adversely. These are, in no particular order: i) oil spills (primarily in winter quarters), ii) eutrophication, iii) predation by mink, iv) increased boat tourism and other forms of mobile outdoor recreation, v) pollution, vi) diseases, vii) bycatches in fishing nets, viii) overgrowth of breeding islands, ix) changes in composition of fish assemblages and x) food shortage. It has not been established which of these factors are behind the declines observed in certain species; in several cases it is likely that declines are due to a combination of factors. It may be noted that some of the species in long-term decline are long-distance migrants (Turnstone, Lesser Black-backed Gull (*fuscus*), Caspian Tern and Sandwich Tern), which means that the reasons for decline are not necessarily to be found in Sweden or the surrounding area.

Our general conclusion is that factors such as mink predation and disturbance caused by mobile outdoor recreation, which are often given as the reason for population declines among coastal birds, mainly have local or regional effects and have not yet had a national impact. Locally, predation by mink has had very serious consequences, and is of course a real problem in those places. Detailed studies have shown that measures taken to mitigate mink predation can have a positive effect for breeding birds (Amcoff 2001), although the degree of improvement has been found to vary from one species to another (Nordström et al. 2002).

Knowledge gaps

We consider our knowledge of trends to be fairly good for this group of birds. As in many other contexts, we do not know enough about the specific causes of population change, particularly for the species in decline. There are obviously prospects here for further studies and elucidation.

A comprehensive system for monitoring population trends of breeding birds along our coasts should be developed. As far as we know, the present analysis is the first covering all Sweden's coastal areas and hence the first presentation of national trends for birds in coastal habitats. Reports of this type should be produced more often. A monitoring system with more frequent surveys than hitherto is also desirable; methods for such a system have recently been developed for the archipelago off the west coast, Norra Kvarken, and also for the inland archipelagos in Lakes Vänern and Mälaren. Synchronised monitoring, not necessarily employing exactly the same methods but with the same interval between repeats, is desirable. For one thing, birds (most being at the top of the food chain) are excellent indicators of the general status of the marine environment (Furness & Camphuysen 1997). For another, we may expect that the positive picture presented here will turn into a more negative one in the near future. This is because we are now probably approaching the end of the positive phase of eutrophication and perhaps heading towards the downside of this phenomenon. Since mobile outdoor recreation is continually growing, there is a need to evaluate the effect of current bird protection areas for the avifauna of archipelagos. If birds have indeed moved from their inner to their outer areas, this may be because of growing disturbance from outdoor recreation. There may therefore be a need for more bird protection areas with prohibited entry during the sensitive breeding period.

Proposed action

- Limit nutrient leaching into the marine environment.
- Vigorous measures to combat oil spills.
- Limit pollution of the marine environment.
- Create more marine reserves.
- Measures to combat bycatches of birds in fishing gear (in our waters mainly auks).

- Measures to counter predation by mink in areas where this is a problem.
- Clearing of overgrown islets and skerries frequented by birds.

Forest birds

Forest covers almost 60% of Sweden's surface and is therefore the most important habitat type in terms of area. We have classified 63 species as being dependent on forest, comprising grouse (3 species), waders (2 species), Stock Dove, Nightjar, woodpeckers (8 species) and passerines (48 species). Of the passerines, we have chosen to divide the Willow Warbler and Chiffchaff into southern and northern subspecies. There are also three raptors (Honey Buzzard, Goshawk and Hobby), and seven owls (Hawk Owl, Pygmy Owl, Tawny Owl, Ural Owl, Great Grey Owl, Long-eared Owl and Tengmalm's Owl (Boreal Owl)) closely associated with forests, but we have chosen to deal with these species in other sections.

We have analysed the trend for forest species in general and for a selection of species split up into groups associated with structurally complex forests[2] (ST), deciduous forests (BL) and cavity-nesting (C) species dependent on large living and dead trees. The division into three categories was performed to achieve a clearer link to the national Environmental Objectives for forests. A species may belong to more than one category (Table 9).

Background data are of satisfactory quality (class 2 and 3) for 81% of the species over the 30 year and 91% over the 10 year period (Table 9).

Table 9. Number (and percentage) of all forest birds (n=63 species*, including two species with two subspecies) in different data quality categories over the last 30 and 10 years.
Antal (och andel) skogsfågelarter (n=63 arter, inklusive två arter med två underarter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.*

Data quality *Datakvalitet*	30 years (n=65) *30 år*	10 years (n=65) *10 år*
0	4 (6 %)	3 (5 %)
1	8 (12 %)	3 (5 %)
2	10 (15 %)	14 (21 %)
3	43 (66 %)	45 (69 %)

* Hazel Hen (BL**), Black Grouse, Capercaillie (ST), Woodcock, Green Sandpiper, Stock Dove (BL, C), Nightjar, Wryneck (BL, C), Grey-headed Woodpecker (BL, C), Green Woodpecker (BL, C), Black Woodpecker (ST, C), Greater Spotted Woodpecker (C), White-backed Woodpecker (ST, BL, C), Lesser Spotted Woodpecker (ST, BL, C), Three-toed Woodpecker (ST, C), Wood Lark, Tree Pipit, Waxwing, Dunnock, Thrush Nightingale (BL), Redstart (ST, C), Fieldfare, Song Thrush, Redwing, Mistle Thrush, Icterine Warbler, Garden Warbler, Blackcap, Greenish Warbler (ST), Wood Warbler (BL), Chiffchaff (*abietinus*), Chiffchaff (*collybita*), Willow Warbler (*acredula*, BL), Willow Warbler (*trochilus*, BL), Goldcrest, Red-breasted Flycatcher (ST, BL), Spotted Flycatcher, Collared Flycatcher (BL, C), Pied Flycatcher (C), Long-tailed Tit (L), Marsh Tit (ST, BL, C), Willow Tit (ST, C), Siberian Tit (Grey-headed Chickadee) (ST, C), Crested Tit (ST, C), Coal Tit (C), Blue Tit (BL, C), Great Tit (BL, C), Nuthatch (BL, C), Treecreeper (ST), Golden Oriole (BL), Jay, Siberian Jay (ST), Nutcracker, Raven, Chaffinch, Brambling, Siskin, Two-barred Crossbill, Red Crossbill, Parrot Crossbill, Pine Grosbeak (ST), Bullfinch, Hawfinch (BL), Rustic Bunting, Little Bunting.
**ST=species in structurally complex forests; BL= species favouring deciduous forest; C=cavity-nesting species.

Trends

Over the 30 years 42% of all forest species show a declining trend, 27% were stable and 26% have increased. The corresponding figures for the last 10 years of the period are 17%, 41% and 39%, respectively (Figure 10). This means that many negative trends have levelled off in recent years and/or been replaced by an increase. This pattern is the same whether or not only species with the best data quality (class 2 and 3) are included. The situation for forest species would have been even more favourable if the species excluded (three raptors and seven owls) had been included in this analysis.

Species dependent on structurally complex forests (15 species), that is mostly non-managed or extensively managed forest, have fared worse over the last 30 years than have forest birds as a whole. Of these more demanding species, 54% declined over 30 years, compared with 42% for the group as a whole. Thirty-four per cent have continued to decline over the last 10 years, compared with 17% for the group as a whole. Thus species dependent on complex forests continue to do more poorly than forest birds in general (Figure 11).

Among species dependent on deciduous forest (21 species) the proportion of species in decline was lower during the last 10 years (10%) as compared with the whole 30-year period (43%). Similarly, the percentage of stable or increasing species has been higher (90%) during the last 10 years of the period than it has over the whole period (57%). Species tied to deciduous forest have thus done bet-

[2] *Here we refer to dense multi-storey forests with numerous old trees, often with a high proportion of standing and lying dead wood. We prefer this term to the less precise term "old forest".*

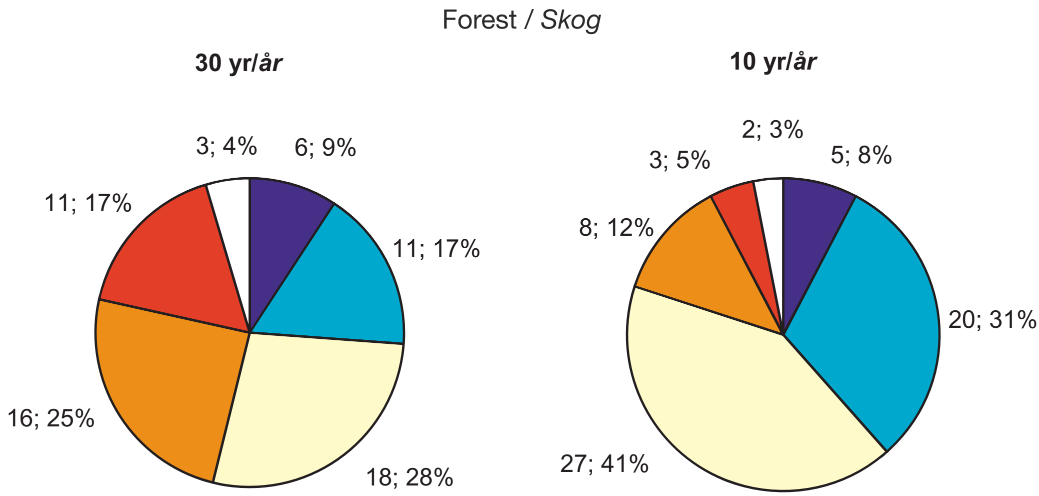

Figure 10. Number and percentage of forest bird species in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to read the graphs, see Figure 3.
Antal och andel skogsfågelarter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

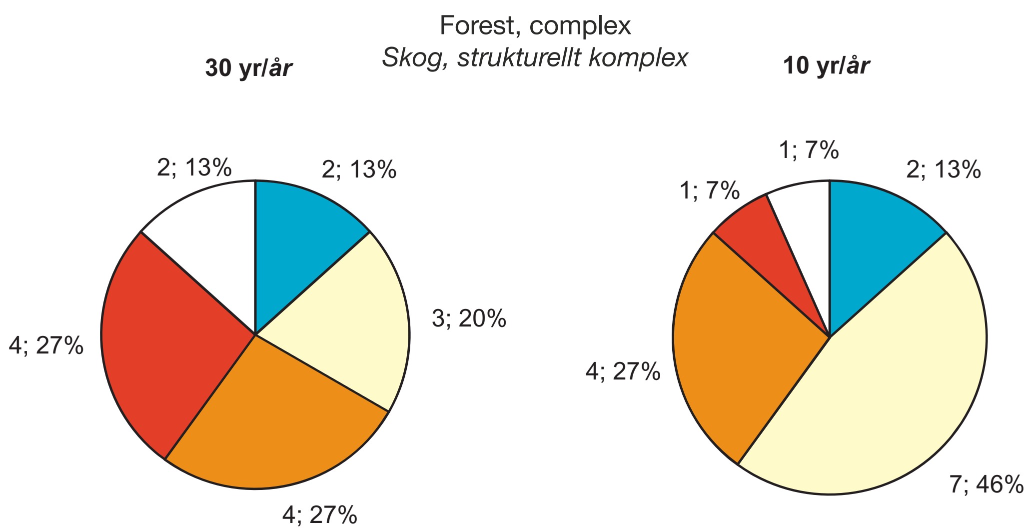

Figure 11. Number and percentage of forest bird species dependent on structurally complex forests in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to read the graphs, see Figure 3.
Antal och andel skogsfågelarter beroende av strukturellt komplexa skogar i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

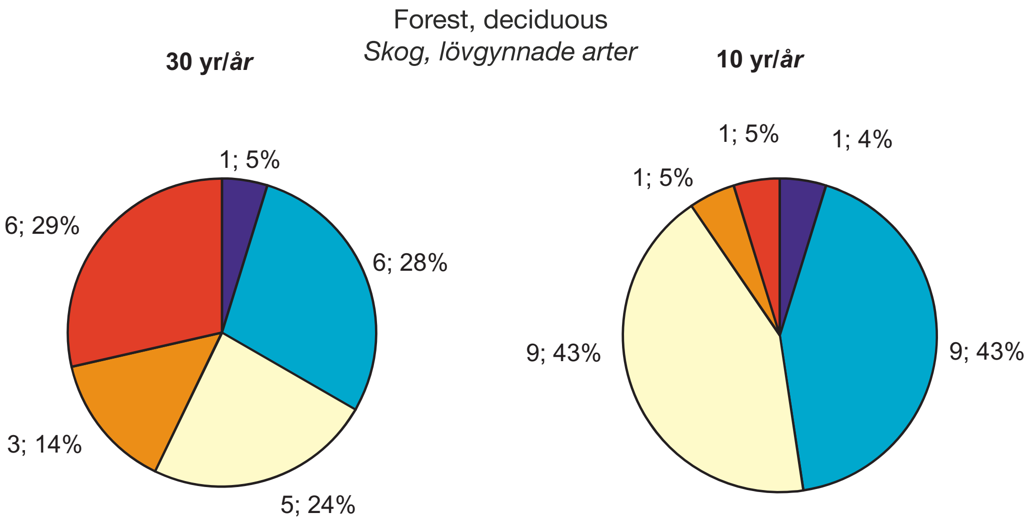

Figure 12. Number and percentage of forest birds favouring deciduous forest in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to read the graphs, see Figure 3.
Antal och andel lövgynnade skogsfågelarter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

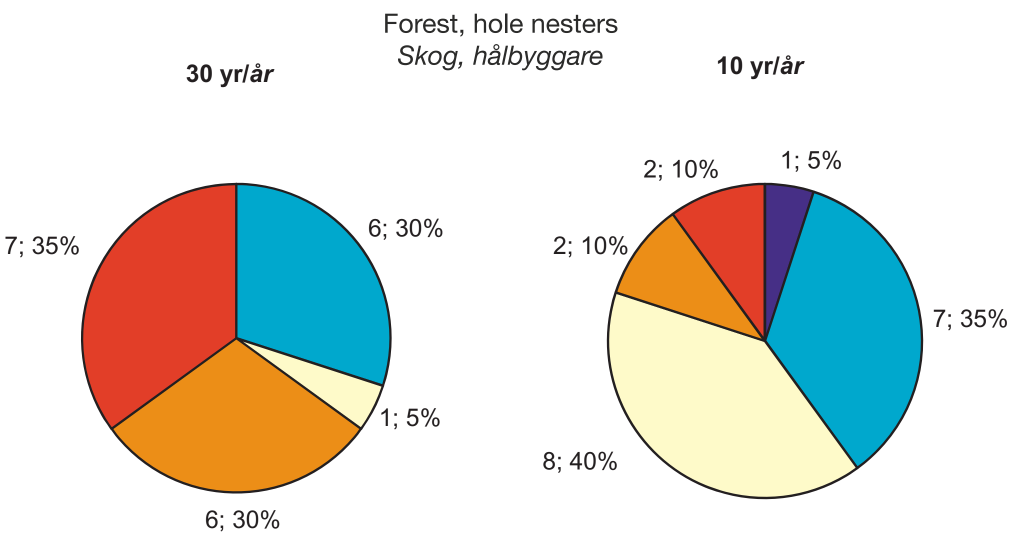

Figure 13. Number and percentage of cavity-nesting forest birds in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to read the graphs, see Figure 3.
Antal och andel hålbyggande skogsfågelarter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

ter that forest birds as a whole (Figure 12). The pattern for cavity nesters (20 species) is similar to that for the whole group, which is that 65% of the species declined during the 30-year period, with 20% continuing to decline over the last 10 years (Figure 13). The corresponding percentages for stable or increasing species are 35% (all 30 years) and 80% (the last 10 years).

Among species dependent on structurally complex forests, the Willow Tit and Treecreeper have both decreased strongly. Several of these species, including Three-toed Woodpecker, Redstart and Siberian Tit (Grey-headed Chickadee), have experienced a long-term decline that recently seems to have levelled out. The Siberian Jay is thought to have declined during the 10-year period, but unfortunately we have no good data to assess the 30-year trend.

Among birds dependent on deciduous habitats, Grey-headed Woodpecker, Blue Tit, Nuthatch and Hawfinch are clear winners, while the Thrush Nightingale is the only obvious loser in the group. The long-term negative trend for Stock Dove, Wryneck and Great Tit seems to have been replaced by a recent increase. The positive trend for Wood Warbler and Collared Flycatcher seems to have levelled off in recent years.

Cavity nesters include one clear loser: the Coal Tit. The negative trend for Green Woodpecker, Greater Spotted Woodpecker and Pied Flycatcher has been reversed, while the Stock Dove and Wryneck are now increasing rather than declining. The Black Woodpecker differs from this picture in that it first increased and then decreased.

Causes

Fragmentation and shrinking areas of older forest, fewer deciduous trees, structurally more uniform forests, and a higher proportion of young forest are factors often discussed in connection with forest bird population trends (Helle & Järvinen 1986, de Jong 2002, Forslund 2003). We thus focus on these factors.

Finnish studies show that fragmentation of older forest has had a particularly negative impact on population trends for many birds – mainly resident species – since the Second World War. Fragmentation of that magnitude and on that scale took place before the 30-year period dealt with here; studies in various parts of the boreal forest show that the landscape transformation resulting from forestry was largely completed by the 1960s and 1970s (Kouki et al. 2001). That does not mean that fragmentation of older forest is no longer of any importance, since the pressure on relict older forest, sufficiently mature for felling outside nature conservation areas is steadily growing. In addition, there may be a time lag in changes in population size caused by habitat changes and bird numbers in the 1970s (when the 30-year study assessment period begins) may have been greater than could be sustained by the habitats in the longer term (that is, "extinction debt", cf. Angelstam & Mikusinski 2001). The population dynamics of relict areas of older forest are heavily influenced by events in the surroundings. Helle (1986) found that, in Finland, areas of up to 70 km^2 did not operate as closed systems. Studies show that the breeding success of the Treecreeper deteriorates in small relict areas of old growth forest and close to borders with young forest (Suorsa et al. 2005). The species has declined markedly over the last 10 years after 20 years of stable numbers. The Willow Tit is also decreasing, but the reasons for this are largely unknown. We know worryingly little about what makes structurally complex forest better for demanding species than efficiently managed forest. It is has been reported from Finland that the Siberian Tit (Grey-headed Chickadee) produces larger broods in undisturbed than in managed forest, and a conceivable explanation is differences in food supply (Virkkala 1990). Swedish studies have shown that the Siberian Jay prefers multi-storey forests for feeding purposes and succeeds better in those forests than in forests that have been thinned, or are otherwise single storey (Edenius & Meyer 2002, Griesser et al. 2007).

According to the National Forest Inventory, the area of old growth forest (defined as forest older than 140 years in northern Sweden and 120 years elsewhere in the country) has increased by just over 30% since 1998. The increase has been particularly marked in southern and central Sweden. Similarly, the quantity of dead wood has increased by almost 60% and the proportion by area of older deciduous-rich forest (that is, at least 25% deciduous trees, older than 80 years in northern Sweden and 60 in the rest of the country) has increased by around 15% since 1998, according to the same source. It may be that legislation, designation of nature reserves and forestry measures reflecting greater concern for the environment have helped to slow or halt the decline in numbers of many forest bird species.

One important factor that has probably played a part in the trends we can see is climate change. For instance, the average winter temperature increased by just over two degrees Celsius in the north-western part of central Sweden and much of the north of the country from the period 1961–1990 to 1991–2005 (Figure 23). Short-distance migrants may have benefited in terms of increased winter survival, but effects on resident species in the northern coniferous forests are less certain.

Evaluating the significance of individual factors is difficult, since birds react differently to changes in their habitat, depending on their life history, annual movements and resource requirements. The overall impression from research on the topic is that causes behind variations at the scale of populations of boreal forest birds are complex and that species with apparently identical ecological requirements may exhibit different patterns (Niemi et al. 1998). Moreover, there is a pronounced dependence of geographical scale in the responses of birds to changes in their habitat (Elmberg & Edenius 1996, Jokimäki & Huhta 1996, Angelstam et al. 2004), which makes interpretation more difficult. Resident birds are usually thought to be particularly sensitive to habitat changes, since they are completely dependent on local resources throughout the year, but our analyses show that the group exhibits highly heterogeneous trend patterns. For example, the Blue Tit and Nuthatch have increased markedly, and have also expanded their range northwards in recent years. In their case it is reasonable to suspect that the effect of warmer winters has gone hand in hand with, for them, positive habitat changes. Finally, many forest-dwelling passerines have a high reproductive capacity and short reproductive cycles in relation to the speed at which habitats can change over time. The ability to rapidly increase in number creates noise in the data and makes analysis of cause and effect more difficult.

Knowledge gaps

Much of what is known about long-term changes in Swedish forest bird populations comes from point counts made in the southern third of the country. From the late 1990s onwards the use of fixed routes has produced better national coverage and hence better knowledge of the situation in the north of the country. However, one problem is that we have such poor data on low density "taiga" species such as Siberian Tit (Grey-headed Chickadee), Siberian Jay and Pine Grosbeak. Although we are starting to obtain increasingly good quality data on population trends for forest birds, we still know little about underlying causal links. We are therefore unable to distinguish the effect of conservation measures from climate-related factors. This makes us poorly equipped to make predictions for the future.

Sweden is predominantly a forested country. Although we do know quite a lot about forest bird ecology thanks to Swedish studies (Edenius & Elmberg 1996, Jansson & Andrén 2003), and particularly Finnish studies (Schmiegelow & Mönkkönen 2002), it is obvious that more analyses of the relationship between forest bird trends and changes in forestry practices and the forest landscape need to be carried out. Forest data for different periods and covering the whole country are available, but the potential they offer for predicting forest bird occurrence and population trends has only been tested at a small scale. An initial step is analysis of national forest inventory data and bird trends, as well as the National Inventory of Landscapes in Sweden (NILS) and other data on forests and bird occurrence (Ottvall et al. 2007). Lastly, there is a need for large-scale experimental studies similar to those performed in North America (Schmiegelow et al. 1997). This would allow a critical evaluation of the importance and cost-effectiveness of various conservation measures.

