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Horned Grebe *Podiceps auritus* and Red-necked Grebe *Podiceps grisegena* in Sweden 2011 – results from a national survey

Svarthakedopping Podiceps auritus *och gråhakedopping* Podiceps grisegena *i Sverige 2011 – resultat från en nationell inventering*

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Abstract

The breeding populations of Horned Grebe *Podiceps auritus* and Red-necked Grebe *Podiceps grisegena* were surveyed in Sweden 2011. The estimate for Horned Grebe was 2000 pairs, an increase from about 1200 pairs in 1996 towards the estimate of 2200 pairs in 1972. The estimate for Red-necked Grebe was 1300 pairs and the population size has most certainly increased in the last decades. Habitat use among the breeding birds differed between species and region. In south Sweden, both species were most commonly found in artificial water bodies, and a recent increase in the numbers of such waters may have contributed to the population increases. In north Sweden the species were mainly found in natural inland water bodies or along the Baltic coast. Similar long-term population trends were also seen in a long-term observational dataset of passage birds from Ottenby Bird Observatory in southeast Sweden. There was no obvious effect of the coldness at their wintering grounds on the amount of birds seen at Ottenby the following year, but indirect effects of winter harshness cannot be ruled out.

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Introduction

For conservation purposes it is important to track the status and trend of a given population. Trends can be estimated when the size of the population is regularly estimated (Sutherland 2006). A common approach for bird population monitoring is to take repeatable sample measurements, either in the breeding areas (e.g. line transects or point counts), along the migratory pathway (e.g. standardized ringing or observation schemes), or during winter for birds forming dense flocks (e.g. counting numbers: Bibby et al. 2000). Breeding bird censuses are per definition spatially linked to a certain region, which is a great advantage when monitoring a local population. But surveying a breeding species over a vast area is often demanding and costly. Observation schemes along the migratory pathway are relatively cheap and can therefore be carried out regularly, and a relative measure of the amount of birds passing can be summarized on a yearly basis. The apparent weakness with this method is that the population size and the true distribution of the birds counted rarely are known.

Two sparsely occurring bird species in Sweden are the Horned Grebe *Podiceps auritus* and the Red-necked Grebe *Podiceps grisegena*. Due to the low population numbers and stratified breeding distributions of the two species, the general techniques used in bird monitoring in Sweden are not sufficient for trend and population size estimates (Bibby et al. 2000, Lindström & Green 2013). The Swedish Ornithological Society therefore announced Horned Grebe and Red-necked Grebe to be subjects of a national survey during the breeding season of 2011, and urged each local birding community to contribute with observations. In contrast to the Red-necked Grebe, the Horned Grebe has been surveyed before. The first time was in 1972, when the population was estimated at 2200 pairs and then again in 1996, when the results suggested a drop in the Swedish population to 1200 pairs (Regnell 1981b, Douhan 1998).

The aims of this paper are to describe the implementation of the survey throughout the country, to summarize the results from the individual provinces, and to give an estimate of the current status of the two species in Sweden. Furthermore, the data on habitat choices of breeding birds are presented. In addition, the results from this survey and previous surveys are accompanied with long-term observational data from Ottenby Bird Observatory, in an attempt to estimate current population trends of these two secretive Swedish breeders. Finally, winter harshness and recent Swedish wetland establishments, two factors suggested to influence population size of the two grebe species through winter survival and breeding success, are discussed and evaluated.