Proposed action

- Increased area of protected forest. The few remaining sizeable areas of dense, structurally complex forest must receive long-term protection. They fulfill an important function as reference areas and potential strongholds for species under pressure.
- Landscape planning adapted to reflect environmental and conservation concerns. For example, the timing of felling should be viewed in relation to the age of the surrounding forest and its extent. Species such as Hazel Hen and Siberian Jay are reluctant to fly long distances over open ground; the spatial relationship between habitat patches is important to them, and landscape ecology planning is therefore required.
- Recreate structurally complex forests. Studies show that forest stratification is important. Leaving larger trees untouched during felling and smaller trees during clearing and thinning is therefore important. As far as possible, spruce should be saved in the under-storey on poorer soils.
- More conservation-oriented fires. Burning standing forest is an effective way of creating dead wood and good food substrates for various bird species. Experiments show that the Three-toed Woodpecker benefits from the plethora of insects occurring following a fire.
- Increased retention of old coniferous and de-

ciduous trees when felling. Ensure a continuous supply of older and dead trees. Individual trees and clumps of trees serve as song perches and look-out perches and are used by birds as they move between stands of trees.

- More consideration for forests bordering wetter land. Forest edges of this kind are important habitats for Capercaillie chicks and Rustic Bunting.
- Changes in management of forest edges. This habitat is important to several forest-dwelling species, as well as farmland birds.

Farmland birds

We have included 36 species that to a great extent breed on agricultural land. Other species frequenting agricultural land but not included are several wetland birds (for example, geese and waders). These are dealt with under "Freshwater birds". Although most of the species discussed in this section are also found in non-arable habitats, we have chosen to classify them as farmland birds. We further divided the group into farmland 'specialists' or 'generalists'. The generalists include species with large populations in other habitats as well. Specialists include species that largely or solely breed in farmland habitats.

The quality of data on farmland birds is consistently good or very good for southern Sweden populations (Table 10). Thirty-year trends in northern Sweden are largely unknown, since data are either absent or too scant for analysis. The trends presented below for farmland birds should therefore be seen as trends primarily for southern Sweden. On the other hand, by far the largest populations are to be found in the south of the country (with the exception of Curlew and Ortolan Bunting).

Table 10. Number (and percentage) of all farmland birds (n=36 species*) in different data quality categories over the last 30 and 10 years.
Antal (och andel) jordbruksarter (n=36 arter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.*

Data quality Datakvalitet	30 years (n=36) 30 år	10 years (n=36) 10 år
0	0 (0 %)	0 (0 %)
1	1 (3 %)	1 (3 %)
2	5 (14 %)	3 (8 %)
3	30 (83 %)	32 (89 %)

* *Specialists*: Red Kite, Montagu's Harrier, Kestrel, Grey Partridge, Quail, Pheasant, Corncrake, Lapwing, Curlew, Skylark, Barn Swallow, Yellow Wagtail (*flava*), Marsh Warbler, Whitethroat, Rook, Starling, House Sparrow, Tree Sparrow, Goldfinch, Linnet, Yellowhammer, Corn Bunting. Generalists: Buzzard, Wood Pigeon, Stock Dove, Wryneck, Green Woodpecker, Meadow Pipit, White Wagtail, Wheatear, Red-backed Shrike, Magpie, Jackdaw, Hooded Crow, Greenfinch, Ortolan Bunting.

Trends

The percentage of species in various trend classes is shown in Figure 14. Figures 15 and 16 show corresponding data for farmland specialists and generalists separately.

The farmland avifauna has had a difficult time over the last 30 years. In total, 58% of species have declined in number, of which 22% have declined sharply. Other species display either stable (14%) or increasing populations (28%). Increasing species are relatively uncommon ones such as Red Kite, Kestrel, Quail, Corncrake and Marsh Warbler whereas a number of common species, such as Skylark, Starling, Linnet and House Sparrow are among the decliners. The trends over the last 10 years suggest that several species are no longer declining and that some seem to be increasing in numbers again. There might be several reasons for this pattern. One possible explanation is that several species have simply reached a lower equilibrium after a sharp decline in the late 1970s and early 1980s. Unfortunately, several species continue to decline, including Skylark, Wheatear, Starling, House Sparrow and Linnet.

The present study reveals no clear difference in trends between generalists and specialists (compare Figures 15 and 16). The main reason for this is that uncommon species classified as specialists are also included in the study, and several of them have increased in recent years. If only common species had been included, the specialists would have exhibited a clearer decline than the generalists.

On balance, it might appear that the negative trend for farmland avifauna is to some extent levelling out, but a recent study has shown that population trends are extremely sensitive to prevailing agricultural policy (Wretenberg et al. 2007). For example, the strong decline of a number of species was halted and for some even increases were observed during the agricultural programme "Transition 90", when large areas of arable land were laid fallow. Numbers subsequently fell rapidly again when Sweden joined the EU and farming once more became more polarised (that is intensive on lowland plains with large farms and extensive in the small-scale agricultural landscape of forest regions). Since changes in agricultural policy instant-

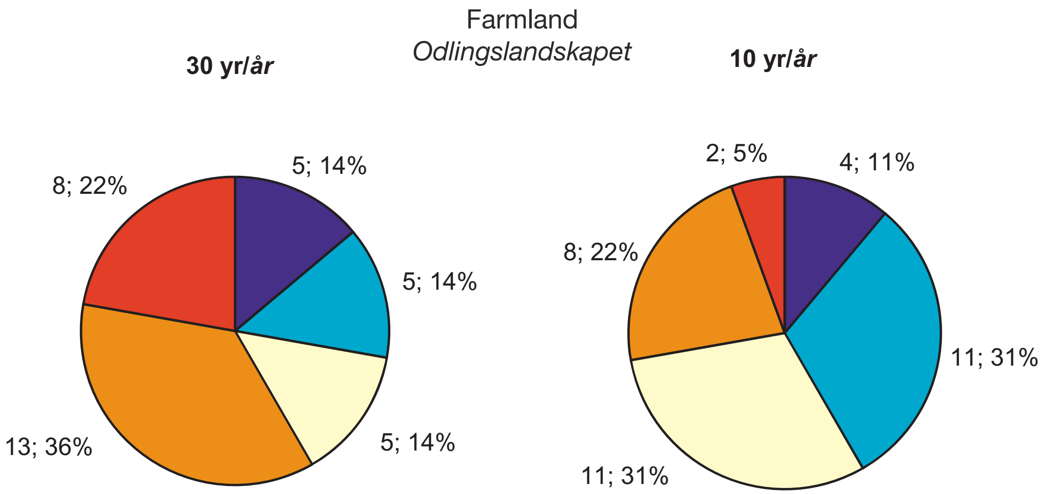

Figure 14. Number and percentage of farmland species in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to read the graphs, see Figure 3.
Antal och andel jordbruksarter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

ly affect the intensity with which land is farmed, future agricultural policy decisions likely will have a great impact on farmland birds. Recent drives to increase grain productions could therefore have a large negative impact on many species, at least in the low-land plains of intensive farming (see also below).

Causes

The decline of farmland birds and its causes have been in focus of both monitoring and research for at least two decades (Newton 2004). A multitude of explanations for the decline have been put forward. This is because all species have their own specific habitat requirements and ecology and are therefore vulnerable to different kinds of change. In general, it is considered that the overall explanation for the decline in many species is the rationalisation and intensification of agriculture. More intensive farming has caused many changes, such as reduced variation in farmland habitats (loss of heterogeneity), larger farms, new crops, more efficient pesticides and loss of non-arable habitats for many species (for example, ditches, wetlands, mid-field pockets, shrubby marginal zones, grassy headlands around fields, stone walls, mounds of stones and barns). At the same time, a growing demand for more efficient agricultural practices has rendered many farms unprofitable, causing them to close, lie fallow or change to extensive farming (for example growing fodder crops instead of cereals). The structural transformation of agriculture has also radically reduced the proportion of traditionally managed semi-natural grasslands. Nowadays the remaining semi-natural grassland is mainly pasture grazed by live stock, whereas semi-natural grasslands used for hay mowing are virtually confined to ‘museum farms’. Management of semi-natural grassland is now largely dependent on environmental subsidies.

The intensification of farming in Sweden can be seen most clearly in the southern lowland agricultural regions (provinces Skåne, Halland, Västergötland, Östergötland and parts of Mälardalen), while extensification and abandonment of farming mainly have occurred in forested regions (for example, the upland areas of Småland in southern Sweden, western and northern parts of Svealand and in the north of the country (Wretenberg et al. 2007). Since many bird species use a number of different habitats during the breeding season (nesting and feeding often take place in different habitats), the decline in landscape heterogeneity is probably a factor contributing to the decline in many species. For example, Wretenberg et al. (2007) showed that the decline in numbers of Skylark, Linnet, Starling and Lapwing was very similar in lowland intensive farming areas and forested areas between 1975 and

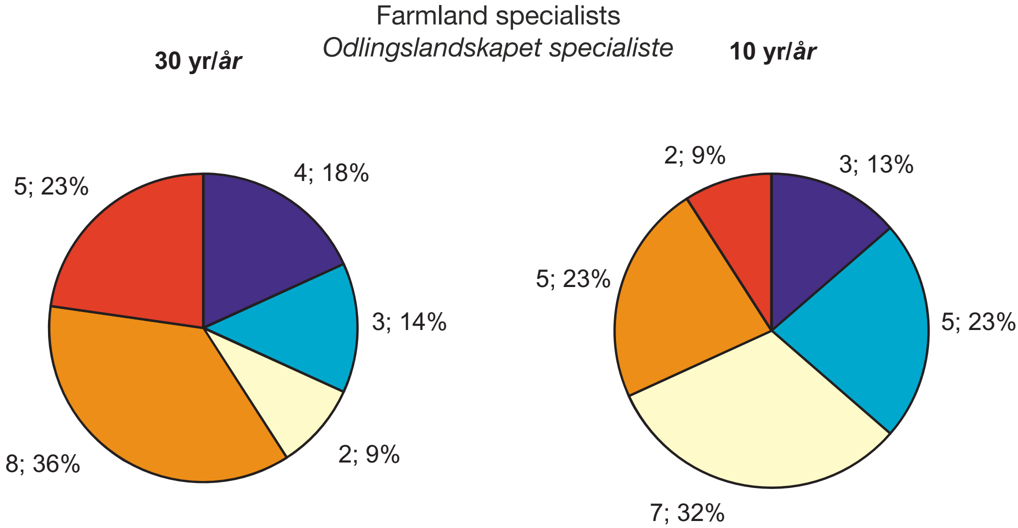

Figure 15. Number and percentage of farmland species (specialists) in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to read the graphs, see Figure 3.
Antal och andel jordbruksarter (specialister) i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

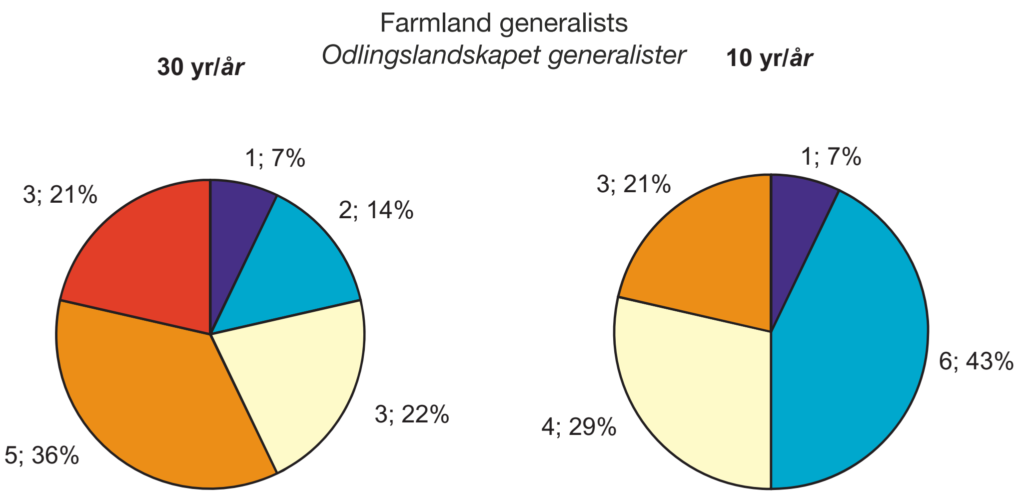

Figure 16. Number and percentage of farmland species (generalists) in various trend categories over the last 30 years (left-hand diagram and 10 years (right-hand diagram). For further information on how to reed the graphs, see Figure 3.
Antal och andel jordbruksarter (generalister) i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

1985, and after 1995 (EU membership), despite differing land-use trends. During "Transition 90" (1987–1995) large areas were laid fallow, which increased the heterogeneity of the lowland agricultural landscape and reduced the heterogeneity of the forest landscape (shortage of cereal fields). Although fallow land generally favoured these four species, the effect was most pronounced, at least for Lapwing and Linnet, in lowland farming areas, where there previously had been a lack of fallow land (for positive effects of fallow land, see also Berg & Pärt 1994). It may therefore be inferred that changes in land use have different effects on the populations of farmland birds, depending on the type of agricultural landscape (that is lowland plains, patchwork landscape, forested areas) in which the change occurs.

Another factor that may explain the decline in several farmland bird species is deteriorated conditions in their winter quarters. For instance, detailed analyses of population trends for short-distance migrants such as the four species mentioned above suggest that the lack of stubble fields and a predominance of autumn-sown crops in western Europe are factors behind the negative trends observed in Sweden (Wretenberg et al. 2006, 2007) and probably also in Finland (see Pitkänen & Tiainen 2001). Two British studies also suggest that it is the survival during the winter months that in much affects the dynamics that have been observed (Siriwardena et al. 1998, 1999). As explained in the section "Importance of wintering grounds", deteriorating conditions in winter quarters may at least partially explain why several long-distance migrants have declined (for example, Wryneck, Red-backed Shrike and Wheatear).

In summary, the reasons behind the decline of some species is complicated by effects related to landscape heterogeneity and to the dichotomous change in Swedish agriculture, namely more intensive farming on fertile lowland plains and less intensive farming or abandonment of farming in less fertile forest regions. This has lead to that mixed farming with both livestock and cereal production has become less common, since many farms, in fact entire regions, specialise in one type of farming. At the same time, virtually nothing is known about the specific factors influencing the population dynamics of a given species, although detailed studies of Starlings and Wheatears demonstrate that a decrease in areas of traditionally managed grasslands and an increase in the amount of highly fertilized arable grassland and autumn-sown crops have negative impact on reproduction and survival (Smith & Bruun 2002, Arlt & Pärt 2007, Arlt 2007). The decreased area of traditional semi-natural grasslands has also been a factor behind the decline of many other species (Söderström & Pärt 2000, Piha 2007).

But why, then, are some species increasing? Apart from the increasing raptors (see discussion under heading "Raptors"), the increase seen in Corncrake numbers might be due to increased overgrowth in areas with lower agricultural intensity (Berg & Gustafson 2007). Whatever the case, the increase in Corncrake numbers is hardly the result of recent measures designed to benefit the species, since a clear majority of the population is found outside areas with "Corncrake-friendly" conservation measures. The recent rise in Wood Pigeon and Stock Dove numbers is considered to be linked to more widespread use of oil plants, at least in south-western Europe (Inglis et al. 1990). It is less clear why the Greenfinch, Goldfinch and particularly Quail have increased, although the first two of these are common bird feeder guests and have therefore probably benefited from more people putting out bird food in winter. Although it is very much a guess, this winter feeding may also have reduced the steep decrease in House Sparrow and Tree Sparrow number. These two species have a very similar ecology to the other common species in sharp decline mentioned above.

Knowledge gaps

Although trend data for farmland birds are considered to be of high quality according to our criteria, they could be better. In the analyses presented in Wretenberg et al. (2006, 2007) it was noted that few surveys have been made of the open, most intensively farmed, lowland plains. Thus, it is not clear how the bird community has changed in these extreme landscapes. Similarly, there are scarcely any quantitative data on how farmland bird populations have changed in northern Sweden. In the future the use of fixed routes will to some extent remedy this lack of knowledge – at least in the case of the south Swedish lowlands. The problem of poor coverage remains for farming areas in northern Sweden, since only a small proportion of agricultural land is covered by the fixed routes.

There is very limited knowledge about cause and effect in population changes for individual species. For example, it is not known whether reproduction or survival is the key factor behind observed decreases and increases. Nor is it known which factors (for example, pesticides, habitat or land-use changes) affect these demographic parameters. Finally, in the case of increasing species it is not evident how important annual immigration is in relation to these species' own reproductive capacity in Sweden.

Proposed action

When taking the proposed measures, it is important to bear in mind that a specific change that is positive for one species can sometimes be negative for others, and that it is important to ensure that action is taken where it will most cost-efficient. As of yet, environmental subsidies take no explicit account of the structure and habitat variation of the surrounding landscape. This will need to change if we are to give effective support for conservation of farmland avifauna. In particular, we propose an increase in the following:

- Cultivation taking account of conservation interests, particularly in lowland farming areas.
- Self-sown fallow land (i.e. not stubble fields sown with clover) in lowland farming areas.
- Shrubby marginal zones and a patchwork of open and shrubby mid-field pockets in landscapes of all kinds.
- Obstacles to cultivation, for example, piles of stones, hedges and solitary trees.
- Semi-natural pastures in predominantly arable landscapes, and arable farming in areas where grazing predominates, that is generally more varied agricultural practices.
- Agriculture in predominantly forest landscapes.
- Varied grazing regimes for semi-natural pastures so that grazing land with support produces a patchwork landscape of pastures grazed heavily to lightly.
- Hay meadows rich in herbaceous plants.
- Grassy headlands around fields.
- Meadows allowed to flood and wetlands.

In summary, it is necessary to achieve a greater degree of habitat heterogeneity on all scales: from individual fields/cultivation units, via farms and landscapes to entire regions.

Mountain birds

In the present context 'mountain habitats' include all habitats above timberline, mountain birch forest and bogs in them. We have included 36 bird species that solely or primarily breed in these habitats. Some species that are very numerous in mountain birch forest but also are common far from mountain regions have been excluded (for example, Willow Warbler, Redwing and Brambling). The few data sets covering longer time series of standardised surveys in the Swedish mountain range are monitoring and ringing in Ammarnäs, Lapland (the LUVRE Project since 1963) and Ånnsjön, Jämtland ('Ånnsjön bird observatory' since 1989). Bird observatory data of birds on passage outside the actual mountain range also provide important additional information.

Data on 20 of the 36 species (56%) are of poor or weak quality for the entire 30-year period; data quality for 14 species (40%) is also poor for the final 10-year period (Table 11). Apart from owls, there is no other group of birds dealt with in this study with background data of such low quality. Essentially, nothing is known about the trends for four of the mountain species: Bar-tailed Godwit, Purple Sandpiper, Arctic Warbler and Arctic Redpoll.

Table 11. Number (and percentage) of all mountain birds (n=36 species*) in different data quality categories over the last 30 and 10 years.
Antal (och andel) fjällfågelarter (n=36 arter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.*

Data quality *Datakvalitet*	30 years (n=36) *30 år*	10 years (n=35) *10 år*
0	4 (11 %)	4 (11 %)
1	16 (45 %)	10 (29 %)
2	12 (33 %)	13 (37 %)
3	4 (11 %)	8 (23 %)

* Lesser White-fronted Goose, Scaup, Long-tailed Duck, Common Scoter, Hen Harrier, Rough-legged Buzzard, Merlin, Gyrfalcon, Willow Ptarmigan, Rock Ptarmigan, Ringed Plover, Dotterel, Golden Plover, Temminck's Stint, Purple Sandpiper, Dunlin, Ruff, Great Snipe, Bar-tailed Godwit, Redshank, Red-necked Phalarope, Long-tailed Jaeger, Snowy Owl, Horned Lark, Meadow Pipit, Red-throated Pipit, Dipper, Bluethroat, Wheatear, Ring Ouzel, Arctic Warbler, Twite, Redpoll (*flammea*), Arctic Redpoll, Lapland Longspur, Snow Bunting.

Trends

Over the last 30 years, trends of just over half of the species have been stable, which is in line with our perception of the mountain regions as being our least exploited habitat (Figure 17). Bearing this in mind, it is perhaps surprising that the long-term trend for a third of the species is declining. This is even more remarkable in view of the fact that

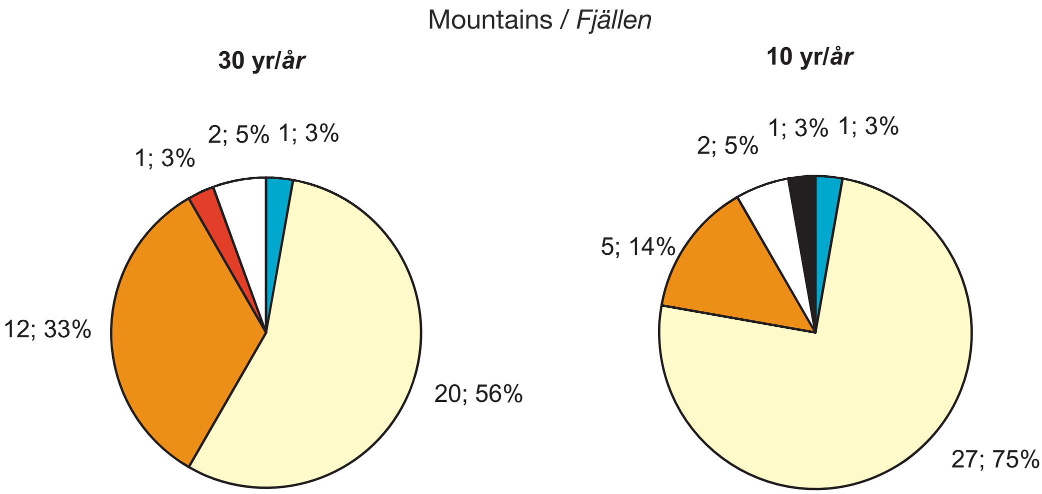

Figure 17. Number and percentage of mountain bird species in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to reed the graphs, see Figure 3.
Antal och andel fjällfågelarter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

only one species appears to have increased in the long term (Rock Ptarmigan, although data quality is only category 1). The situation over the last 10 years is somewhat better: 75% of species exhibit a stable trend. The only species believed to have increased over the last 10 years is the Lesser White-fronted Goose, which is entirely due to reintroductions and migration route changes. These have improved winter survival rates for this population as compared with the original one. If we confine ourselves to the species for which there is good quality data, the picture is, if anything, even gloomier. Half of the species for which there is good quality data has declined in number over the last 30 years.

Declines have occurred in different systematic groups, but in particular several passerines frequenting mountain habitats above the tree line have done poorly. These include the Horned Lark, Red-throated Pipit, Twite and Snow Bunting. However, data quality for mountain birds is generally very poor. Available trend data for species typical of habitats above timberline are mainly derived from migration counts at Falsterbo in southernmost Sweden, but largely accord with scattered observations from the Swedish mountains. As a group, wader trends in the mountains appear stable, although the Ruff is a clear negative exception. Four specialist lemming predator species are in long-term decline. By and large, trends are not as negative over the last 10 years and a degree of stability seems to be prevailing among mountain birds at present.

Causes

The relative population stability of so many mountain species is consistent with the perception of this region as perhaps being the least disturbed habitat thus far. On the other hand, bearing this stability in mind, it is particularly worrying that such a large proportion of species are in long-term decline, albeit that the picture over the last 10 years is somewhat less gloomy. Generally speaking, very little is known of the reasons for these declines. Some of the declining mountain species spend the winter along the North Sea coasts (for example, Horned Lark and Twite). It may be that negative habitat changes have occurred there. Since most mountain birds in our classification are migratory (all species except for grouse species and Gyrfalcon), and most of them have a stable population, it does not seem to be a general problem facing migratory birds. On the other hand, no dramatic long-term changes in the status of the mountain habitat have been reported, at least not from the Ammarnäs area (Enemar et al. 2004, Svensson 2006). In this area the Horned Lark has disappeared from several known localities, despite a good documented breeding success (Svensson et al. 1992, Svensson 2006) and even though there have been few visible changes in its breeding habitat (S. Svensson, pers. comm.).

Several factors have been put forward as potentially negative in areas above the tree line. These include tree line migration, overgrazing by reindeer and a decreased breeding success for some species due to a long absence of "lemming years". The negative effects of reindeer grazing on biodiversity have most likely been exaggerated. In fact, a decrease in reindeer grazing above tree line should probably result in increased overgrowth of these areas (Linkowski & Lennartsson 2006). The reason for the absence of "rodent years" above the tree line remains unknown. There is no doubt that the long-term decline in the four owl and raptor species (Hen Harrier, Rough-legged Buzzard, Snowy Owl and Short-eared Owl) is very much due to the absence of peak lemming years. Over the last decade, lemmings seem to have reappeared in some numbers, which ought to have helped to halt the decline. The Long-tailed Jaeger, another species feeding on lemmings, has done better over the long term, but it is able to breed with some success even when fewer lemmings are available (Larsson 2007).

The fact that hardly any typical mountain species have been found to be increasing during the last 30 years is not necessarily alarming, since it is conceivable that populations in a habitat that has changed little for so long time ultimately reach the level the habitat can sustain. The only possible change then is decline. Eventually species of lower altitudes may be expected to colonise mountain regions. Such effects remain to be conclusively demonstrated.

Knowledge gaps

There are many knowledge gaps for the less common breeding birds of the Swedish mountain regions. In particular, very little is known about trends or detailed distributions for species found above tree line. Examples include Bar-tailed Godwit, Purple Sandpiper, Horned Lark and Red-throated Pipit. In other cases there is a lack of data on trends, for example in Red-necked Phalarope, Ring Ouzel and Snow Bunting. Essentially, good long time series of data are only available from two localities: Ammarnäs and Ånnsjön. It is not known how representative these localities are of the rest of the mountain region. Moreover, few detailed studies have been made of the breeding biology of birds nesting above tree line. In light of the crucial influence of lemmings and other rodents for a number of species (directly and indirectly), the knowledge of lemming ecology and trends, as well their effect on the avifauna is surprisingly poor.

It is essential that more is learnt about the birds of the high mountains in particular, since they are expected to be the ones to suffer most in the present climate change scenario. Fixed route censuses will eventually improve the available data considerably. In addition, it would also be a good idea to have more localities in the mountains with detailed monitoring of birds in general, as well as species-specific projects.

Proposed action

Given that mountain bird numbers have been relatively stable over the last 30 years, and probably long before that, there is no present need for general conservation measures. However, it is important that the large areas that are currently protected continue to enjoy far-reaching protection. Current and recurring threats are expansion of hydropower, mining operations, peat extraction and, in recent years, plans for large-scale wind power production. Little is known about the effects of reindeer grazing. One obvious threat – perhaps ultimately the greatest threat – is that posed by climate change, with resulting northward and altitudinal shifts in vegetation zones, and also vegetative migration on mountainsides.

- Continuing rigorous protection against development in pristine mountain habitats.
- There is a need for an overall plan for wind power development in the mountains taking account of bird protection.

Red listed species

Interim target 2 under Environmental Quality Objective 16 states that the proportion of species classified as threatened should have fallen by at least 30 per cent by 2015 as compared with 2000, without any increase in the proportion of extinct species. This goal applies to the total number of threatened species belonging to all groups of organisms, but in this study we have assumed that the target also ought to apply separately for birds.

Threatened species are those classified according to the IUCN criteria (1994, 2001 and 2003) as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). Species meeting the criteria for Near Threatened (NT) are not threatened but are at risk of becoming so unless the situation improves.

The Swedish Species Information Centre has published two red lists following the IUCN criteria since 2000 (Gärdenfors 2000, 2005). Thus, an initial analysis can be made of the category changes occurring during the period 2000–2005. The total number of red listed taxa remained largely unchanged between these two reports. In the latest (Gärdenfors 2005), 89 bird species/subspecies breeding in Sweden are red listed: Regionally Extinct (RE) 8, Critically Endangered (CR) 5, Endangered (EN) 9, Vulnerable (VU) 31 and Near Threatened (NT) 37. However, a considerable number of species/subspecies were moved between the various red list categories for a wide variety of reasons ranging from actual change in status in the wild (31 species), changes due to new data, altered criteria or rules of application, or possibly new interpretation of earlier data. If we examine the actual changes, which ought to be the focus of our attention in this context, we find that 18 category changes were due to declining populations and 13 to increasing ones. Among the threatened species/subspecies (CR, EN, VU), there were eight that left the three threatened categories due to tangible environmental improvements. Six were added to those categories due to declining numbers, that is, a net reduction of two species (-4.3% in relation to the total number of threatened species/subspecies in 2000).

It should be added that one species (Kentish Plover) ceased to breed regularly in the country during the period and is therefore listed as extinct (RE) in the latest red list.

Trends

Numerically speaking, the interim target of reducing the proportion of threatened species (CR, EN and VU) by 30% by 2015 means 14 fewer listed bird species/subspecies as compared with the red list for 2000. For a species to be moved in the right direction, that is from one of the threatened categories to Near Threatened (NT), or at best to the Least Concern (LC) category, requires a population increase, or that a fairly common species has a stable population for a period of at least 10 years.

On the basis of the red list for 2005, it may be seen that a majority of the threatened bird species/subspecies (63%) have declined in number over the last 30 years and that only 15% have increased in number (Figure 18). Over the last 10 years, the percentage of increasing bird species has remained largely unchanged, whereas a substantially lower proportion of species declined. The main difference between the full 30-year period and the last 10 years is that the number of species with apparently stable populations was much higher during the latter period (52% as compared with 20%, Figure 19).

Even though 10 years is a short period in which to reliably determine population trends, it appears that a trend shift has occurred in the 2000s, namely that the decline in numbers of many bird species has slowed down and stabilised, often at an appreciably lower level than before. The task in the years to 2015 is to make it easier for the species that are now stable to remain so, or, preferably, regain their previous population sizes, thereby hopefully leaving the threatened species categories.

While the number of currently threatened species must be reduced by 2015, no "new" species must become threatened. Species in line to join the threatened categories are termed Near Threatened. Over the last 30 years 58% of Near Threatened species have displayed negative population trends, whereas 28% have increased in number. The situation over the last 10 years is similar as for threatened species, i.e. the number of declining bird species is fewer and the number of species with stable populations is more than four time greater than for the 30-year period as a whole (Figure 20). Here, too, we can thus discern a trend shift – many species no longer seem to be in decline.

Causes

The apparent trend shift during the 2000s, with many threatened and near threatened species stabilising in number, probably has several explanations. One may be that agricultural and forest habitats have gradually deteriorated and that the red listed species, which often have more specific habitat requirements than other species, only survive in reserves, sub-optimal relict habitats or sparsely distributed in areas used for agriculture and forestry. Hence, it is conceivable that they have stabilised at the lower level that the landscape of today can sustain or reached a level that may remain stable provided further habitat changes do not occur. For these species to recover in number and recolonise former territories will probably require continuing establishment of reserves and substantial species-specific nature conservation measures at large, including habitat restoration. The Swedish EPA species recovery programme for threatened species is of vital importance in this context. Moreover, many red listed species are long-distance migrants that winter in southern Europe or Africa, where many habitats have deteriorated enormously over the last 30 years, and the above reasoning may also serve as an explanation here.

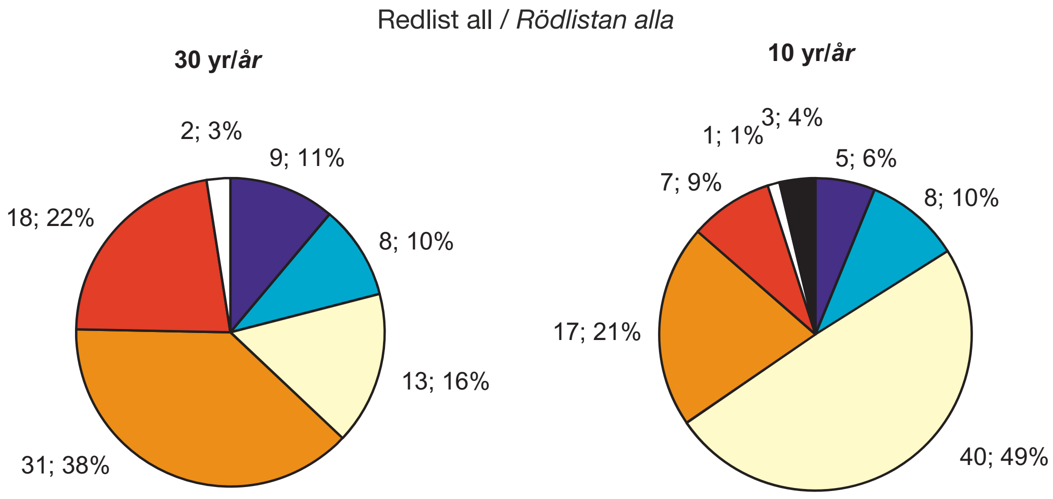

Figure 18. Number and percentage of all red listed species in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to reed the graphs, see Figure 3.
Antal och andel av alla rödlistade arter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

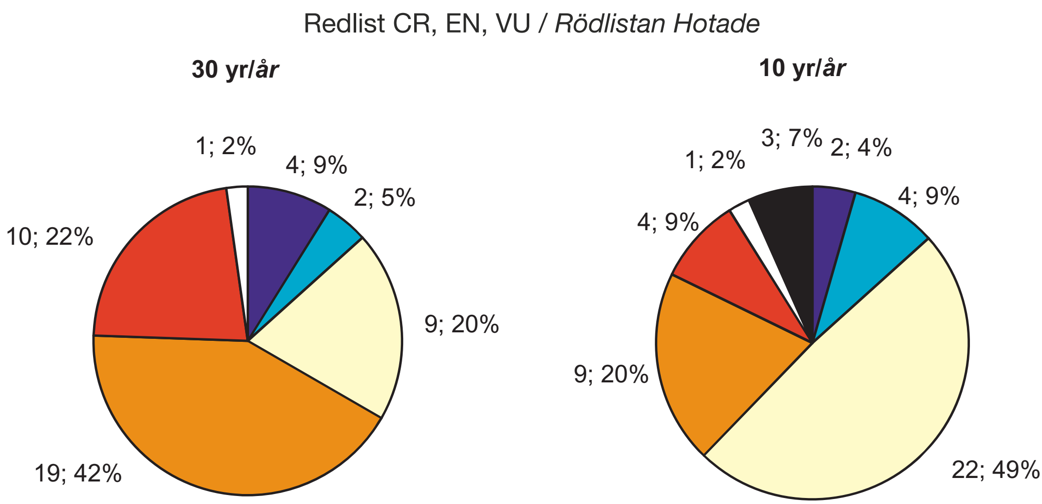

Figure 19. Number and percentage of threatened red listed species (CR EN VU) in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to reed the graphs, see Figure 3.
Antal och andel hotade (CR, EN, VU) rödlistade arter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

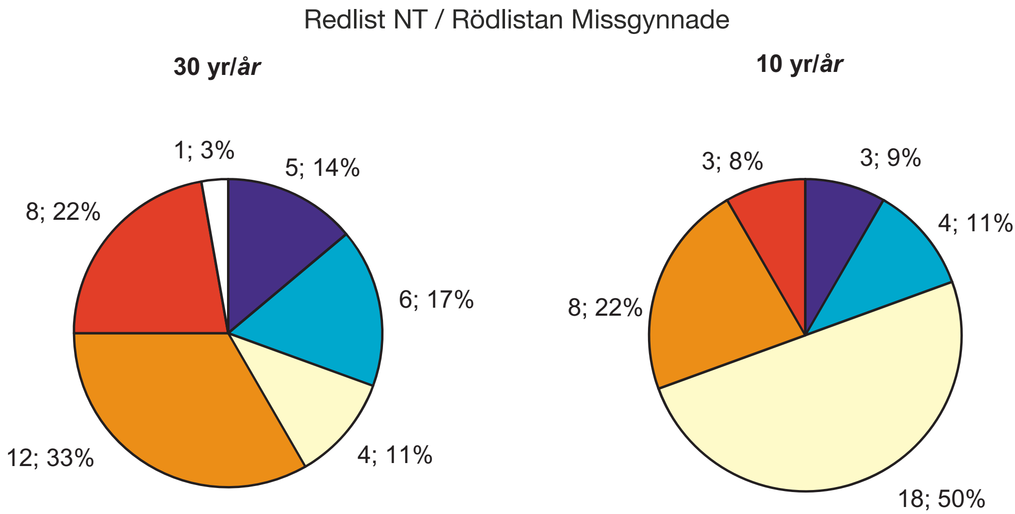

Figure 20. Number and percentage of Near Threatened (NT) red listed species in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to reed the graphs, see Figure 3.
Antal och andel missgynnade (NT) rödlistade arter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

Forecast

What, then, are the prospects of meeting interim target 2 under Environmental Quality Objective 16? Even though some improvements occurred between the red lists for 2000 and 2005, we are a long way from meeting the target. The red listing procedure involves assessment of numerous criteria, among which the population trend is of great importance. Another key factor is actual population size. The IUCN decided in 2003 that a species must have a population exceeding 1,000 sexually mature individuals (500 breeding pairs) to be classified as Near Threatened (NT). If we analyse the red list for 2005, we find that 26 of 45 threatened taxa have such small populations that it is virtually inconceivable that they will be moved to the Near Threatened category by 2015 (for example, Golden Oriole, Serin, Kingfisher and Horned Lark). Natural causes will in fact prevent some of these species from ever leaving the threatened list (for example, Gyrfalcon). This leaves 19 species for which an improvement is possible. Of these, 12 have exhibited stable or increasing populations over the last 10 years. Hence, there is a slight possibility of achieving the interim target of reducing the proportion of endangered species by 30 per cent by 2015. Interim target 2 also stipulates that the proportion of extinct species must not increase. This objective is more difficult to achieve. One species has already stopped breeding regularly in Sweden since 2000 (Kentish Plover) and three are worryingly close to doing so (Barn Owl, Hoopoe and White-backed Woodpecker).

Our review shows that the red listed species/subspecies break down into habitats as follows: wetlands 29%, mountains 21%, coasts/archipelagos 11%, forests 21% and farmland 18%. There are also species not included in any of the habitats analysed, some of which occur in urban habitats, for example. This classification according to habitats is of course a simplification of reality, as some species occur in several habitats. However, one conclusion to be drawn is that the red listed species are fairly evenly distributed among the various habitats. This means that there is no shortcut whereby targeted measures in a given habitat will enable us to reach the 2015 target.

Knowledge gaps

Somewhat less is known about population trends for red listed species than for Swedish breeding birds in general (Table 12). Virtually nothing is known about eight species (10%) (Bean Goose, Pintail, Bar-tailed Godwit, Great Grey Owl, Short-eared Owl, Arctic Warbler, Pine Grosbeak and Little Bunting), and the knowledge of a further eight

Table 12. Number (and percentage) of all red listed birds (n=81 species*) in different data quality categories over the last 30 and 10 years.
Antal (och andel) rödlistade fågelarter (n=81 arter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.*

Data quality *Datakvalitet*	30 years (n=81) *30 år*	10 years (n=78) *10 år*
0	9 (11 %)	8 (10 %)
1	11 (14 %)	8 (10 %)
2	22 (27 %)	23 (30 %)
3	39 (48 %)	39 (50 %)

* Critically Endangered: Lesser White-fronted Goose, Barn Owl, Snowy Owl, Hoopoe, White-backed Woodpecker
Endangered: Honey Buzzard, Montagu's Harrier, Gyrfalcon, southern Dunlin (*schinzii*), Lesser Black-backed Gull (*fuscus*), Kittiwake, Tawny Pipit, Golden Oriole, Corn Bunting.
Vulnerable: Horned Grebe, Black-necked Grebe, Garganey, Scaup, Hen Harrier, Peregrine Falcon, Spotted Crake, Corncrake, Ruff, Black-tailed Godwit, Bar-tailed Godwit, Turnstone, Caspian Tern, Sandwich Tern, Little Tern, Black Tern, Collared Dove, Nightjar, Kingfisher, Three-toed Woodpecker, Horned Lark, Red-throated Pipit, River Warbler, Greenish Warbler, Arctic Warbler, Penduline Tit, Nutcracker (*caryocatactes*), Pine Grosbeak, Serin, Twite, Ortolan Bunting.
Near Threatened: Red-throated Loon, Bittern, Bean Goose, Pintail, Shoveler, Pochard, Velvet Scoter, Smew, White-tailed Eagle, Rough-legged Buzzard, Golden Eagle, Grey Partridge, Quail, Temminck's Stint, Great Snipe, Curlew, Stock Dove, Eagle Owl, Great Grey Owl, Short-eared Owl, Wryneck, Lesser Spotted Woodpecker, Skylark, Sand Martin, Wheatear, Grasshopper Warbler, Great Reed Warbler, Barred Warbler, Red-breasted Flycatcher, Marsh Tit, Siberian Tit (Grey-headed Chickadee), Red-backed Shrike, Siberian Jay, Linnet, Scarlet Rosefinch, Little Bunting.

species is definitely deficient (Scaup, Smew, Hen Harrier, Grey Partridge, Nightjar, Red-throated Pipit, Red-breasted Flycatcher and Twite). It is worth noting that 13 of these are boreal species.

More extensive and more frequent standardised surveys should be carried out in the mountains and in the forests of northern Sweden to provide better monitoring data on rare species. It is important to bear in mind that many red listed species occur only in small numbers and in highly specific habitats. This necessitates surveys of specific species using special methods.

Proposed action

- Continuing creation of reserves.
- Note that, as far as birds are concerned, sustainable use of biodiversity and biological resources can only be achieved by concern for conservation manifested on a large scale outside protected areas. This will require that forestry and agricultural practices in the countryside at large reflect far greater concern for the environment. The kind of action required is presented under the "Proposed action" headings in the previous sections in this paper.
- Species recovery programmes for threatened species that are currently in progress or being planned should be carefully monitored to ensure that the proposed measures are actually taken.
- Measures to help species with a long history in Sweden should be given priority over measures for species with small marginal populations that have only recently arrived in Sweden.

Game species

There are more than 280,000 hunters in Sweden. Historically, hunting has had great impact on numbers of several Swedish bird species (for example, Lesser White-fronted Goose and some raptors). At present it is permitted to hunt 33 bird species in Sweden. The Greater White-fronted Goose is the only one of these that does not breed in the country. However, in the case of several game species, the annual bag of birds in Sweden includes or comprises populations nesting in other countries, for example, Tufted Duck. There are also several species that are not hunted in Sweden, but that are shot during migration or in their wintering grounds in other countries (for example, Pintail and Golden Plover).