Study species

Horned Grebe and Red-necked Grebe are two medium-sized diving birds that prefer smaller water-bodies such as shallow lakes and reservoirs (del Hoyo et al. 1992). The Horned Grebe mainly breeds in moderate-sized eutrophic lakes and pools in the boreal region of the Holarctic. The Red-necked Grebe has a more southerly distribution, with a higher preference for lowland basins of on average larger sizes (Cramp & Simmons 1977, Fjeldså 2004). Their winter distributions are largely over-lapping in Europe. They stretch from western Scandinavia and the North Sea to the Mediterranean basin (Gilissen et al. 2002, SOF 2002, Fjeldså 2004). However, there are relatively more Red-necked Grebes found in Danish waters (Jensen 1993, Stone et al. 1995), and recently a large winter population of Horned Grebes was discovered in the Pomeranian Bight in the southern Baltic Sea (Durinck et al. 1994, Sonntag et al. 2009 and references therein). A Horned Grebe ringed in the province of Östergötland and found in The Netherlands is the only link between the Swedish breeding population and their presumed winter distribution (Fransson et al. 2001), but two Finnish ringed Horned Grebes were found in Poland and France (Saurola et al. 2013). Three recoveries of Red-necked Grebe tie Denmark winter birds and Finland summer population together, and one Red-necked Grebe ringed in southern Germany was found breeding in Denmark (Bønløkke et al. 2006, Saurola et al. 2013). The breeding range of the two species in Sweden overlaps greatly in the south-eastern and north-eastern part of the country, and in the south they are increasingly occurring in the same type of man-made habitats (Axelsson 1997, Douhan 1998, SOF 2002). Despite decreasing global population numbers (BirdLife International 2013), the two species are listed as "Least concern" on the IUCN Red List for birds (IUCN 2012). In Sweden, both species seem to have increased in recent decades (Regnell 1981b, Grenmyr 1984, Axelsson 1997, Douhan 1998, Olsson & Wiklund 1999, Hedberg Fält 2012, Ottosson et al. 2012).

Method

National survey

Prior to the breeding season of 2011, an invitation was sent to the regional birding communities throughout Sweden to participate in a nation-wide survey, to encourage birders to contribute with details of observed grebes to the local report committees, which regionally summarized the information. To facilitate reporting and compilation, the local report committees were provided with protocols and methodological guidelines for the survey. Water bodies potentially harbouring breeding grebes should be surveyed for birds at least once during the breeding season. If there were any uncertainties in the assessment of breeding birds after the initial visit, a second visit was proposed. To keep concordance with the national surveys on Horned Grebe in 1972 and 1996, displaying birds or territory holding birds were counted as breeding attempts (Regnell 1981b, Douhan 1998). This followed the methodological recommendations by Regnell (1981a), in order to increase the efficiency of the survey while reducing the risk of disturbing breeding birds. To streamline the survey, a first visit was suggested to be carried out in the period when all birds were assumed to have arrived at the local area, but before the first birds had started incubation. Depending on when lakes became ice-free, suitable dates varied considerably between different parts of the country.

The compiled survey results were obtained from the local report committees together with information of the scope in which the survey had been carried out. These results were here arranged in three categories depending on the regional survey scope. Category A: Areas where the surveys had been conducted according to the guidelines, or in a way resulting in an almost complete coverage of presumed breeding areas. Category B: Regions that were less thoroughly surveyed, but where population estimates could be based on recent surveys, or proper knowledge of the breeding grebes. Category C: Regions where the numerical estimates of the populations were less well substantiated, or where no survey had been carried out at all. In these cases, estimates were based on spontaneous reports to the local report committee, information from earlier years, population numbers in neighbouring regions, and for Horned Grebe, results from prior national surveys that were extrapolated to a rough size estimate of the populations of 2011. Numbers in category C are hence accompanied with a large uncertainty and should be treated carefully. Surveys based on few visits like here can give an underestimation of the number on breeding grebes in the range of 20–60 % (Regnell 1981a). Therefore, the observed number of breeding pairs has in each province been presented together with an estimate of the true number of breeders. The uncertainty in the estimation varies with the coverage of the survey (A–C), which serves as the measure when the accuracy of the observed number (good = *** – poor = *) was estimated. To facilitate the comparison with prior national surveys of Horned Grebe the results have been presented per province, which only in a few cases were fully synonymous to the regions defined by the local report committees. Thus, in some cases the provincial numbers have been based on information from more than one regional survey. While discussing the Swedish populations of the two species in a general sense, the broader definition "region" has been used. The Swedish provinces are traditionally organized into the three regions *Götaland*, *Svealand* and *Norrland* (Figure 1).