Trends

Of the 32 breeding species hunted in Sweden, 72% (30 years) and 74% (10 years) are classified as increasing or stable (Figure 21). Data quality is fairly good (75% in category 2 or 3), which is probably because many species are relatively common and are therefore well covered by surveys (Table 13, Table 14). A notable exception is the Bean Goose, about whose Swedish breeding population trend virtually nothing is known. Two game species – the Velvet Scoter and Hooded Crow – have declined over both the entire 30-year period and the last 10 years. In other words, Swedish game birds are generally doing well.

Two factors may be contributing to the positive situation for hunted birds. Hunting seasons have traditionally largely been determined on the basis of population trends for each species. Hunting is permitted where population numbers and trends so allow. Another possible explanation is that some

Game birds / *Jaktbara arter*

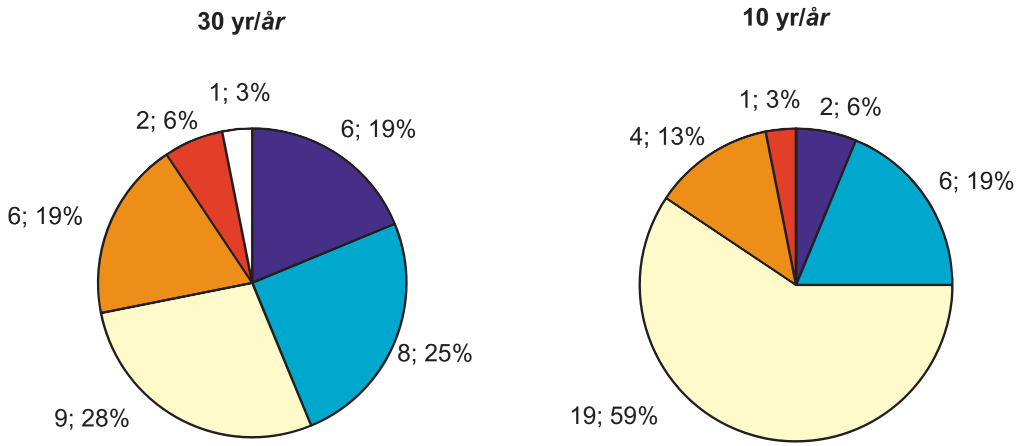

Figure 21. Number and percentage of game bird species in various trend categories over the last 30 years (left-hand diagram) and 10 years (right-hand diagram). For further information on how to reed the graphs, see Figure 3.
Antal och andel jaktbara arter i olika trendkategorier de senaste 30 åren (figur till vänster) respektive 10 åren (figur till höger). För ytterligare information om tolkning av diagrammen, se Figur 3.

game species (for example, some dabbling ducks) may benefit in various ways from action taken by hunters and landowners, who see these species as a resource.

Hunting in Sweden

The Swedish Association for Hunting and Wildlife Management has collated bag statistics since 1938 (see Appendix 1). Where hunting pressure has not changed over time, bag statistics normally reflect changes in population size. Apart from species population trends, bag statistics is affected by changes in hunting seasons and the interest in hunting particular species. That interest is, in itself, often influenced by the availability of a species. If a species declines or increases, the interest in hunting it may change swiftly, which adds to the variation in the bag statistics, as compared with actual population trends.

It was estimated that 700,000 birds (excluding Willow Ptarmigan and Rock Ptarmigan) were shot in Sweden during the 2005/2006 hunting season (Table 14). The species hunted most are Mallard, Wood Pigeon and Hooded Crow, which together accounted for 45% of all birds shot. If we assume that the bag of Willow Ptarmigan and Rock Ptarmigan has not changed during the period for which the county administrative boards have been responsible for collating grouse bag statistics, some 100,000 grouse were shot during the 2005/2006 hunting season.

Grouse hunting has been discussed in relation to the Gyrfalcon, which is very much a grouse specialist. There has been concern that grouse hunting would reduce prey numbers available to the Gyrfalcon. Swedish grouse hunting concentrates on Wil-

Table 13. Number (and percentage) of all game birds (n=32 species*) in different data quality categories over the last 30 and 10 years.
Antal (och andel) jaktbara arter (n=32 arter) i olika datakvalitetskategorier de senaste 30 respektive 10 åren.*

Data quality *Datakvalitet*	30 years (n=32) *30 år*	10 years (n=32) *10 år*
0	2 (6 %)	1 (3 %)
1	6 (19 %)	5 (16 %)
2	2 (6 %)	4 (12 %)
3	22 (69 %)	22 (69 %)

* Bean Goose, Greylag Goose, Canada Goose, Wigeon, Teal, Mallard, Tufted Duck, Eider, Long-tailed Duck, Common Scoter, Velvet Scoter, Goldeneye, Red-breasted Merganser, Common Merganser, Hazel Hen, Willow Ptarmigan, Rock Ptarmigan, Black Grouse, Capercaillie, Grey Partridge, Pheasant, Woodcock, Common Gull, Herring Gull, Greater Black-backed Gull, Wood Pigeon, Fieldfare, Jay, Magpie, Jackdaw, Hooded Crow, Rook.

Table 14. Game birds and numbers shot in Sweden. The trends for numbers shot have been classified as "Increase", "Stable" or "Decline". The classification of the indices for numbers shot and the survey indices were made in the same way. Raw data come from the Wildlife Monitoring Programme of the Swedish Association for Hunting and Wildlife Management.
De jaktbara arterna och deras avskjutning i Sverige. Trenderna för avskjutning har klassats i kategorierna ökning, stabil eller minskning. Klassningen av avskjutningsindex och taxeringsindex gjordes på ett likvärdigt sätt. Rådata kommer från Svenska Jägareförbundets Viltövervakning.

Species *Art*	Numbers shot in hunting season 2005/2006 *Avskjutning jaktåret 2005/2006*	Estimate trend of index of numbers shot *Skattad trend för avskjutningsindex*	
		10-year *10 år*	30-year *30 år*
Bean Goose	6,400	*	*
Greylag Goose	12,200	Increase	Increase
Canada Goose	41,700	Increase	Increase
Wigeon	800	Stable	Decline
Teal	9,700	Stable	Decline
Mallard	114,700	Increase	Increase
Tufted Duck	3,600	Stable	Decline
Eider	2,100	Stable	Decline
Long-tailed Duck	< 500	Stable	Stable
Common Scoter	< 500	**	**
Velvet Scoter	<500	(Stable)**	Decline
Goldeneye	10,300	Stable	Decline
Red-breasted Merganser	<500	Stable	Decline
Common Merganser	2,300	Increase	Decline
Hazel Hen	7,300	Stable	Decline
Willow Ptarmigan	No data	X	Increase
Rock Ptarmigan	No data	X	Stable
Black Grouse	20,300	Stable	Stable
Capercaillie	16,300	Stable	Stable
Grey Partridge	9,500	Stable	(Increase)
Pheasant	31,800	Stable	Increase
Woodcock	1,700	***	***
Common Gull	15,000	Increase	Decline
Herring Gull	11,800	Stable	Decline
Greater Black-backed Gull	3,000	Stable	Decline
Wood Pigeon	96,500	(Increase)***	Stable
Fieldfare	<500	**	**
Jay	25,000	Stable	Stable
Magpie	54,600	Stable	Stable
Jackdaw	54,500	Increase	Increase
Hooded Crow	107,300	Increase	Stable
Rook	15,600	***	***

* Technical problems in gathering data render the data difficult to interpret
** Too few individuals render the trend difficult to interpret
*** Changes in hunting seasons render trends difficult to interpret
X No data on grouse since county administrative boards assumed responsibility for data gathering in 2000.

Table 15. Number of species in trend combinations based on bird data and hunting statistics over the last 30 years for 27 species for which hunting data allows a trend appraisal. The table shows that 3 species that declined according to the bird data also declined according to the hunting data; 3 species that were stable according to bird data declined according to hunting data, and so on.
Antal arter i olika kombinationer av trender baserade på fågeldata respektive jaktstatistik för de senaste 30 åren för 27 arter där jaktdata tillåter att en trend kan uppskattas. Tabellen läses så att för 3 arter som minskade enligt fågeldata även minskade enligt jaktdata, 3 arter som var stabila enligt fågeldata minskade enligt jaktdata, osv.

	Trend bird data *Trend fågeldata*				
Trend hunting statistics *Trend jaktdata*	Decreasing *Minskande*	Stable *Stabil*	Increasing *Ökande*	Unknown *Okänd*	Total *Summa*
Decreasing *Minskande*	3	3	5	1	12
Stable *Stabil*	3	3	2	0	8
Increasing *Ökande*	2	1	4	0	7
Total *Summa*	8	7	11	1	27

Table 16. Number of species in trend combinations based on bird data and hunting statistics over the last 10 years for 27 species for which hunting data allows a trend appraisal (for more information, see Table 14).
Antal arter i olika kombinationer av trender baserade på fågeldata respektive jaktstatistik för de senaste 10 åren för 27 arter där jaktdata tillåter att en trend kan uppskattas (för mer information, se tabell 14).

	Trend bird data *Trend fågeldata*			
Trend hunting statistics *Trend jaktdata*	Decreasing *Minskande*	Stable *Stabil*	Increasing *Ökande*	Total *Summa*
Decreasing *Minskande*	0	0	0	0
Stable *Stabil*	4	13	0	17
Increasing *Ökande*	1	1	6	8
Total *Summa*	5	14	6	25

low Ptarmigan, whereas the Gyrfalcon hunts mainly Rock Ptarmigan (Nyström et al. 2007). Swedish studies have been unable to measure any difference in population trends for Willow Ptarmigan in areas where hunting takes place, as compared with areas where hunting is not permitted (Hörnell-Willebrand 2005). The absence of hunting effects on the grouse population has been explained as by the large territory used by grouse – much larger than the areas visited by hunters. In other words, new individuals move in to replace grouse that have been shot.

Bag statistics and bird trends

Of the 52 instances where a trend can be estimated on the basis of annual bag statistics, trends follow the population trends recorded in this study for the species in question in 29 cases (56%). The figures are more consistent for the 10-year period, where bag statistics follow population trends for 19 species (76%), as compared with ten species (37%) over 30 years (Table 15, Table 16). The bag statistics on ten species are more negative than the species' population trend over 30 years. In other words, the number of birds being shot is decreasing faster than the population size. This applies to diving ducks, for example, which are traditionally hunted along Swedish coasts. Interest in this form of hunting is declining (Swedish Association for Hunting and Wildlife Management 2005). Over the last 10 years the bag of diving ducks has stabilised at a fairly low level compared to earlier years.

In twelve cases bag statistics show a more positive trend than the bird monitoring data. These are distributed equally between the two periods (10 and 30 years). The Pheasant and Grey Partridge are two species with increasing bag statistics trend during the 30-year period, and whose population trends are negative. These two and the Hooded Crow constitute the only species with increasing bag and suffering a population decline at the same time. The continuing high or even increasing hunting pressure on the Hooded Crow is probably due to a growing interest in shooting these birds to reduce predation on other (game) species. A surprisingly high number of Hooded Crows are shot (see Table 14) according to Wildlife Monitoring Programme statistics. Pheasants, Grey Partridges and Mallards are stocked in substantial numbers for hunting purposes (Wiberg & Gunnarsson 2007). More widespread hunting of stocked and introduced individuals may to some extent explain the rising numbers in the bag statistics. A clear correlation has been found in Denmark between Grey Partridge bag statistics and the population index, even though stocked birds are released in the wild (Heldbjerg 2005).

In recent years the Wildlife Monitoring Programme has used a questionnaire to be answered by hunting permit holders as a parallel method of collecting data alongside the traditional method. The aim of the questionnaire is to test and assure the quality of the traditional data. Preliminary results show that the number of Hooded Crows (and Magpies) shot is much lower according to the questionnaires. The Hooded Crow thus differs from other species and it may be that the numbers shot have been overestimated in the traditional bag statistics (Kindberg pers. comm.).

Species hunted in other countries

Several bird species breeding in Sweden are hunted solely or mainly in other countries. This applies primarily to raptors (illegal hunting of all species), several dabbling ducks and waders. The Woodcock is the only wader hunted in Sweden nowadays, but the main hunting pressure on the Swedish breeding population is in other countries. Relatively few Woodcocks are shot in Sweden (estimated at 1,700 birds). In France and Italy, where most Woodcocks are shot, the figures are 1.1 million (France) and 0.5–1 million (Italy) (Lutz & Jensen 2005), although the breeding population of Woodcock in these countries is small. Several duck species are also hunted to a much greater extent abroad than in Sweden. Many of them breed primarily in northern Sweden (for example, Pintail), where our data on population size and trend are deficient.

Several species hunted during migration or in their wintering grounds in other countries are declining, in some cases rapidly, and also have small populations. The hunting of migratory birds on passage (for example, Honey Buzzard) in Mediterranean countries, and certain waders (for example, Black-tailed Godwit) in their winter quarters may represent a real threat to these species in Sweden. This is described in greater detail in the respective habitat and species group sections. Passerines migrating to the tropics are also hunted in the Mediterranean countries. Little is known about the impact of hunting on the populations of the species concerned.

Knowledge gaps

Better data on northern duck population sizes, trends and which populations occur where and when during migration is desirable from both a wildlife management and a conservation viewpoint (see, for example, Elmberg et al. 2006). It is also important to establish coordinated programmes to monitor annual breeding success of game species, so that hunting quotas can be continuously adjusted – known as "adaptive management" (Elmberg et al. 2006 and references given there). It is essential to determine whether hunting of Velvet Scoter threatens that species' favourable conservation status.

The bag statistics of Rock Ptarmigans are of less quality compared with Willow Ptarmigan, and the population trend estimate for Rock Ptarmigan is also of poor quality. Bag statistics and population trend of Rock Ptarmigan show that the species has been stable or has increased over the long term. It is essential that the knowledge of the correlation between bag statistics and bird trends is improved.

Proposed action

- Coordinated and quality-controlled bag statistics in the EU.
- Annual review of the population index and

breeding success of game species.
- Initiate research on the effects of realizing stocked individuals to wild bird populations.
- Sweden should strive to ensure that the EC Birds Directive is made more dynamic to cope with changes in bird populations, e.g., guidelines on which species can be hunted on the basis of a European and national threatened category.
- Sweden should contribute to stop all illegal hunting in the EU, including the shooting of raptors in Mediterranean countries.

The importance of wintering grounds

Most birds breeding in Sweden are migratory and spend much of the year outside the country. When endeavouring to find out why species are increasing or declining in number, it must be borne in mind that factors in the breeding habitat are not the only ones of importance. Factors on the wintering grounds and along migration routes play an important role. For instance, the greater part of mortality among some small birds migrating long distances has been found to occur during migration (Holmes 2007). Other species suffer a major proportion of their mortality during the winter months (for example, Kingfisher, Winter Wren and Goldcrest). Nonetheless, factors in the breeding habitat may be the main determinant of population dynamics (Holmes 2007), which means it is important to gain an overall and around-the-year picture. Accordingly, we here analyse population trends for birds travelling to different winter quarters. Such an analysis is a first step for ascertaining when and where critical periods occur, which is essential if the ultimate aim is to propose remedial measures. A general analysis of this kind is only capable of providing some general guidance as to tendencies. Accurate identification of cause and effect requires detailed studies of population levels for each species and throughout the annual cycle.

Hence, we divided Swedish migratory birds into three groups: long-distance migrants (mostly migrating to wintering grounds outside Europe); medium-distance (mainly wintering in Europe but outside Sweden); and wintering in Sweden. Species were classified according to where the majority of the Swedish populations spend the winter. Using these classification criteria, 31% of species were classified as long-distance migrants, 42% as medium-distance migrants and 27% as wintering in Sweden (Appendix 2). It should thus be noted that only just over one quarter of Swedish breeding bird species spend the entire year in Sweden, and only for those we can be sure that only conditions in this country affect population trends.

Trends

Over the 30-year period 36% of species wintering in Sweden declined and 33% increased (Figure 22). 35% of medium-distance migrants declined, while 40% increased during the same period. The long-distance migrants have done worst: 45% of the 79 species in this category declined; only 20% increased their population size.

Medium-distance migrants have also done best over the last 10 years: 37% have increased, 46% have been stable and 16% have declined. The proportion in decline of species wintering in Sweden has been lower over the last 10 years (24%) as compared with the 30-year period as a whole (36%), and the proportion of stable species is higher in the 10-year period (42% as compared with 25%).

The percentage of declining populations among long-distance migrants is significantly lower (20%) over the final 10 years as compared with the 30-year period (45%). The proportion of declining species the last 10 years is thus the same for long-distance migrants as for species wintering in Sweden. Further, the rate of decline for many of the declining populations appears to have slowed; 62% have been stable over the last 10 years. On the other hand, the percentage of increasing populations has not been higher among long-distance migrants over the last 10 years.

Causes

Swedish breeding populations of long-distance migrants (mainly species wintering south of the Sahara) have had a particularly difficult time over the last 30 years. The same applies throughout Europe. Even though there are a multitude of factors potentially explaining this pattern, few studies have been able to establish the underlying cause and effects (for a list of conceivable factors, see Sanderson et al. 2006). One Swedish example is the sudden drop in the number of several tropical migrant species that was noted in the records of birds caught at Ottenby Bird Observatory following the disastrous drought in parts of West Africa in the 1970s (Hjort & Lindholm 1978). There is little doubt that winter mortality was very high for a number of years among birds wintering in or passing through that area (Peach et al. 1991). In this case a very dramatic change was reflected in bird populations in Sweden and the rest of Europe. But less dramatic

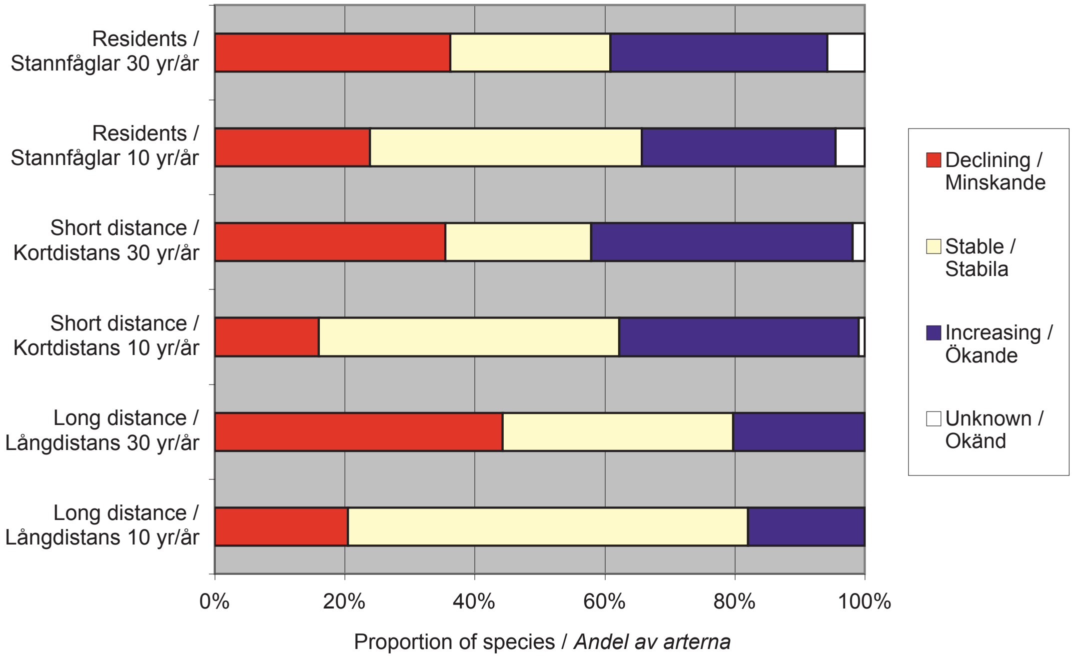

Figure 22. Proportion of species in each trend category for long-distance migrants (30 and 10 years), medium-distance migrants (30 and 10 years) and residents, that is species wintering in Sweden (30 and 10 years).
Andelen arter i respektive olika trendkategori för långdistansflyttare (30 och 10 år), medeldistansflyttare (30 och 10 år) samt stannfåglar, dvs. arter som övervintrar i Sverige (30 och 10 år).

changes in bird numbers seem much more difficult to explain with environmental data.

The marked lack of reliable causal links is primarily due to two factors. First of all, our long-distance migrants spend much of the year outside the country, often in inaccessible areas, which makes detailed ecological studies impracticable. Secondly, it is not only their migration itself that distinguishes them from short-distance migrants and residents; there are other fundamental ecological characteristics such as late arrival in spring and the fact that they are generally more dependent on food in the form of invertebrates, mainly insects. Nevertheless, the main problems facing migratory birds could of course be found in their breeding habitats here in Sweden, even though they only spend a small proportion of the year there.

Sanderson et al. (2006) found that the birds that had done worst of all were those wintering in the dry open habitats of the Sahel, just south of the Sahara (for example, Whinchat and Wheatear). Having made a thorough review of the literature, these authors conclude that recent droughts (even though the rains have to some extent returned) and increased use of land for agriculture have probably affected the birds adversely. But they also point out that this cannot be the whole explanation. Many tropical migrants that frequent open landscapes, such as Whinchat and Wheatear, are also dependent on the agricultural landscapes of northern Europe for their breeding habitats, with the problems that exist there. It is important to bear in mind that even if processes in wintering grounds are found to be the cause of population changes (for example, Hjort & Lindholm 1978, Peach et al. 1991), processes in breeding habitats cannot be ignored just because the birds are only there for a short period each year. Holmes (2007) reviewed almost 40 years' work on the population dynamics of North American tropical migrants, including studies both of breeding habitats in the US and of winter quarters in Jamaica, and showed that the processes operating on the nesting locality explain much of the population fluctuations in the breeding populations.

There are also indications that ongoing climate change is having a negative impact on long-distance migrants, both directly because they find it more difficult to time their nesting to coincide with peak insect availability (Both & Visser 2001), and indirectly, as they find it harder to compete with species spending winter close to their breeding habitats in northern Europe (Lemoine & Böhning-Gaese 2003). Milder winters improve the prospects of survival for medium-distance migrants and resident species wintering in Sweden. Since these birds are already in place in spring, their increased numbers may make it more difficult for later arrivals from the tropics to find suitable territories and nesting sites. Both in Sweden and in Europe as a whole, short-distance migrants have done better, although, as far as we know, there are no definite causal links between their population changes and changes in populations of long-distance migrants (Gregory et al. 2007).

Knowledge gaps

More detailed studies of bird ecology during migration and wintering outside Sweden are of great importance. Examples of such studies are the Swedish Ornithological Society's project in Nigeria, in which the winter ecology of several Swedish bird species is being studied (Ottosson et al. 2005). Knowledge of the effects that climate change may have on migratory birds is still in its infancy. What is certain is that these effects are complex. Further details on this difficult issue are described in the section on 'Climate change and bird numbers'.

Proposed action

Given that we know so little for sure about the causes of population trends for long-distance migrants, we do not see any point in proposing specific nature conservation measures.

Climate change

Ongoing climate change also impacts on Sweden and our fauna. One hypothesis, for example, is that the fall in rodent numbers in the north of Sweden is due to the milder climate, resulting in a deterioration in winter conditions for these animals (www.emg.umu.se/personal/lankar/hornfeldt/index3.html). This alone provides a link to changes in the avifauna, since rodents are the main source of food for several bird species. Following this train of thought, a lower number of rodents might force generalist predators (for example foxes and weasels) to prey on birds to a greater extent, which might impact on far more species than those specifically dependent on rodents.

The most likely scenario is that a general rise in temperature will cause the range and main population centres of our species to migrate northwards (Huntley et al. 2007). New species will invade from the south and some will be displaced, their future in the arctic uncertain. No fewer than half of the birds breeding above the tree line are under threat as the tree line creeps upwards (Lindström & Agrell 1999). In this section we briefly discuss whether climate-related population changes are already reflected in population figures and geographical range of species.

Over the last 15 years Sweden's average temperature has been 1°C warmer than during the period 1961–1990 (Figure 23. Source: Swedish Meteorological and Hydrological Institute (SMHI) 2006. Fact Sheet No. 29, www.smhi.se/sgn0102/n0205/faktablad_klimat.pdf). In particular, the winters have been warmer, most of all in northern Sweden (with a rise in average temperature of 2°C). Spring, too, has become warmer, although the change is instead least in northern Sweden (Figure 23). How, then, have our birds been affected by this warming?

Climate change and phenology

Changes in phenology (timing of key ecological variables) can potentially have a great impact on birds, not least on their breeding success. Many insect-eating birds time their nesting so that maximum food availability coincides with their chicks' peak energy requirements. It has been noted in the Netherlands and elsewhere that some tropical migrants no longer arrive in time to take advantage of earlier peak insect availability (warmer springs), and that breeding success therefore has deteriorated (Both & Visser 2001). This may ultimately result in declining population sizes (Both et al. 2006).

The best knowledge we have about climate effects on birds is the effect on their phenology. Many migratory birds (albeit not all) now arrive in southernmost Sweden earlier (data from Ottenby and Falsterbo bird observatories and other sources; Stervander et al. 2005, Jonzén et al. 2006). Arrival at nesting sites is now also occurring earlier in many cases, for example, in Värmland (western central Sweden) (Borgström & Schütt 2006). In Jämtland (northern central Sweden), on the other hand, where average spring temperatures have changed least, no changes have been observed, either in arrival time or nesting start (Sjöberg 2006).

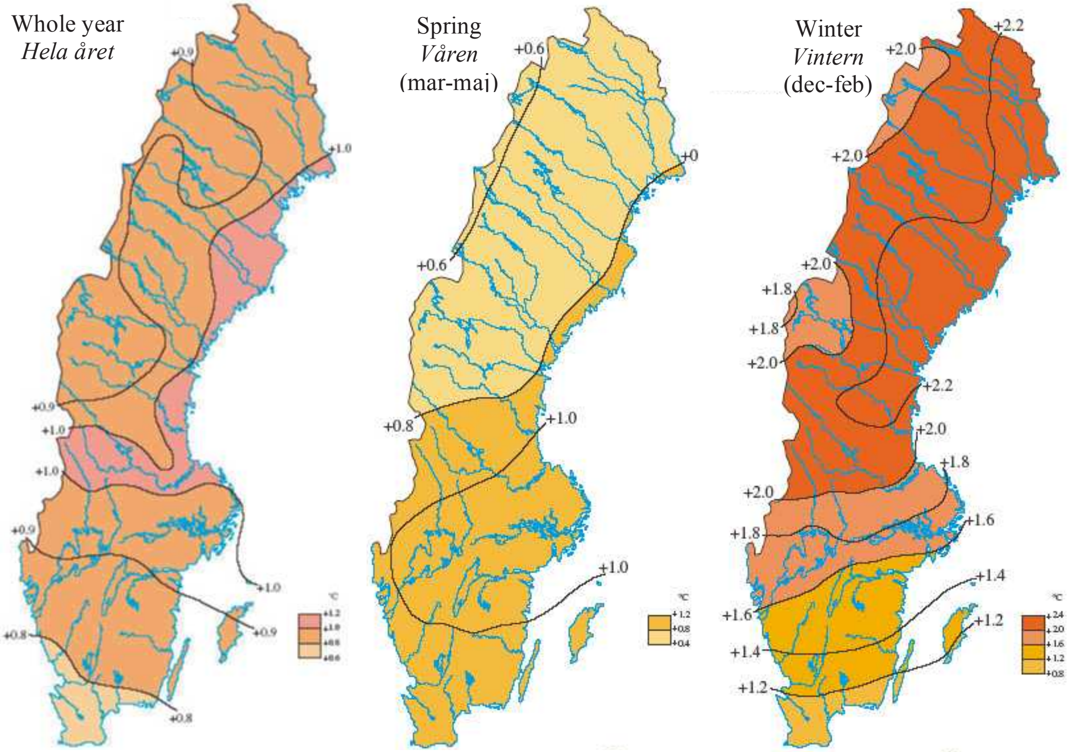

Figure 23. Difference in mean temperature 1991–2005, compared with the normal period 1961–1990 calculated for the full year, spring and winter. Source: Meteorological and Hydrological Institute (SMHI).
Skillnad i medeltemperatur 1991–2005 jämfört med normalperioden 1961–1990 beräknat för hela året, våren respektive vintern. Källa: SMHI.

It is true that Starlings, studied throughout Sweden, have been nesting somewhat earlier since 1981, but this is probably due more to a number of very late springs in the 1980s than a general long-term change (Svensson 2004). There is generally a great degree of variation between adjacent years, and it is therefore more reasonable to assume that the response of some bird species in recent years reflects their great flexibility (on an individual level) rather than genetic changes in their populations.

Climate change and range

Very little is known about whether the warmer climate experienced in recent years has had any effect on the geographical range of bird species. In the somewhat longer term, over the last century, several major changes in range in Sweden have been documented (Järvinen & Ulfstrand 1980). For instance, we have been colonised from the east by Scarlet Rosefinch and Rustic Bunting, from the south by Collared Dove and Chiffchaff (*collybita*) (Svensson et al. 1999, SOF 2002). It is quite clear that changes in geographical range within Sweden have also occurred over the last decades, although it is virtually impossible at present to link them specifically to climate change.

It is obviously reasonable to assume that species that were previously typical of southern Sweden, which have spread northwards over the last fifty years, such as Blue Tit, Nuthatch and Greenfinch, have been helped by a warmer climate. A contributory factor in the spread of these species may also be increasingly widespread winter feeding in gardens. On the other hand, these species have also increased dramatically in number in southern Sweden, which could, in itself, have contributed to their expansions, regardless of climate change. Moreover, the Greenfinch has been spreading northwards since the 1930s.

Thanks to the use of the Fixed routes, for the last decade there has been a more accurate and more objective means of detecting changes in range on a smaller scale, although the short time series does not yet allow us to make in-depth analyses.

Climate change and bird numbers

The first international studies showing probable links between ongoing climate change and changes in bird numbers have now been published (Both et al. 2006). As far as we are aware, no in-depth studies have been carried out in Sweden. As far as is known, other large-scale changes have so far overshadowed any recent climate impact, for example changes in populations of farmland birds as a result of changes in agricultural policy (Wretenberg et al. 2007).

It is known that several Swedish bird species are adversely affected by cold winters, for example, Grey Heron, Winter Wren and Goldcrest (Nilsson 1986, Lindström & Svensson 2006a). The first two species in particular have increased sharply in number in recent decades and there are grounds for assuming that a warmer winter climate has favoured them. However, the decline in Goldcrest numbers clearly shows that other factors (in this case unknown) may also be important. Whatever the case, it is reasonable to believe that several short-distance and partially migrating species will benefit in future if our climate continues to warm up.

Let us assume that a bird's range is mainly explained by the distribution of a certain kind of habitat or a certain climate. If the climate continues to become warmer, we may therefore expect that the species' main range will migrate northwards. This means that at a given locality there may be more or fewer birds of a given species (insofar as a warmer climate is a worse or better thing). It is hard to say whether this would cause the Swedish population of a given bird species to increase or decrease, or whether a general pattern could be expected. Some of our bird species do not occur in the north of the country and might be expected to extend their range there. Other species are already present throughout the country and might be expected to decline in the south and increase in the north.

Using data from the Fixed routes, we estimated and compared trends for southern and northern Sweden for the period 1998–2006 for those species occurring in reasonable numbers in both the south and north of the country. The border was set at 61°N. This made it possible to test the trends for 96 species in southern and northern Sweden against each other (Table 17, Figure 24). The percentage of species in an increasing trend (68%) and a decreasing trend (32%) was the same in the north as in the south. However, in purely numerical terms, the trends were more favourable for birds in the north. On average, they fared 2.2% better per year (Figure 24). For example, the annual trend for the Song Thrush was +11.1% in northern Sweden and +3.1% in the south. On average, the species thus fared 8.0% better per year in the north. The trend for the Goldcrest was -3.7% a year in northern Sweden and -4.7% a year in southern Sweden. The species thus fared 1.0% better a year on average in the north.

Species doing significantly better in the north were the Wryneck, Red-breasted Merganser, Tufted Duck, Red Crossbill, Wood Warbler, Dun-

Table 17. A comparison of population trends in northern and southern Sweden (border at 61°N) for 96 bird species during 1998–2006. The trend for 59 species was more favourable in the north, but for 28 species the difference was not statistically significant (NS). Other differences between trends were confirmed using * $p<0.05$, ** $p<0.01$, *** $p<0.001$. Data from the Fixed routes of the Swedish Bird Survey.
*En jämförelse av populationstrender i norra respektive södra Sverige (gräns vid 61°N) för 96 fågelarter perioden 1998–2006. För 59 arter var trenden fördelaktigare i norr. För 28 av arterna var dock skillnaden inte statistiskt säkerställd (NS). I övrigt var skillnaderna i trenderna säkerställda enligt * p<0.05, ** p<0.01, *** p<0.001. Data från Svensk Fågeltaxerings standardrutter.*

Trend difference *Trendskillnad*	NS	*	**	***	Total *Totalt*
Better in the north *Bättre i norr*	28	7	7	17	59
Better in the south *Bättre i söder*	23	6	3	5	37
No. Species *Antal arter*	51	13	10	22	96

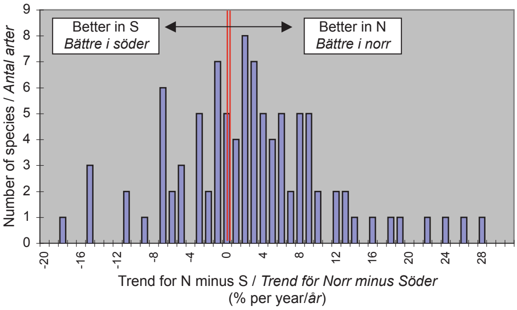

Figure 24. Breakdown of species faring better and worse in northern Sweden, as compared with the south (border at 61°N). The figures on the Y-axis are the trend for northern Sweden (% per år) minus that for southern Sweden. It may be seen that most species are to the right of zero, i.e. most of them have fared better in northern Sweden.
Fördelningen av arter som det gått bättre respektive sämre för i norra jämfört med södra Sverige (gräns vid 61°N). Värdena på y-axeln är trenden för norra Sverige (i % per år) minus den för södra Sverige. Som synes ligger tyngdpunkten av fördelningen till höger om 0, dvs. för majoriteten av arter har det gått bättre i norra Sverige.

nock, Winter Wren, Whinchat, Redshank, Siskin, Blackbird, Black-headed Gull and Song Thrush. Species faring significantly worse in the north were the House Sparrow, Redpoll, Red-throated Loon, Common Merganser, Swift, Meadow Pipit, Hazel Hen and Greenfinch.

Hence, whether or not a species increased or decreased in absolute figures, the situation was generally better in the north. Bird density generally declines towards the north-west in Sweden, essentially owing to the lower primary production in a colder climate. It is therefore possible that there is a proportional correlation between a warmer climate and the population increase in the region in question. In other words, all things being equal, a warmer climate would cause a more positive population trend in the north than in the south of Sweden. We cannot at present say with any degree of certainty that the differences observed between northern and southern Sweden are the result of a warmer climate.

Conclusions

Among the 255 species and subspecies we have examined, we have found all combinations of trends. Some species have increased continuously and sharply for 30 years; others have declined just as steadily. In other cases trends have shifted dramatically even over a period as short as 30 years. The Swedish avifauna had changed a great deal even before these three decades, but systematic data becomes less reliable and more anecdotal the further back in time we go. Hence, changes in the number of species and individuals occur continuously and surely always have. Moreover, changes occur both with and without any obvious human interference.

A number of clear patterns in Swedish bird trends can be discerned over the last 30 years. As many as 38% of our species have declined in number over that period. Species decline can be seen in all categories, classified both systematically and according to habitat. The largest relative decreases have been seen among birds of the agricultural landscape and woodland species (Figure 25). Over the last 30 years farmland birds have generally fared worst, with 58% of species declining during the period. The decline was sharpest in the 1970s and 1980s, although many species are still declining. The next most pronounced declines have been seen among forest birds, with 42% of species in decline. It may be inferred that these decreases began some time before the period in question. In general, populations of many woodland species and farmland birds are now far below the levels prevailing during the 20th century. The underlying causes of this may be found in a general increase in intensive forestry and agriculture, combined in the latter case with farm closures. Since farmland and forest are the habitats of many of our bird species, it is obvious that sustainable use of biodiversity and biological resources in relation to our avifauna can only be achieved by broad concern for nature conservation priorities extending beyond the boundaries of protected areas. This means that agricultural and forestry practices must reflect much greater concern for the overall landscape, particularly bearing in mind that the production pressure on these sectors is hardly likely to diminish in the future.

Other categories of birds of which many species are in decline are waders and long-distance migrants. In the case of waders, the main decline has been seen among birds breeding on grazed wet meadows, notwithstanding extensive habitat management projects over the past 20 years. There are many theories as to why long-distance migratory birds have declined, but few have been substantiated.

Among coastal and wetland species, a larger proportion of species have increased than have declined. On average, coastal birds have fared best, with 48% of species (12 out of 25) increasing over the 30-year period. Birds frequenting mountain

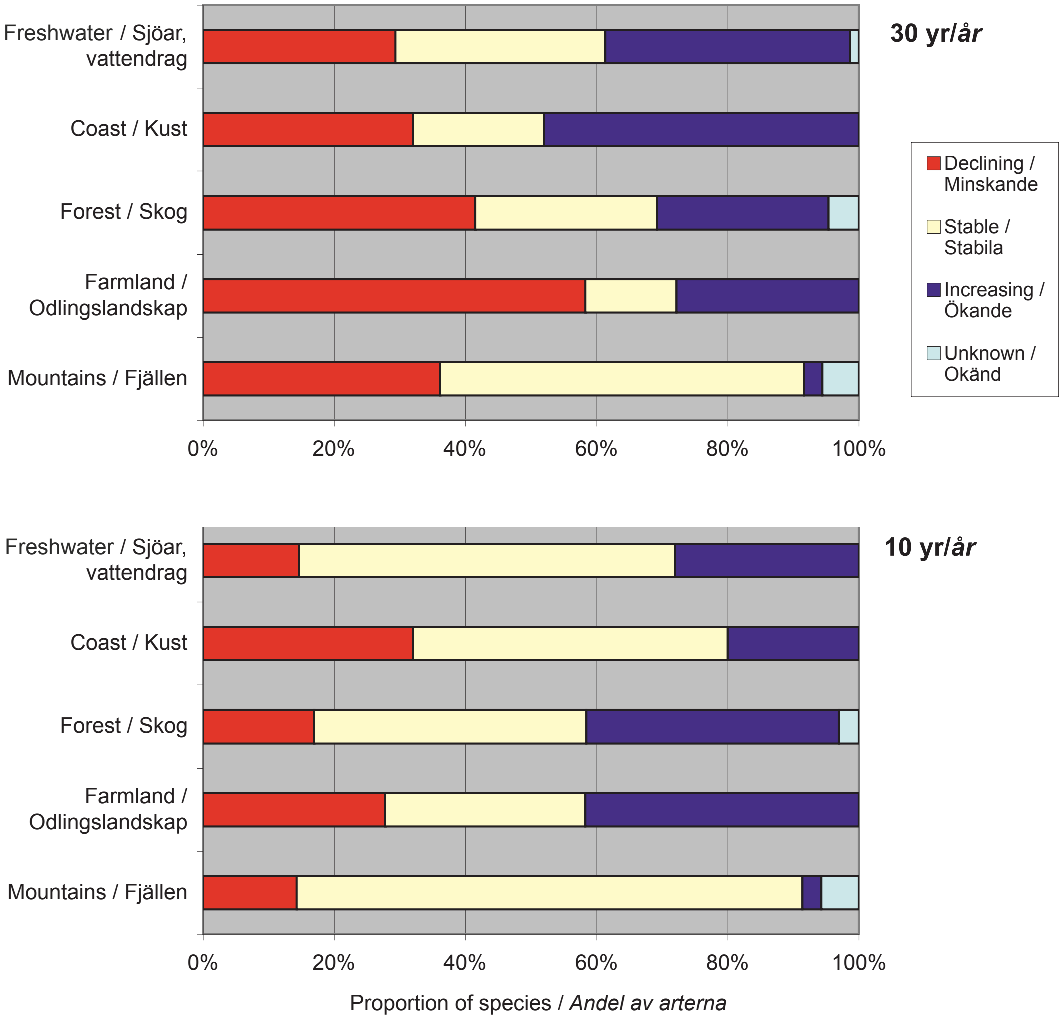

Figure 25. Population trends for Swedish bird species over the last 30 and 10 years grouped according to habitat preferences related to the Swedish environmental objectives. The selection of species for the various habitats is presented in the relevant section.
Sammanfattning av populationstrender hos svenska fågelarter fördelat på olika miljömålsrelaterade naturtyper under de senaste 30 respektive 10 åren. Arturvalet för de olika naturtyperna presenteras i respektive avsnitt.

habitats have had the most stable trends, although it may be noted that the many declines are not "counterbalanced" by some increases.

However, not all Swedish birds are under threat. In total, 32% of Sweden's breeding species have instead increased over the last 30 years. In particular, these include raptors, which have to some extent recovered from previous collapses in their numbers. Other success stories include many of our larger birds such as geese, swans, Crane and Cormorant. Less hunting has most probably benefited several of these species, combined with a marked increase in food availability due to changes in farming practices.

And geese and swans as a group provide a good opportunity to describe how complex the situation can be. Outside the breeding season, this group of birds are heavily dependent on the agricultural landscape, where the situation for most of our breeding birds has deteriorated. But geese and swans have done well. One key factor relating directly to the agricultural landscape is that farmers across Europe have changed over from spring sowing to autumn sowing. This has in turn resulted in many green fields in winter on which the birds can graze. This transition to autumn sowing has had an adverse effect on seed-eating birds of the farming landscape, such as Skylarks and Linnets, which feed outside the breeding season on grain left behind on stubble fields after spring sowing. Geese and swans have in all probability also benefited from the milder winters with less snow that Sweden and northwest Europe has experienced in recent years.

In the more recent past, over the last 10 years, the general situation for Swedish birds can best be described as "increasingly stable". True, there are still species that are on the increase (29%) and decrease (19%), but 50% of species were stable, compared with 28% over the 30-year period. Even though some trends may have been mistakenly thought to be stable because of the short period involved, there is no doubt that many changes have in fact levelled off, as regards both species in long-term decline and those increasing in the long term. Of the species for which the 30-year trend differs from the 10-year trend, far more have done better than have done worse over the last 10 years. It is possible that many species have now reached the (often lower) population level allowed by changes in their habitat and other environmental factors. On the other hand, nature conservation measures such as the creation of wetlands have helped to achieve more positive trends for a number of species. More environmentally friendly forestry practices have increased the proportion of broadleaved trees and dead wood in forests. Growing populations of some woodland species, for example, Lesser Spotted Woodpecker, are probably a result of these measures. Notwithstanding this somewhat improved basic situation, farmland birds are still doing quite badly. It is also worth noting that coastal birds actually seem to have been faring worse in recent years as compared with the period as a whole.