Breeding habitat

Along with survey data on the breeding grebes, the birds' choice of habitat was also recorded. To avoid interference with the time and effort put on observing the birds, the surveyor was instructed to just briefly describe the water body hosting the breeding grebes (e.g. eutrophic lake, wetland, irrigation pond etc.). This information has been thoroughly reported from Gotland, Östergötland and the eastern part of Småland through the survey protocols. Data from Skåne, Värmland, Dalarna, parts of Södermanland and Uppland, Gästrikland, Medelpad and Hälsingland have been presented in alternative ways. For the other provinces, this information has been retrieved from Artdatabanken (2013). Water bodies with breeding grebes were categorized in four general groups based on descriptive information gathered from Artdatabanken (2013) or with help from the local report committees. These groups were then used to illustrate the habitat choice of the breeding grebes throughout the country. The four groups were defined as follows:

Natural inland water bodies: This group consists of water bodies not directly or deliberately influenced by humans, as for example lowland basins and woodland lakes, tarns and natural pools.

Artificial water bodies: Newly established irrigation ponds and small wetlands on golf courses belong to this group. There are also thoroughly managed wetlands found in this category, as well as restored wetlands, which retain their attractiveness through repeated human efforts. The well-known Lake Hornborga and Lake Tåkern are two examples of lowland basins that have received extensive actions to retain current appearance (Naturvårdsverket 1997). They both belong to this group.

Figure 1. The geographical distribution of the Swedish provinces, with bold lines separating the three regions where Götaland is in the south, Svealand in central Sweden and Norrland in the north.
Den geografiska fördelningen av de svenska landskapen med fetare linjer som avskiljer Götaland, Svealand och Norrland.

Coast: Breeders found in bays and around islets along the coast of the Baltic Sea are included in this group. In some cases birds breeding in outlets of larger rivers have been included here as well (see below), since the border between the habitat groups is not easy to resolve.

Others: Single breeding pairs found in other habitats than the above mentioned have been placed in this group together with observations made in habitats intermediate to the descriptions above.

Regional and interspecific differences in habitat use were evaluated with chi-square tests. R version 3.0.0. was used in the statistical analysis (R Core Team 2013).

Long-term observation data

Ottenby, at the southern tip of the Baltic island Öland (56°12´N, 16°24´E), located off the Swedish southeast coast, is well-known for its richness in both resting and migrating birds (Edelstam 1972). At Ottenby Bird Observatory, birds have been ringed for almost 70 years (Hjort & Lindholm 1978). Since 1963, daily notes of birds observed in the vicinity of the observatory have been taken, alongside the bird observatory´s ringing activity. Sight records of Red-necked Grebe and Horned Grebe have been extracted and then summarized on a yearly basis for spring and autumn seasons, respectively. This gives the number of days per season and year that the two species have been observed. The manning of the bird observatory has mainly followed the time schedule of the standardized trapping scheme introduced in 1972, and the same periods have hence set the limit for the counting of spring and autumn observations in this study (Hjort & Lindholm 1978): these time

Table 1. Reported and estimated numbers of Horned Grebes per Swedish province in 2011. For each province is given the method of data collection (A–C [see method for further info]) and accuracy of the estimate (* = poor, ** = medium, *** = good).
Rapporterade och skattade antal svarthakedoppingar per landskap år 2011. För varje landskap presenteras vilken metod som använts för att få fram uppgifterna (A–C [se metod för ytterligare information]) och precisionen i de skattade antalen (= dålig, ** = måttlig, *** = god).*