Just as in the above example of the changeover from spring to autumn sowing, a given change in the environment often has contrasting effects of different species. It is therefore difficult to identify the changes that have consistently had a positive or a negative effect on birds. However, factors that in general have led to population decreases are increasingly intensive agriculture and farm closures and increasingly intensive forestry. Factors that overall have caused population increases are milder winters, increased input of nutrients to our seas, less hunting and persecution, lower load of environmental toxins, protection of nesting sites, feeding (including bird feeders) and breeding in captivity with subsequent release.

Knowledge gaps about population trends

Knowledge on population trends for 16% of Swedish breeding bird species is either poor or nonexistent (data quality 1 and 0). Quantitative data on a further 21% of species is of limited quality (data quality 2). Although a new national monitoring programme (Fixed routes) began in 1996, and has increased the number of species monitored throughout Sweden, a single system of this kind cannot encompass all species. Two groups of birds that are particularly poorly covered during the breeding season are owls and ducks breeding in the north of the country. Specific national monitoring programmes should be initiated for these groups. For owls, this might consist of collating the ample local data available, and also starting new projects in parts of the country or for species that are not currently covered. But particular attention should also be given to mountain birds, a group about which our knowledge is especially scant, not least because climate change suggests that this entire habitat may ultimately be under threat.

Knowledge gaps of reasons for population changes

There is insufficient scientific evidence on the causes of changes in the populations of most of our bird species. By this we mean that there is a lack of systematic, well-planned studies, in which it is possible with a high degree of statistical probability, to reject some explanatory models and substantiate others. Nonetheless, in many cases we have a good or very good idea of the underlying reasons for specific population changes. This enables and justifies us to propose specific measures.

There are several reasons why relatively few causes of population change are proven. Firstly, there is not a great deal of research in Sweden aimed specifically at explaining numerical changes. For example, it is remarkable that there is no formal link at present between reporting of sharp population declines under the national environmental monitoring programme and the funding of research to examine the causes of the decline.

Secondly, it is difficult to prove cause and effect because there are usually numerous factors affecting the number of individuals of a species, factors often operating at different times and places during the year. Research of this kind is usually based on the correlation between bird numbers and changes in relevant variables in the surroundings, e.g. how the number of skylarks and linnets has changed in relation to the amount of arable land and fallow land. A common problem is then that the most relevant information is not available, since data on the agricultural landscape, for example, is mainly gathered for production purposes. As a result, ecological variables that are more relevant for birds, such as straw density, degree of landscape heterogeneity, the ecological significance of various types of fallow land (quantity of seeds and insects), and the quantity of small habitats, are not appraised on a large scale.

A more effective approach would be to allow long-term research specifically aimed at explaining population trends so that variables could be gathered in parallel with population data. One promising exception to the prevailing approach is the coordination taking place between the Swedish Bird Survey (*Fixed routes*) and the National Inventory of Landscapes in Sweden (NILS, www.nils.slu.se/), where changes in habitat variables of importance to birds can be used to analyse changes in bird occurrence.

It is surprising that there is currently no research integrated with the often large-scale measures being taken to conserve and improve biodiversity, such as environmental grants for agriculture, nature conservation measures in forestry, forest certification and designation of sizeable areas as nature reserves. This is unfortunate, since it is not necessarily so that measures of this kind have the desired effect. In Sweden it has long been the aim that part of the construction cost of public buildings should be allocated for artistic decoration. In the same way, it ought to be given that some of the large sums of money allocated to improve biodiversity are accompanied by targeted research, so that the effects of the measures can be evaluated. To ensure that research of this kind is of high quality, it is particularly important that it be integrated with the measures right from the outset, preferably on an experimental basis. This is to ensure both that biodiversity does in fact benefit, and also that nature conservation money is well spent.

Acknowledgements

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Sammanfattning

Denna översikt är en lätt omarbetad version av Maxwell Ardings engelska översättning av en tidigare publicerad svensk rapport (Ottvall m.fl. 2008). Nedan följer den korta sammanfattningen från den rapporten. För den som vill läsa rapporten i sin helhet på svenska hänvisar vi till Naturvårdsverkets hemsida, www.naturvardsverket.se/Documents/publikationer/620-5813-5.pdf.

Vi har för var och en av Sveriges drygt 250 häckande fågelarter analyserat förändringarna i antalet individer över de senaste 30 respektive 10 åren. Analysen baseras på data från nationella, regionala och lokala övervakningsprojekt under häckningstid, räkning av flyttande fåglar vid fågelstationer, samt enskilda artprojekt. För 16 % av arterna saknas tillfredställande kunskap om pågående populationsförändringar.

Den senaste 30-årsperioden är det fler arter där antalet individer minskat i antal (38% av alla arter) än där antalet individer ökat (32%). Minskningar har framför allt drabbat flera tidigare vanliga arter i jordbruks- och i viss mån skogslandskapet. Ett alltmer rationaliserat och likriktat jord- och skogsbruk tränger undan många arter som riskerar att bli ovanliga eller försvinna om utvecklingen inte kan vändas. Bland arter som ökat återfinns framför allt rovfåglar, gäss och svanar. Dessa ökningar beror i huvudsak på mänskliga insatser i form av ökat skydd, minskat jakttryck, ändrad markanvändning samt minskad giftbelastning.

Den senaste 10-årsperioden är det fler arter där antalet individer ökat i antal (29% av alla arter) än där antalet individer minskat (19%). För flera arter där utvecklingen under lång tid varit neråtgående har trenden planat ut och i en del fall även börjat vända uppåt. Det går inte att säga om denna förändring beror av aktiva naturvårdsåtgärder eller att antalet fåglar helt enkelt stabiliserats på en ny lägre nivå som det förändrade landskapet medger.

Det är påfallande hur rudimentär vår kunskap ofta är om orsakerna till observerade populationsförändringar. Det är därför angeläget att initiera forskning direkt inriktad på att förklara pågående populationsförändringar, inte minst vad gäller de långsiktigt minskande arterna. En del nya art- och biotopvisa uppföljningsprogram behövs så att alla svenska arters populationsutveckling kan följas.

Det är viktigt att pågående insatser för natur- och fågelskydd fortgår och ytterligare stärks. För att klara miljömålen och för att leva upp till internationella mål om hållbart nyttjande och bevarande av biologisk mångfald måste större hänsyn tas av framför allt de areella näringarna (jord- och skogsbruk) eftersom dessa omfattar så stora arealer och därmed majoriteten av alla fåglar.

Det är av största vikt att genomförda naturvårdsåtgärder, inte minst inom de areella näringarna, med automatik åtföljs av en vetenskaplig utvärdering av åtgärdernas effekter. Detta görs endast i mycket liten omfattning idag. Endast på detta sätt kan gjorda insatser anpassas för att maximera sannolikheten att ett hållbart nyttjande av naturen uppnås.

Appendix 1. Data sources.

Monitoring during the breeding season

The Swedish Bird Survey

The Swedish Bird Survey (SBS) is run by the Department of Ecology, Lund University as part of the Swedish EPA environmental monitoring programme (Lindström & Svensson 2007). The object of the project is to monitor changes in breeding populations of Swedish birds. Monitoring is performed by means of annually recurring censuses using strictly standardised methods. Point counts (summer and winter) began in 1975. A new monitoring programme (the Fixed routes) began in 1996. These three programmes run in parallel. Most of the data is collected by ornithologists working on a voluntary basis, although some are also gathered by paid staff. Some 500 people took part in SBS in 2007. The winter bird count naturally takes place outside the breeding season, but is included here for the sake of simplicity.

Point counts are made in the summer (and are then included in the survey of breeding birds) and/or in the winter ("the winter bird count"). The census takers themselves create routes along which there are 20 points (stopping places) sufficiently far apart to avoid duplicating birds from different points. All birds heard and seen during a five-minute period are counted. The count takes place once a year during the summer and up to five times during the winter on approximately the same dates and starting at approximately the same time of day. The method has been used since 1975. Each point count is the responsibility of a given individual and is concluded when that person so decides. Since the location of the routes is chosen by the census taker, their location in Sweden largely mirrors the distribution of the Swedish human population, i.e. most routes are located in the southern half of the country. Censuses have been taken along between 84 and 306 routes each summer, with more than 250 routes since 1996. A somewhat higher number of censuses are taken in the winter, with more than 300 routes surveyed every year since 1975/1976.

Censuses are taken along fixed routes once each summer. They comprise a network of 716 systematically located routes throughout Sweden (Figure 1). During the period 1996–2006 2855 fixed route censuses were carried out, distributed over 714 of the 716 routes. The number of routes increased gradually over the period, from 48 the first year to 411 in 2006. Unlike the point count, or "free choice", routes, the person responsible for taking a census along a given fixed route may vary from year to year.

A fixed route is an 8 km-long combined linear and point census. It comprises a quadrant of 2×2km; in the corners and at the mid-point between the corners there are points at which all birds are counted during a five-minute period. Between the points birds are counted while the census taker walks slowly (line transect) – approximately 30–40 minutes per kilometre. The point counts and line transects are performed as two independent censuses. The routes have predetermined positions throughout the country, at a distance of 25 km from north to south and from west to east. All birds heard and seen at the points are counted during a five-minute period. Along the line transects all birds heard and seen are counted while the census taker walks slowly, stops, listens and searches, where necessary. Each 1-kilometre section should be walked at a pace such that the time taken is never less than 30 minutes. For more details of the method, see the website (address below).

Data gathered under the Swedish Bird Survey is processed statistically each year and presented for each species and sub-programme in the form of annual indices (Lindström & Svensson 2007). In addition, a trend is estimated – described as an average change over the period as an annual percentage change per year. We analysed point count trends for the period 1975–2006 and fixed route trends for the period 1998–2006 (we excluded the first two years of the latter programme because too few counts were performed).

These analyses were performed using TRIM (TRends & Indices for Monitoring data), an analysis programme developed by the central statistical office in the Netherlands. TRIM is the method chosen for the European Union common bird monitoring programme PECBMS (Gregory et al. 2005). Statistically speaking, TRIM is a type of log- linear analysis based on the maximum likelihood method, which assumes that the number of birds (that is, the number of individuals observed of a given bird species at each census point/route) is Poisson-distributed. The model is able to take into account the problems often found in census data, that is that the birds sometimes occur in colonies or large flocks, that one year's data is not entirely independent of that from the previous year ("serial correlation", that is, many birds live for more than one year and are included two years in a row), and that censuses are not taken along all routes every year. TRIM is used to calculate the most likely figures for those years when a census is not taken along a route. These figures are then used in the statistical treatment of indices. The figures imputed do not affect indices as such, but allow more advanced calculations. For more sophisticated details of TRIM indices, reference is made to the manual, which can be downloaded at www.ebcc.info.

All methods have their pros and cons. The strength of fixed routes (as compared with point count (free choice) routes) is that they cover the entire country proportionally, both geographically and habitat-wise, and that they are performed regardless of environmental changes (many census takers choose to discontinue their point counts when a habitat deteriorates). One potential drawback of fixed routes is that the census taker is sooner or later replaced, which creates an undesirable annual variation, although this need not necessarily affect the trends when based on many routes. Regardless of these methodological differences, point count times series are also considerably longer.

Website:http://www.zoo.ekol.lu.se/birdmonitoring/

LUVRE

As part of LUVRE (Lund University Vindel River Expedition) a number of censuses and species-specific projects intended to examine and monitor the bird fauna of Vindelfjällen in the mountains of northern Sweden have been performed since 1963. We have used data from the following sub-projects as a basis for our trend appraisals.

Mountain birch forest: A nine square-kilometre area west of Ammarnäs has been surveyed each year since 1963 with the help of territory mapping and line transects (Enemar et al. 2004). The area extends from the upper limit of coniferous forest to the transitional zone between birch forest and mountain heath.

Mountain heath: Two one-kilometre sample areas of mountain heath located at separate altitudes have been territory mapped annually since 1964 (Svensson 2006). The study was extended in 1972 to include six line transects over a total distance of 95km, covering wide areas around Ammarnäs, with the aim to make a general survey of all species, including sparse ones. A census is taken once a year. A larger area (13 km^2) around Lake Raurejaure west of Ammarnäs has been territory mapped since 1984 (with some gaps), the focus being on waders and waterfowl (Svensson 2007).

Website: http://www.luvre.org

Ånnsjön – Lake Ånn

The Lake Ånnsjön Bird Observatory at Handöl has been studying the birdlife in a sub-montane habitat in western Jämtland, central Sweden since 1988. The aim is to create a comprehensive picture of bird communities in the area and changes in them. This is being achieved by surveying mountains, bogs and other wetlands (including Lake Ånn itself), nestbox projects and by ringing passerines.

We have used data from the bog censuses (1989–2005) and ringing of passerines (1988–2005) in our trend assessments. The bog census is an annual census of bogs around Lake Ånn, Storlien and Blåhammaren. These censuses are conducted using a specially adapted method that is essentially a variant of territory mapping based on a single visit. Ringing of passerines is done using standardised capture (June–September) at Handöl and the River Enan delta.

Website: http://www.annsjon.org/

Coastal bird censuses

Censuses of breeding seabird populations along the coasts of Sweden have been performed since the 1960s and 1970s. All in all, most stretches of coastline have been covered repeatedly (at least twice) during the period dealt with here. In a few cases there has been some form of annual monitoring for part of the period. In most cases censuses have taken the form of large-scale projects with lengthy intervals between repeat censuses. For this report we have collated census data from all the major sources we have been able to find. Essentially speaking, this has entailed reviewing county administrative board reports and regionally published data. Personal contact with those responsible for various censuses has also been used as a means of obtaining non-published material. Studies covering large geographical areas (entire counties or a large part of them) have been given priority. Obvious geographical gaps in the material are Norrbotten in northern Sweden and Södermanland, just south of Stockholm. In the former case the first comprehensive census is currently in progress; in the latter we have not been able to obtain any data covering a sizeable geographical area. The data sources we have used are shown in Table 18. The table also includes the censuses performed at Lakes Vänern and Mälaren, which we have used when making national trend assessments. All coastal bird censuses have been carried out using a method essentially following the recommendations in the

Table 18. Coastal bird censuses included in the trend assessments for coastal bird species.
Kustfågelinventeringar som ingår i trendbedömningarna för kustfågelarter.

County *Län*	Area/coverage *Område/täckning*	Census year *Inventeringsår*	Reference *Referens*
Västerbotten	Whole area *Heltäckande*	1976	Grenmyr et al. 1978
Västerbotten	Whole area* *Heltäckande*	2001–2002	Sundström & Olsson 2005
Västerbotten	Holmöarna	1985	Sundström 1995
Västerbotten	Holmöarna	1995	Sundström 1995
Västerbotten	Holmöarna, parts of area *delområden*	2000–2003	Bader et al. 2006
Västerbotten	Holmöarna, parts of area *delområden*	2007	Edenius et al. 2007
Västernorrland	Whole area *Heltäckande*	1999	Pettersson 1999
Västernorrland	Ångermanland	1973	ÅOF 1974
Västernorrland	Ångermanland	1987	Grenmyr & Holmkvist 1994
Gävleborg	Whole area *Heltäckande*	1997–1998	Aspenberg & Axbrink 1998
Gävleborg	Gästrikland	1971–1972	Risberg et al. 1976
Uppsala	Whole area *Heltäckande*	2002–2003	Pettersson & Landgren 2005
Uppsala	Forsmark	1976–2001	Sevastik 2005
Uppsala	Norduppland, selection urval	1997–2006	Amcoff 2007
Stockholm	Whole area *Heltäckande*	2000–2003	Lindén in a letter *i brev*
Stockholm	Whole area *Heltäckande*	1974–1975	Andersson & Staav 1980
Stockholm	Selected parts *Utvalda delar*	1985–1997	Amcoff 2003
Stockholm	Selected parts *Utvalda delar*	1985–2006	Skärgårdsstiftelsen 2007
Östergötland	Outer archipelago *Ytterskärgård*	2007	Gezelius in a letter *i brev*
Östergötland	Outer archipelago *Ytterskärgård*	1997	Gezelius 1999
Östergötland	Outer archipelago *Ytterskärgård*	1981	Magnfält & Olofsson 1982
Kalmar	Outer archipelago, selection *Ytterskärgård, urval*	1984, 1990–2000	Johansson & Larsson 2001
Kalmar	Outer archipelago, selection *Ytterskärgård, urval*	2001–2007	Johansson & Larsson in a letter *i brev*
Gotland	Stora Karlsö	2005**	Hedgren & Kolehmainen 2006
Gotland	Stora Karlsö	1998	Hedgren & Kolehmainen 2000
Gotland	Stora Karlsö	1984–1985	Hedgren 1985
Blekinge	Whole area *Heltäckande*	2003	Wolgast & Carlsson 2003
Blekinge	Whole area *Heltäckande*	1979	Wolgast & Carlsson 2003
Blekinge	Utklippan, eiders only *bara ejder*	1984–2004	Larsson 2004
Skåne	North-east archipelago *Nordöstra skärgården*	2004	Waldemarsson 2005
Skåne	North-east archipelago *Nordöstra skärgården*	1995	Waldemarsson 1996
Skåne	North-east archipelago *Nordöstra skärgården*	1983–1984	Cronert & Svensson 1991
Skåne	Hallands Väderö	1937–2006***	Andersson 2007
Halland	Northern & central *Norra & Mellersta*	2005–2006	Flodin in a letter i brev
Halland	Northern & central *Norra & Mellersta*	1993–1995	Åhlund 1996b
Halland	Northern & central *Norra & Mellersta*	1966–1970	Pehrsson & Unger 1970
Halland	Nidingen	1970–1999	Järås et al. 1999
Halland	Varberg Municipality *kommun*	1970,1974,1989	Åhlund 1996b
Halland	Tylön	2005–2006	Wirdheim 2006
Halland	Tylön	1995	Wirdheim 2006
Västra Götaland	Random samples, whole county *Stickprov, hela länet*	2001–2006	Alexandersson in a letter *i brev*
Västra Götaland	Göteborg & Bohus län	1993–1994	Åhlund 1995, 1996a
Västra Götaland	Göteborg & Bohus län	1966–1968	Pehrsson & Unger 1970
Västra Götaland	Göteborg Municipality *kommun*	1976	Mathiasson 1977
Västra Götaland	Göteborg Municipality *kommun*	1993–1995	Åhlund 1999
Västra Götaland	Göteborg Municipality *kommun*	1966–1970	Pehrsson & Unger 1970
Vänern		1994–2007	Landgren 2007
Mälaren		2005–2007	Pettersson 2007a
Mälaren		1975	Andersson in Pettersson, 2006

* Not including Holmöarna (the Holm islands) and inner bays *Inkluderar inte Holmöarna och inre fjärdar*

** Annual data covering longer periods is presented for some species *För vissa arter presenteras årliga data för längre perioder*

*** Not all years; different species were surveyed different years. More complete censuses were carried out in 1937, 1963–1966, 1972, 1979, 1986, 1994, 2005 *Inte alla år, olika arter inventerade olika år, mer heltäckande inventeringar 1937, 1963–1966, 1972, 1979, 1986, 1994, 2005*

Swedish EPA Environmental Monitoring Handbook. This entails a combination of pair, nest and individual counts during two – three visits. For more detailed accounts in each case, see the references in Table 18.

Data have been analysed using TRIM (see explanation above under the Swedish Bird Survey) to obtain trends over the 30-year and 10-year periods for all species occurring. In addition to the data sources presented here, our trend estimates have incorporated data (on relevant species) from the wet meadow censuses listed in the following chapter.

Wet meadow censuses

Censuses of birds of coastal wet meadows have been carried out regularly since the 1980s. Sporadic censuses were also taken earlier but they were often local. The majority of Swedish coastal wet meadows have thus been surveyed on at least two occasions in recent decades, censuses usually being arranged by the relevant county administrative board. As a result, there is now a system for monitoring this specific habitat, even though the census intervals vary (and have varied over time) between different counties. In most cases repeated large-scale surveys are performed at five-year intervals. On the island of Öland, which has by far the greatest area of coastal wet meadows, an interval of 10 years is used for the total area. Annual censuses are performed in relatively small areas of Skåne and Öland. For this report we have collated census data from all the main sources we have been able to find. Just as with coastal birds in general, we have given priority to data from geographically extensive censuses (Table 19). Together with the data sources presented above under coastal bird censuses, these two selections form the basis for our trend assessments for all species occurring primarily in coastal areas.

All the coastal wet meadow censuses have been performed using a modified variant of the territory mapping method, combined with pair and nest counts for some species. This method entails two – five visits per area. See the references in Table 19 for more detailed descriptions in each case.

Also here the data have been analysed using TRIM to obtain trends over the 30-year and 10-year periods for all species occurring. In addition to the data sources presented here, our trend estimates have incorporated data (on relevant species) from the coastal bird censuses listed in the preceding chapter.

Birds reported by the public

Nowadays many bird observations are reported online via the Species Gateway. (www.artportalen.

Table 19. Wet meadow censuses included in the trend assessments for coastal bird species.
Strandängsinventeringar som ingår i trendbedömningarna för kustfågelarter.

County *Län*	Area/coverage *Område/täckning*	Census year *Inventeringsår*	Reference *Referens*
Gotland	Whole area *Heltäckande*	2006	Johansson et al. 2007
Gotland	Whole area *Heltäckande*	2001	Johansson et al. 2002
Gotland	Whole area *Heltäckande*	1996	Hedgren et al. 1996
Öland	Whole area *Heltäckande*	1998	Pettersson 2001
Öland	Whole area *Heltäckande*	1988	Ottosson et al. 1989
Öland	Parts of area *Delområden*	2003–2004	Ottvall & Larsson 2005
Skåne	North-eastern part *Nordöstra delen*	2004	Waldemarsson 2005
Skåne	North-eastern part *Nordöstra delen*	1995	Waldemarsson 1996
Skåne	North-eastern part *Nordöstra delen*	1983–1984	Cronert & Svensson 1991
Skåne	Western part *Västra delen*	2007	Flodin, Green & Ottvall 2008
Skåne	Western part *Västra delen*	2002	Flodin & Grahn 2002
Skåne	Vellinge Municipality *kommun*	1997–2007	Falsterbo Bird Observatory *in litt* Falsterbo fågelstation i brev
Skåne	Vellinge FSO	1988–2007	Falsterbo Bird Observatory *in litt* *Falsterbo fågelstation i brev*
Halland	Whole area *Heltäckande*	2002	Flodin & Grahn 2002
Halland	Whole area *Heltäckande*	1970	Pehrsson & Unger 1970
Västra Götaland	Selected parts *Utvalda delar*	1999	Ahlén et al. 2000
Västra Götaland	Selected parts *Utvalda delar*	1983	Åhlund et al. 1987

se). These observations form the basis for annual regional and national analyses of bird numbers presented in the publication *Fågelåret* ("Bird Year"), published by the Swedish Ornithological Society. Other important regional sources used in our examination of bird trends are: *Upplands fåglar* ("Birds of Uppland", Fredriksson & Tjernberg 1996), *Skånes fåglar* ("Birds of Skåne", Ekberg & Nilsson 1994, 1996), *Västerbottens fåglar* ("Birds of Västerbotten", Olsson & Wiklund 1999) and *Blekinges fåglar* ("Birds of Blekinge", Nilsson & Lundgren 1993). The most important national reference works have been *Svensk fågelatlas* ("Swedish Bird Atlas", Svensson et al. 1999) and *Sveriges fåglar* ("Birds of Sweden", SOF 2002). Included among bird reports are also county administrative board reports that are not specifically included in a systematic monitoring programme.

Species-specific projects

A number of species are the subject of specific projects to monitor the national population trend, often using special methods. Highly detailed follow-up monitoring is usually performed, entailing counts of occupied nests, nest visits and ringing of chicks. These projects are often directly linked to ongoing or previous protection or support (such as introducing captive birds into the wild and guarding of large raptor nests). Some projects are split into regional sub-projects, and the timing and geographical extent of the monitoring may thus vary from one part of the country to another. Reports from these projects are published regularly in the publication Fågelåret.

We have used published data from projects for the following species: Black-throated Loon, Red-throated Loon, Lesser White-fronted Goose, White-tailed Eagle, Golden Eagle, Gyrfalcon, Peregrine Falcon, Caspian Tern and Eagle Owl.

Websites/links:
http://www.projekt-lom.com/
http://www.jagareforbundet.se/news/documents/fjllgss.pdf
http://www.snf.se/verksamhet/djur-natur/proj-havsorn/
http://www.eagle72.se/
http://www.jorf.se/projekt_jaktfalk.htm
http://www.snf.se/verksamhet/djur-natur/proj-pilgrimsfalk/index.htm
http://www.hkust.se/berguvnord/

Local projects

In addition to species-specific projects, we have used data from some projects or censuses that we have classified as local projects. Our rationale is that, unlike species-specific projects, local projects have mainly local or regional support (various projects on owls and the Siberian Tit (Grey-headed Chickadee) in a large and remote area of northern Swedish spruce forest). We are aware that the distinction between a species-specific and a local project is not always crystal clear. In our view, a local project does not have the expressed aim of presenting national data. The extensive Dipper ringing project is a borderline case, since an annual report is published in the form of Cinclus Scandinavicus. We have treated the ringing of Dippers as a local project.

National censuses organised by the Swedish Ornithological Society

The year the national surveys officially began was 1969, when a call was published in Vår Fågelvärld (see issue no. 1/1969, volume 28, page 84). The purposes of the survey and rationale for the selection of species were explained at that time: "species chosen for the national survey are those that may be expected to yield useful information, which usually means that only uncommon species are likely to be considered". Rare birds are covered by general reporting and are not suitable for the normal national survey. The survey was not in operation during the period 1981–1993, except for 1984, but otherwise the concept has continued in the same spirit into the 21st century (Table 20). Species previously included in the survey are given high priority to enable trends to be identified. As far as possible, species with good regional distribution are chosen.

Monitoring of birds outside the breeding season

Our bird populations are also monitored during passage and in their winter quarters. This is done by ringing migratory birds, counting birds on passage and by winter censuses. The various programmes complement one another, since all methods have advantages and drawbacks (of which the most important are addressed here). The main advantages of studies during the breeding season are the high level of geographical precision, which makes it possible to analyse at different levels (nationally, regionally and sometimes also locally), and, as

Table 20. National surveys included in the trend assessments for individual species.
Riksinventeringar som ingår i trendbedömningarna för enskilda arter.

Species *Art*	Census year *Inventeringsår*	Year of comparison *Jämförelseår*	Source *Källa*
Cormorant	2006		Fågelåret 2006
Lesser Black-backed Gull	2006		Fågelåret 2006
Sand Martin	2003		Vår Fågelvärld 7/04
Black-headed Gull	2002		Vår Fågelvärld 5/04
Osprey	2001	1971	Vår Fågelvärld 7/04
Little Gull	2000	1971	Vår Fågelvärld 8/02
Bittern	2000	1979	Vår Fågelvärld 2/02
Curlew	1999		Vår Fågelvärld 2/01
Collard Dove	1998	1974–75	Vår Fågelvärld 8/99
Whooper Swan	1997	1979	Vår Fågelvärld 3/99
Horned Grebe	1996	1972	Vår Fågelvärld 1/98
Marsh Harrier	1995	1979	Vår Fågelvärld 4/96
Corncrake	1994	1968	Vår Fågelvärld 2/95
Eagle Owl	1984	1975	Vår Fågelvärld 3/86

in the case of the Swedish Bird Survey, the fact that a very large numbers of localities are visited. Moreover, territory mapping in particular enables us to make a very good estimate of the number of breeding pairs, which is often the information that is most sought after.

Studies outside the breeding season offer a number of advantages. As long as methods are standardised, changes in the number of birds passing a given place can be studied with relative ease (only a few people are needed to man a bird observatory). In addition, unlike breeding censuses of breeding birds, which mainly record singing males, a sample is taken of the size of the entire population, including females, non-breeding adults and young born that year.

Counts outside the breeding season also have their drawbacks. Birds from a large breeding area are normally counted, which often results in analyses with poor geographical precision. Furthermore, all studies carried out at a single place are sensitive to local habitat changes, particularly of the kind potentially affecting the extent to which birds fly over, land and/or allow themselves to be trapped. It is also well known that weather conditions affect results at migratory bird localities such as the southern tip of the island of Öland and Falsterbo at the southern tip of Sweden. This often results in larger fluctuations from one year to another than during the breeding season. These fluctuations in themselves do not prevent the analysis of trends over a longer time horizon.

Naturally, the severity of the winter affects the number of birds recorded in winter bird counts, since many birds wintering in Sweden are partial migrants that remain in the country as long as it is not too cold and snow and ice conditions are not too difficult. Counts of typical resident birds such as Marsh Tits, Nuthatches and grouse are less affected by these factors, if at all.

Ringing at Ottenby Bird Observatory

Ottenby bird observatory at the southern tip of the island of Öland has conducted standardised trapping of migratory birds since 1972 in autumn and since 1979 in spring (e.g., Stervander et al. 2005, Helseth et al. 2006, Lindström et al. 2007). Capture has taken place each year since 1946 (Hjort & Lindholm, 1978). Three main capture methods are used: mist nets, stationary Heligoland traps and wader traps. Each spring and autumn the mist nets are opened for capture approximately 30 minutes before sunrise and are closed at the earliest at 11.00am. The nets are not used if it is raining or very windy. But birds can still be caught in Heligoland traps in bad weather. Walk-in "Ottenby traps" are used to catch waders on the beds of rottening seaweed on the near-by shores . Capture begins around 1 July and normally continues into September. The number of birds captured during a given season is used to estimate populations trends (Lindström et al. 2007).

Website:
http://www.sofnet.org/ofstn/noframes.htm

Ringing at Falsterbo Bird Observatory

Falsterbo bird observatory has conducted standardised capture since 1980 in spring and autumn using mist nets around Falsterbo lighthouse gardens, and in autumn using mist nets in the reed beds at Södra Flommen, immediately north of Falsterbo lighthouse. Netting takes place for at least four hours in spring and for six hours in autumn, starting at dawn (see Karlsson et al. 2005).

Website: http://www.skof.se/fbo/index_e.html

Ringing at Stora Fjäderägg

Autumn ringing at Stora Fjäderägg (Västerbotten, north Sweden) began in 1984, with more standardised methods being employed from 1985. Mist netting is the primary method, but use of a large Heligoland trap began in 2004, followed by a smaller one in 2006. The placement and number of nets has been virtually constant over the last 10 years. As at other bird stations, the weather is a key factor affecting fluctuations from year to year. To minimise the effect of the weather, trends are estimated using a 20-year data series based on annual totals of birds ringed divided by the number of capture days for individual species.

Website:
http://www.sofnet.org/index.asp?lev=1949&typ=1

Migratory bird counts at Falsterbo

Up until 2000 two standardised migratory bird count projects for diurnal migrants were in progress at Falsterbo. One of them covered all species; the other focused on raptors. Since 2001 these projects have been combined in a single project, which means that bird data have been gathered using three methods: Counts at Nabben 1973–2000, raptor counts 1986–2000 and coordinated counts since 2001 (2 observers). Birds are counted daily 1 August–20 November from dawn until at least 14.00 local winter time.

In Kjellén (2002) adjustments for the differing amounts of work done and the differing timing of the counts have been made. With the help of these adjustments it is possible to use the heterogeneously gathered data to make trend estimates.

Website:
http://www.skof.se/fbo/research/migrco_e.htm

International waterbird censuses

Waterbirds (swans, geese and, in recent years, Crane) are counted on a large scale in recurrent international censuses in the autumn and winter as part of the International Waterbird Census (IWC) programme under the auspices of Wetlands International. The primary aim of the census programme is to survey the occurrence and population trends of various wetland bird species on an international scale. The censuses therefore focus on the time of the year when these birds are most geographically concentrated (winter). This means that the relationship with breeding areas is not particularly strong. Among other things, the waterbird censuses form the basis for the criteria used to determine which areas are classified as internationally important under the Ramsar Convention on Wetlands and the IBA.

Two duck censuses in Sweden are performed every year – a midwinter census in January (since 1967) and a September census (since 1973). Random samples are normally taken at some 600 localities in January and around 200 in September. The purpose of these censuses is to gather data for annual indices and trend estimates. At intervals nationwide censuses are also carried out in midwinter, with a view to achieving maximum possible coverage. This was done 1969–1973, 1987–1989, 2004 and 2007.

Geese are counted on several occasions during September–January. These censuses focus to some extent on certain species; hence they do not cover exactly the same selection of localities on the different occasions. All species are counted in each census. Since 1987 a census has been performed in September, the primary focus being on Greylag Geese (and also Cranes for the last two years). The main subject of the October–November census is bean geese (since 1987), whereas the January census (since 1987) aims to cover all localities where there might be geese at that time of year. Between 1977 and 1987 monthly censuses of all conceivable bean goose localities were performed during October–April. The goose censuses generate data in the form of the total number of birds of each species, which can then be used for trend estimates.

Censuses of specific species are performed some years. For instance, there is a whooper swan count every five winters. Most censuses are performed from land-based sites. Airborne censuses are used to cover large expanses of archipelago habitat and offshore reefs as part of overall censuses.

Website: http:// www.zoo.ekol.lu.se/waterfowl/

Other ringing

For a number of reasons we have not attempted to use ringing data from bird observatories other than those mentioned above. One principal reason is availability; many bird observatories do not have the expressed aim of using capture data for the specific purpose of monitoring bird population trends. One exception to this is Kvismaren bird station in the central Swedish province of Närke, which publishes trends for a number of tropical migrants in Fågelåret 2006 (SOF 2007). However, in the case of some species (Sedge Warbler, Reed Warbler and Marsh Warbler), we have supplemented available monitoring data from the Swedish Bird Survey with capture data from the Bird Ringing Centre, and more specifically from Kvismaren and from Bingsmarken in Skåne, southern Sweden. In assessing the trend for the Horned Grebe, we have obtained material from annual reports published by the Lake Hornborgasjön Field Station in Fågelåret. A census is made of the only Swedish Kittiwake colony at Nidingen Bird Observatory.

There is an ongoing CES bird ringing project (Constant Effort Sites, Pettersson 2007b) in Sweden, which, apart from population monitoring, also provides data on juvenile numbers and annual survival. So far the number of localities (6–24 sites annual with recurring activities between 1996 and 2007) and the number of individuals captured have both been fairly low. Moreover, the species included are often well covered using other census methods that are already included in our analysis. Hence, we have not attached a great deal of importance to the CES material in this analysis. We would be happy to see more extensive monitoring performed as part of the CES system, since this would increase the chances of understanding the causal links underlying bird trends.

Wildlife monitoring – the Swedish Association for Hunting and Wildlife Management

The Swedish Association for Hunting and Wildlife Management has been running a wildlife monitoring programme since 1995. The aim of the programme is to improve hunting statistics and monitoring of wildlife populations. The association has gathered statistics on the number of animals shot since 1939. They are based on reports from hunting teams and district hunting clubs and are gathered on a county-by-county basis. The total number of individuals of each wildlife species shot is calculated on the basis of the area covered by the report. The statistics include a number of major sources of confounding variation, such as changes in the hunting season (Woodcock) and as in the case of the Long-tailed Duck, occasional large killings of birds suffering the effects of oil pollution. The statistics for each district are added to produce county statistics. Hunting statistics from reporting units stating they have released game are not adjusted upwards for the species released. The same applies to statistics from local authorities and the like.

Statistics on the number of animals shot can be gathered either in the form of total figures, or by random sampling. Reporting can be based on information from individual hunters or reports from geographically defined hunting units. The advantage of statistics on an area basis is that they relate to a well-defined geographical area and provide a relatively high level of detail. They serve well as a measure of trends, particularly in areas where the same units report year after year. Moreover, numbers shot can be placed in relation to other geographical information. The drawback is that there is seldom any indication of how representative the reporting units are. This makes it difficult to specify the accuracy of the estimate of total numbers shot. Hunting statistics can be regarded in all contexts as an index, even though they are presented as actual numbers.

The total area covered by the reports for hunting season 2006/2007 was almost 14 million hectares. This represents approximately 42% of the area available for hunting (below the limit of cultivation/ reindeer grazing zone in the Swedish mountains).

Appendix 2. Trends and peripheral data.

Estimated trends over 30 and 10 years are listed here, together with relevant peripheral data on all species and subspecies dealt with in the review. **Species:** Species whose name is in a coloured field are on the Swedish red list. The scientific subspecies name is given for the seven species divided into subspecies. **Trend:** '--' = large decline, '-' = decline, 0 = stable, '+' = increase, '++' = large increase, '?' = trend unknown, and also 'nrb' = not a regular breeding bird. **Size:** Average population change (%) for the period. Figures are given only for species with the highest data quality. **Data quality:** '3' = high degree of certainty, '2' = some uncertainty, '1' = high degree of uncertainty, and '0' = no quantitative data available. **Annex 1**: 'A' for species listed in Annex 1 of the EC Birds Directive. **Winter:** Main winter quarters of the species: 'S' = Sweden, 'E' = Europe except Sweden, and 'T' = Africa/Asia. **Group:** States in which species group analysis the species was included: 'Wet' = Freshwater (wetland) birds, 'Red' = Red listed species, 'C' = Coastal birds, 'G' = Game birds, 'M' = Mountain birds, 'Rap' = Raptors, 'Farm' = Farmland birds, 'For' = Forest birds, 'Wad' = Waders, and 'O' = Owls. **References:** The figures refer to the main data sources, which are listed in the right column of this page.

References in Appendix 2:

1 Point count (free choice) routes – summer
2 Point count (free choice) routes – winter
3 Fixed routes
4 Falsterbo migratory bird count
5 Ottenby ringing of migrants
6 Falsterbo ringing of migrants
7 Stora Fjäderägg ringing
8 Ammarnäs – LUVRE
9 Ånnsjön
10 Waterbird censuses
11 Coastal and wet meadow censuses, including Lakes Vänern and Mälaren
12 Swedish Ornithological Society national censuses
13 Bird reporting by the public
14 Swedish Species Information Centre
15 Species-specific projects
16 Local projects
17 Other ringing
18 Hunting statistics

Species/subspecies	30 years Trend	30 years Size	30 years Data quality	10 years Trend	10 years Size	10 years Data quality	Annex 1	Winter	Group	References
Red-throated Loon *Gavia stellata*	-	10-19	3	0		3	A	E	Wet, Red	1,3,15
Black-throated Loon *Gavia arctica*	+	20-29	3	+	10-19	3	A	E	Wet	1,3,15
Little Grebe *Tachybaptus ruficollis*	+		2	+		2		E	Wet	13
Great Crested Grebe *Podiceps cristatus*	-	10-19	3	0		3		E	Wet	1,3,11,13
Red-necked Grebe *Podiceps grisegena*	+		2	+		2		E	Wet	13
Horned Grebe *Podiceps auritus*	-		2	0		2	A	E	Wet, Red	12,13
Black-necked Grebe *Podiceps nigricollis*	+ +	>80	3	+	10-19	3		E	Wet, Red	13,17
Great Cormorant *Phalacrocorax carbo*	+ +	>80	3	+ +	>80	3		E	Wet, C	1,3,11,12
Eurasian Bittern *Botaurus stellaris*	+ +	>80	3	0		3	A	E	Wet, Red	12,13
Grey Heron *Ardea cinerea*	+ +	>80	3	0		3		E	Wet	1,3,12
Mute Swan *Cygnus olor*	+ +	50-79	3	0		3		S	Wet, C	1,3,10,11
Whooper Swan *Cygnus cygnus*	+ +	>80	3	+	20-29	3	A	E	Wet	1,3,10,12
Bean Goose *Anser fabalis*	0		0	0		0		E	Wet, Red, G	13,14
Lesser White-fronted Goose *Anser erythropus*	- -	>80	3	+	10-19	3	A	E	M, Red	14,15
Greylag Goose *Anser anser*	+ +	>80	3	+ +	>80	3		E	Wet, G	1,3,10,11
Canada Goose *Branta canadensis*	+ +	>80	3	+ +	>80	3		S	Wet, G	1,3,10,11
Barnacle Goose *Branta leucopsis*	+ +	>80	3	0		3	A	E		1,3,11,13
Common Shelduck *Tadorna tadorna*	+ +	>80	3	0		3		E	C	1,3,11
Eurasian Wigeon *Anas penelope*	?		0	0		1		E	Wet, G	3
Gadwall *Anas strepera*	+ +	>80	3	+ +	>80	3		E	Wet	11,13
Eurasian Teal *Anas crecca*	-	30-49	3	0		3		E	Wet, G	1,3,9,10
Mallard *Anas platyrhynchos*	+ +	50-79	3	+	10-19	3		E	Wet, G	1,3
Northern Pintail *Anas acuta*	-		0	-		0		E	Wet, Red	11,14
Garganey *Anas querquedula*	0		2	0		2		T	Wet, Red	11,14
Northern Shoveler *Anas clypeata*	0		2	0		2		E	Wet, Red	11,14
Common Pochard *Aythya ferina*	-		2	0		2		E	Wet, Red	13,14
Tufted Duck *Aythya fuligula*	0		3	0		3		E	Wet, G	1,3,11
Greater Scaup *Aythya marila*	-		1	-		1		E	Wet, C, M, Red	8,11

Common Eider *Somateria mollissima*	+ +	50-79	3	- -	30-49	3		E	C, G	1,3,11
Long-tailed Duck *Clangula hyemalis*	0		1	0		1		E	Wet, M, G	8,9
Black Scoter *Melanitta nigra*	0		1	0		1		E	Wet, M, G	8
Velvet Scoter *Melanitta fusca*	- -	50-79	3	-	10-19	3		E	Wet, C, Red, G	11
Common Goldeneye *Bucephala clangula*	+	20-29	3	0		3		E	Wet, G	1,3
Smew *Mergellus albellus*	+		1	+		1	A	E	Wet, Red	14
Red-breasted Merganser *Mergus serrator*	+	30-49	3	0		3		E	C, G	1,3,11
Common Merganser *Mergus merganser*	+	30-49	3	0		3		E	Wet, G	1,3,11
European Honey Buzzard *Pernis apivorus*	- -	50-79	3	0		3	A	T	Rap, Red	4
Red Kite *Milvus milvus*	+ +	>80	3	+ +	>80	3	A	E	Rap, Farm	1,3,4
White-tailed Eagle *Haliaeetus albicilla*	+ +	>80	3	+ +	50-79	3	A	S	Rap, Red	15
Western Marsh Harrier *Circus aeruginosus*	+ +	>80	3	0		3	A	T	Rap, Wet	1,3,4,12,13
Northern Harrier *Circus cyaneus*	-		1	0		1	A	E	Rap, M, Red	4
Montagu's Harrier *Circus pygargus*	-	30-49	3	-	20-29	3	A	T	Rap, Farm, Red	15
Northern Goshawk *Accipiter gentilis*	0		2	0		2		S	Rap	1,3
Eurasian Sparrowhawk *Accipiter nisus*	+		2	+		2		E	Rap	1,3,4
Common Buzzard *Buteo buteo*	0		3	+	10-19	3		E	Rap, Farm	1,3
Roughleg *Buteo lagopus*	-		2	0		2		E	Rap, M, Red	4,8
Golden Eagle *Aquila chrysaetos*	+	30-49	3	+	10-19	3	A	S	Rap	15
Osprey *Pandion haliaetus*	+ +	>80	3	0		3	A	T	Rap, Wet	1,3,4,12,16
Common Kestrel *Falco tinnunculus*	+ +	>80	3	+ +	>80	3		E	Rap, Farm	1,3,4
Merlin *Falco columbarius*	0		1	0		1	A	E	Rap, M, Red	4
Eurasian Hobby *Falco subbuteo*	0		1	+		1		T	Rap	3,4,16
Gyrfalcon *Falco rusticolus*	0		3	0		3	A	S	Rap, M, Red	15
Peregrine Falcon *Falco peregrinus*	+ +	>80	3	+ +	>80	3	A	E	Rap	15
Hazel Grouse *Tetrastes bonasia*	0		2	0		2	A	S	For, G	1,3,18
Willow Ptarmigan *Lagopus lagopus*	0		1	0		2		S	M, G	3,8,16
Rock Ptarmigan *Lagopus muta*	+		1	0		1		S	M, G	3,8,16
Black Grouse *Lyrurus tetrix*	- -	50-79	3	0		3	A	S	For, G	1,3,18
Western Capercaillie *Tetrao urogallus*	0		2	0		2	A	S	For, G	1,3,18

Grey Partridge *Perdix perdix*	-		1	0		1		S	Farm, Red, G	14,18
Common Quail *Coturnix coturnix*	+		2	+		2		T	Farm, Red, G	13
Common Pheasant *Phasianus colchicus*	-	20-29	3	0		3		S	Farm, G	1,3
Water Rail *Rallus aquaticus*	0		1	0		1		E	Wet	13
Spotted Crake *Porzana porzana*	0		2	0		2	A	T	Wet, Red	13
Corncrake *Crex crex*	+		2	+		2	A	T	Farm, Red	13
Common Moorhen *Gallinula chloropus*	-		1	0		1		E	Wet	13
Eurasian Coot *Fulica atra*	0		3	+	20-29	3		E	Wet	1,3,10
Common Crane *Grus grus*	+ +	>80	3	+ +	50-79	3	A	E	Wet	1,3
Eurasian Oystercatcher *Haematopus ostralegus*	+	30-49	3	0		3		E	Wad, C	1,3,11
Pied Avocet *Recurvirostra avosetta*	+ +	>80	3	+	20-29	3	A	E	Wad	11,13
Little Ringed Plover *Charadrius dubius*	0		2	0		2		T	Wad, Wet	13
Common Ringed Plover *Charadrius hiaticula*	0		1	0		2		T	Wad, Wet, C, M	8,11
Kentish Plover *Charadrius alexandrinus*	- -	>80	3	nrb			A	E	Wad	13,15
Eurasian Dotterel *Charadrius morinellus*	0		1	0		1	A	E	Wad, M	8
European Golden Plover *Pluvialis apricaria*	0		2	0		3	A	E	Wad, Wet, M	1,3,8,11,16
Northern Lapwing *Vanellus vanellus*	-	20-29	3	+	10-19	3		E	Wad, Farm	1,3,11
Temminck's Stint *Calidris temminckii*	0		1	0		2		T	Wad, M, Red	5,8,14
Purple Sandpiper *Calidris maritima*	?		0	?		0		E	Wad, M	
Dunlin *Calidris alpina alpina*	0		2	0		2		E	Wad, M	3,8
Southern Dunlin *Calidris alpina schinzii*	- -	>80	3	- -	>80	3	A	E	Wad	11,15
Broad-billed Sandpiper *Limicola falcinellus*	0		1	0		1		T	Wad, Wet	5
Ruff *Philomachus pugnax*	-		2	-		2	A	T	Wad, M, Red	3,5,11
Jack Snipe *Lymnocryptes minimus*	0		0	0		0		E	Wad, Wet	16
Common Snipe *Gallinago gallinago*	- -	50-79	3	+ +	30-49	3		E	Wad, Wet	1,3,8,9
Great Snipe *Gallinago media*	0		2	0		2	A	T	Wad, M, Red	15
Eurasian Woodcock *Scolopax rusticola*	+		1	+		2		E	Wad, For	1,3
Black-tailed Godwit *Limosa limosa*	- -	50-79	3	- -	50-79	3		T	Wad	11
Bar-tailed Godwit *Limosa lapponica*	0		0	0		0	A	E	Wad, M, Red	13
Eurasian Curlew *Numenius arquata*	-	30-49	3	0		3		E	Wad, Farm, Red	1,3,12

Whimbrel *Numenius phaeopus*	0		1	0		3		T	Wad, Wet	3,8,9
Spotted Redshank *Tringa erythropus*	0		0	0		1		T	Wad, Wet	13
Common Redshank *Tringa totanus*	-	20-29	3	0		3		T	Wad, Wet	1,3,8,9,11
Common Greenshank *Tringa nebularia*	0		2	0		3		T	Wad, Wet	1,3,9
Green Sandpiper *Tringa ochropus*	0		3	+	20-29	3		T	Wad, Wet, For	1,3
Wood Sandpiper *Tringa glareola*	0		2	0		3	A	T	Wad, Wet	1,3,9
Common Sandpiper *Actitis hypoleucos*	-	30-49	3	-	10-19	3		T	Wad, Wet	1,3,11
Ruddy Turnstone *Arenaria interpres*	- -	50-79	3	-	20-29	3		E	Wad, C, Red	11
Red-necked Phalarope *Phalaropus lobatus*	0		1	0		2	A	T	Wad, Wet, M	8,9
Parasitic Jaeger *Stercorarius parasiticus*	+	30-49	3	-	20-29	3		T	C	11
Long-tailed Jaeger *Stercorarius longicaudus*	0		1	0		2		T	M	8
Little Gull *Larus minutus*	+ +	>80	3	+	20-29	3	A	E	Wet	12,13
Common Black-headed Gull *Larus ridibundus*	- -	50-79	3	0		3		E	Wet	1,3,11,12
Mew Gull *Larus canus*	-	20-29	3	+	10-19	3		E	Wet, C, G	1,3,11
Herring Gull *Larus argentatus*	0		3	-	20-29	3		S	C, G	11
Great Black-backed Gull *Larus marinus*	+ +	>80	3	-	20-29	3		S	C, G	11
Lesser Black-backed Gull *Larus fuscus intermedius*	0		3	-	10-19	3		E	C	11,12
Lesser Black-backed Gull *Larus fuscus fuscus*	- -	50-79	3	0		3		T	C, Red	11,12
Black-legged Kittiwake *Rissa tridactyla*	-	20-29	3	0		3		E	C	13,17
Caspian Tern *Sterna caspia*	-	30-49	3	0		3	A	T	C, Red	15
Sandwich Tern *Sterna sandvicensis*	- -	50-79	3	0		3	A	T	C, Red	11,13
Common Tern *Sterna hirundo*	+ +	50-79	3	+ +	50-79	3	A	T	Wet, C	3,11
Arctic Tern *Sterna paradisaea*	+ +	>80	3	+ +	50-79	3	A	T	Wet, C	3,11
Little Tern *Sterna albifrons*	0		3	0		3	A	T	C, Red	11,13
Black Tern *Chlidonias niger*	0		3	0		3	A	T	Wet, Red	13
Common Murre *Uria aalge*	+	20-29	3	0		3		E	C	11
Razorbill *Alca torda*	+ +	>80	3	+ +	50-79	3		E	C	11
Black Guillemot *Cepphus grylle*	-	10-19	3	-	10-19	3		E	C	11
Common Wood Pigeon *Columba palumbus*	+	10-19	3	+	20-29	3		E	Farm, G	3,4
Stock Dove *Columba oenas*	- -	50-79	3	+ +	>80	3		E	For, Farm, Red	1,3,4

Eurasian Collared Dove *Streptopelia decaocto*	- -	50-79	3	0		2		S	Red	2,12
Barn Owl *Tyto alba*	-		2	nrb				S	O, Red	13
Eurasian Eagle-Owl *Bubo bubo*	+ +	>80	3	-		2	A	S	O, Red	15
Snowy Owl *Bubo scandiaca*	-		2	nrb			A	S	O, M, Red	13
Northern Hawk-Owl *Surnia ulula*	0		0	+		0	A	S	O	13
Eurasian Pygmy Owl *Glaucidium passerinum*	0		0	+		0	A	S	O	13
Tawny Owl *Strix aluco*	0		0	0		0		S	O	13
Ural Owl *Strix uralensis*	+		0	0		0	A	S	O	13
Great Grey Owl *Strix nebulosa*	+		0	0		0	A	S	O, Red	13
Long-eared Owl *Asio otus*	-		0	0		0		E	O	13
Short-eared Owl *Asio flammeus*	-		0	-		0	A	E	O, Wet, Red	13
Boreal Owl *Aegolius funereus*	0		0	0		0	A	S	O	13
Common Cuckoo *Cuculus canorus*	- -	50-79	3	+	10-19	3		T		1,3
European Nightjar *Caprimulgus europaeus*	-		1	+		1	A	T	For, Red	13,16
Common Swift *Apus apus*	-	30-49	3	-	20-29	3		T		1,3
Common Kingfisher *Alcedo atthis*	-		2	-		2	A	E	Wet, Red	13
Eurasian Hoopoe *Upupa epops*	-		2	nrb				T	Red	13,14
Eurasian Wryneck *Jynx torquilla*	- -	50-79	3	+ +	30-49	3		T	For, Farm, Red	1,3,5,6,16,17
Grey-headed Woodpecker *Picus canus*	+		1	+		1	A	S	For	13
European Green Woodpecker *Picus viridis*	- -	50-79	3	0		3		S	For, Farm	1,3
Black Woodpecker *Dryocopus martius*	+	20-29	3	-	20-29	3	A	S	For	1,3
Great Spotted Woodpecker *Dendrocopos major*	-	20-29	3	0		3		S	For	1,3
White-backed Woodpecker *Dendrocopos leucotos*	- -	>80	3	- -	50-79	3	A	S	For, Red	15
Lesser Spotted Woodpecker *Dendrocopos minor*	+		2	+		2		S	For, Red	1,3,13,16
Eurasian Three-toed Woodpecker *Picoides tridactylus*	-		1	0		2	A	S	For, Red	14
Wood Lark *Lullula arborea*	+ +	>80	3	0		3	A	E	For	1,3,4,13
Eurasian Skylark *Alauda arvensis*	- -	50-79	3	-	20-29	3		E	Farm, Red	1,3
Horned Lark *Eremophila alpestris*	-		2	0		2		E	M, Red	8
Sand Martin *Riparia riparia*	- -	50-79	3	0		3		T	Wet, Red	12
Barn Swallow *Hirundo rustica*	0		3	0		3		T	Farm	1,3

Common House Martin *Delichon urbicum*	-	30-49	3	0		3		T		1,3
Tawny Pipit *Anthus campestris*	- -	>80	3	- -	30-49	3	A	T	Red	13,15
Tree Pipit *Anthus trivialis*	-	30-49	3	0		3		T	For	1,3,4,5,6,8
Meadow Pipit *Anthus pratensis*	0		3	0		3		E	Wet, Farm, M	1,3,8
Red-throated Pipit *Anthus cervinus*	-		1	-		1		T	M, Red	4,13
Eurasian Rock Pipit *Anthus petrosus*	0		2	0		2		E	C	11
Western Yellow Wagtail *Motacilla flava flava*	- -	50-79	3	- -	30-49	3		T	Farm	1,11
Western Yellow Wagtail *Motacilla flava thunbergi*	-		1	0		3		T	Wet	3,4,8
Grey Wagtail *Motacilla cinerea*	+ +	>80	3	+ +	50-79	3		E	Wet	4,13
White Wagtail *Motacilla alba*	-	20-29	3	+	10-19	3		E	Farm	1,3,4,5,6
Bohemian Waxwing *Bombycilla garrulus*	+		1	+		2		S	For	2,3
White-throated Dipper *Cinclus cinclus*	0		2	-		2		S	Wet, M	2,16
Winter Wren *Troglodytes troglodytes*	+ +	>80	3	-	10-19	3		E		1,3,5,6
Dunnock *Prunella modularis*	- -	50-79	3	0		3		E	For	1,3,5,6
European Robin *Erithacus rubecula*	-	10-19	3	0		3		E		1,3,5,6
Thrush Nightingale *Luscinia luscinia*	- -	50-79	3	-	10-19	3		T	Wet	1,3,5,6
Bluethroat *Luscinia svecica*	-		2	0		3	A	T	M	3,5,7,8,9
Black Redstart *Phoenicurus ochruros*	+	20-29	3	0		3		E		13
Common Redstart *Phoenicurus phoenicurus*	- -	50-79	3	0		3		T	For	1,3,5,6
Whinchat *Saxicola rubetra*	- -	50-79	3	0		3		T		1,3,5,6
Northern Wheatear *Oenanthe oenanthe*	-		2	-	10-19	3		T	Farm, M, Red	1,3,8
Ring Ouzel *Turdus torquatus*	0		1	0		1		E	M	8
Common Blackbird *Turdus merula*	+	30-49	3	+	20-29	3		E		1,3,5,6
Fieldfare *Turdus pilaris*	+	10-19	3	+	10-19	3		S	For, G	1,3,8
Song Thrush *Turdus philomelos*	0		3	+	20-29	3		E	For	1,3,5,6,8
Redwing *Turdus iliacus*	0		3	+	20-29	3		E	For	1,3,5,6,8
Mistle Thrush *Turdus viscivorus*	+ +	50-79	3	+ +	30-49	3		E	For	1,3
Common Grasshopper Warbler *Locustella naevia*	- -	50-79	3	- -	30-49	3		T	Wet, Red	1,13
River Warbler *Locustella fluviatilis*	+		2	0		2		T	Wet, Red	13
Savi's Warbler *Locustella luscinioides*	+		2	+		2		T	Wet	13

Sedge Warbler *Acrocephalus schoenobaenus*	- -	50-79	3	0		3		T	Wet	1,3,17
Blyth's Reed Warbler *Acrocephalus dumetorum*	+		2	0		2		T		13
Marsh Warbler *Acrocephalus palustris*	+		2	+		2		T	Farm	1,17
Eurasian Reed Warbler *Acrocephalus scirpaceus*	0		3	0		3		T	Wet	1,3,17
Great Reed Warbler *Acrocephalus arundinaceus*	+ +	>80	3	0		3		T	Wet, Red	13
Icterine Warbler *Hippolais icterina*	0		3	+	20-29	3		T	For	1,3,5,6
Barred Warbler *Sylvia nisoria*	-		2	-		2	A	T	Red	13
Lesser Whitethroat *Sylvia curruca*	0		3	+	20-29	3		T		1,3,5,6
Common Whitethroat *Sylvia communis*	0		3	0		3		T	Farm	1,3,5,6
Garden Warbler *Sylvia borin*	0		3	0		3		T	For	1,3,5,6
Eurasian Blackcap *Sylvia atricapilla*	+ +	>80	3	+ +	30-49	3		E	For	1,3,5,6
Greenish Warbler *Phylloscopus trochiloides*	0		2	0		2		T	For, Red	13
Arctic Warbler *Phylloscopus borealis*	0		0	0		0		T	M, Red	13
Wood Warbler *Phylloscopus sibilatrix*	+	20-29	3	0		3		T	For	1,3,5,6
Common Chiffchaff *Phylloscopus collybita abietinus*	- -	50-79	3	+ +	>80	3		E	For	1,3
Common Chiffchaff *Phylloscopus collybita collybita*	+ +	>80	3	+ +	>80	3		E	For	1,3
Willow Warbler *Phylloscopus trochilus acredula*	0		3	0		3		T	For	1,3
Willow Warbler *Phylloscopus trochilus trochilus*	-	10-19	3	0		3		T	For	1,3
Goldcrest *Regulus regulus*	-	10-19	3	- -	30-49	3		S	For	1,3,5,6
Firecrest *Regulus ignicapilla*	+		2	+		2		E		5,6,13
Red-breasted Flycatcher *Ficedula parva*	-		1	0		1	A	T	For, Red	5,13
Spotted Flycatcher *Muscicapa striata*	0		3	+	10-19	3		T	For	1,3,5,6,8
Collared Flycatcher *Ficedula albicollis*	+		2	0		2	A	T	For	17
European Pied Flycatcher *Ficedula hypoleuca*	-	20-29	3	0		3		T	For	1,3,5,6,8
Bearded Reedling *Panurus biarmicus*	+		2	-		2		S	Wet	13
Long-tailed Bushtit *Aegithalos caudatus*	0		3	+	10-19	3		S	For	1,3
Marsh Tit *Poecile palustris*	- -	50-79	3	0		3		S	For, Red	1,3
Willow Tit *Poecile montana*	- -	50-79	3	-	20-29	3		S	For	1,3
Grey-headed Chickadee *Poecile cincta*	-		1	0		2		S	For, Red	1,3
European Crested Tit *Lophophanes cristatus*	0		3	+	10-19	3		S	For	1,3

Coal Tit *Periparus ater*	-	10-19	3	- -	30-49	3		S	For	1,3
Blue Tit *Cyanistes caeruleus*	+	30-49	3	+	20-29	3		S	For	1,3
Great Tit *Parus major*	-	10-19	3	+	10-19	3		S	For	1,3
Eurasian Nuthatch *Sitta europaea*	+	20-29	3	+	20-29	3		S	For	1,3
Eurasian Treecreeper *Certhia familiaris*	-	20-29	3	-	20-29	3		S	For	1,3
Eurasian Penduline Tit *Remiz pendulinus*	+ +	>80	3	-	10-19	3		E	Wet, Red	13,16
Eurasian Golden Oriole *Oriolus oriolus*	0		3	0		3		T	For, Red	13
Red-backed Shrike *Lanius collurio*	-	30-49	3	0		3	A	T	Farm, Red	1,3,5,6,16
Great Grey Shrike *Lanius excubitor*	-		2	0		2		E		2,4
Eurasian Jay *Garrulus glandarius*	-	10-19	3	0		3		S	For, G	1,3
Siberian Jay *Perisoreus infaustus*	?		0	-		2		S	For, Red	14
Eurasian Magpie *Pica pica*	0		3	0		3		S	Farm, G	1,3
Spotted Nutcracker *Nucifraga caryocatactes caryocatactes*	-		2	-		2		S	For, Red	1,3
Spotted Nutcracker *Nucifraga caryocatactes macrorhynchos*	+		2	+		2		S		13
Western Jackdaw *Corvus monedula*	+	10-19	3	+	20-29	3		S	Farm, G	1,3
Rook *Corvus frugilegus*	+ +	>80	3	0		3		S	Farm, G	1,13
Hooded Crow *Corvus cornix*	-	30-49	3	-	10-19	3		S	Farm, G	1,3
Northern Raven *Corvus corax*	+ +	>80	3	0		3		S	For	1,3
Common Starling *Sturnus vulgaris*	- -	50-79	3	-	10-19	3		E	Farm	1,3
House Sparrow *Passer domesticus*	- -	50-79	3	-	20-29	3		S	Farm	1,3
Eurasian Tree Sparrow *Passer montanus*	-	20-29	3	-	10-19	3		S	Farm	1,3
Common Chaffinch *Fringilla coelebs*	0		3	+	10-19	3		E	For	1,3
Brambling *Fringilla montifringilla*	0		2	0		3		E	For	3,8
European Serin *Serinus serinus*	+ +	>80	3	0		3		E	Red	13
European Greenfinch *Carduelis chloris*	+ +	50-79	3	+	20-29	3		S	Farm	1,3
European Goldfinch *Carduelis carduelis*	+ +	>80	3	+	20-29	3		E	Farm	1,3
Eurasian Siskin *Carduelis spinus*	0		3	-	10-19	3		E	For	1,3
Common Linnet *Carduelis cannabina*	- -	50-79	3	- -	30-49	3		E	Farm, Red	1,3
Twite *Carduelis flavirostris*	-		1	0		1		E	M, Red	4
Common Redpoll *Carduelis flammea flammea*	0		2	0		2		S	M	3,8

Common Redpoll *Carduelis flammea cabaret*	+ +	>80	3	-		2		E		1,13
Arctic Redpoll *Carduelis hornemanni*	?		0	?		0		S	M	
Two-barred Crossbill *Loxia leucoptera*	?		0	?		0		S	For	
Red Crossbill *Loxia curvirostra*	0		2	+		2		S	For	1,3
Parrot Crossbill *Loxia pytopsittacus*	0		2	0		2		S	For	1,3
Common Rosefinch *Carpodacus erythrinus*	+ +	>80	3	- -	30-49	3		T		1,3
Pine Grosbeak *Pinicola enucleator*	?		0	?		0		S	For, Red	
Eurasian Bullfinch *Pyrrhula pyrrhula*	-		2	0		3		S	For	1,3
Hawfinch *Coccothraustes coccothraustes*	+ +	>80	3	+	10-19	3		S	For	1,3
Lapland Longspur *Calcarius lapponicus*	0		2	0		3		E	M	8
Snow Bunting *Plectrophenax nivalis*	-		1	0		2		E	M	4,8
Yellowhammer *Emberiza citrinella*	-	30-49	3	0		3		S	Farm	1,3,5,6
Ortolan Bunting *Emberiza hortulana*	-		2	-	10-19	3	A	T	Farm, Red	1,3,13
Rustic Bunting *Emberiza rustica*	-		1	-		2		T	For	3,7
Little Bunting *Emberiza pusilla*	+		0	0		0		T	For, Red	13
Common Reed Bunting *Emberiza schoeniclus*	-	20-29	3	0		3		E	Wet	1,3,5,6,8
Corn Bunting *Emberiza calandra*	-	20-29	3	+ +	>80	3		S	Farm, Red	15