Province *Landskap*	Method *Metod*	Rep. *Rap.* (n)	Estimate *Skattat antal* min	 max	Accuracy *Precision*	References *Referenser*
Gästrikland	B	142	190	215	**	Aspenberg 2012a
Hälsingland	B	126	140	160	***	M. Axbrink, pers. comm.
Medelpad	B	37	45	55	**	P. Helttunen, pers. comm.
Härjedalen	C	12	30	50	*	J. Rågehall, pers. comm.
Jämtland	C	19	100	200	*	G. Storensten, pers. comm.
Ångermanland	C	60	120	180	*	K. Holmqvist, pers. comm..
Västerbotten	C	29	150	220	*	Sundström & Olsson 2005; M, Laisfeldt pers. comm.
Norrbotten	C	15	10	20	*	Sundström & Olsson 2009; R. G. Gustavsson, pers. comm.
Lappland	C	75	50	100	*	H. Rune, pers. comm.
Norrland			*835*	*1200*		
Närke	B	41	45	55	**	L. Johnsson, pers. comm.
Södermanland	A	165	210	250	**	Flodin 2012, M. Åsberg, pers. comm.
Uppland	A,C	160	210	250	**	B. Douhan, M. Åsberg, pers. comm.
Västmanland	C	17	25	35	*	T. Pettersson, pers. comm.
Värmland	A	15	15	20	***	Carlsson 2011
Dalarna	C	6	15	25	*	U. Grenmyr, pers. comm.
Svealand			*520*	*635*		
Skåne	A	0	0	0	***	Bengtsson 2011
Blekinge	C	1	1	3	**	Artdatabanken 2013
Småland	A,B	62	70	80	**	Johansson 2012, C. Ljungberg, pers. comm.
Öland	B	22	25	35	**	A. Helseth, pers. comm.
Gotland	A	193	210	250	***	P. Smitterberg, pers. comm.
Halland	-	-	0	0		Artdatabanken 2013
Bohuslän	-	-	0	0		Artdatabanken 2013
Dalsland	C	1	1	3	*	Artdatabanken 2013
Västergötland	B	54	60	70		P. Hedberg Fält, pers. comm.
Östergötland	A	75	90	110	**	Nygårds 2011
Götaland			*457*	*551*		
Total			1812	2386		

spans are 15 Mars – 15 June and 25 July – 15 November, for spring and autumn seasons respectively. Thus, (the few) observations of grebes noted earlier in spring or later in the autumn were not included in the analysis, nor were the small number of observations of the species made during the summer recess of the standardized trapping. The trends in the number of days per year with observations were evaluated with regression analysis. To get the residuals of the material normally distributed, base-10 logarithms of the yearly numbers of observation-days were obtained.

Winter harshness

A measure of winter harshness in the presumed wintering areas of the Swedish populations of the two grebes was obtained by using mean daily temperature from weather stations in Rotterdam (The Netherlands), Vestervig (Denmark), Falsterbo (Sweden), Rostock (N Germany) and Angermunde (N Germany). A Hellmann index (Ijnsen 1988) was computed for each station following Sauter et al. (2010). This index is the absolute value of the sum of all negative mean daily temperatures between December and February. In the subsequent principal component analysis of the stations' Hellmann indices, the first principal component (PC1) explained 93.3 % of

Table 2. Reported and estimated numbers of Red-necked Grebes per Swedish province in 2011. For each province is given the method of data collection (A-C [see method for further info]) and accuracy of the estimate (* = poor, ** = medium, *** = good). *Rapporterade och skattade antal gråhakedoppingar per landskap år 2011. För varje landskap presenteras vilken metod som använts för att få fram uppgifterna (A-C [se metod för ytterligare information]) och precisionen i de skattade antalen (* = dålig, ** = måttlig, *** = god).*

Province *Landskap*	Method *Metod*	Rep. *Rap.* (n)	Estimate *Skattat antal* min	 max	Accuracy *Precision*	References *Referenser*
Gästrikland	B	2	2	5	**	Aspenberg 2012b
Hälsingland	B	14	15	25	**	M. Axbrink, pers. comm.
Medelpad	B	2	2	5	**	P. Helttunen, pers. comm.
Härjedalen	C	0	0	5	*	J. Rågehall, pers. comm.
Jämtland	C	2	0	10	*	G. Storensten, pers. comm.
Ångermanland	C	22	40	100	*	K. Holmqvist, pers. comm.
Västerbotten	C	25	200	350	*	Sundström & Olsson 2005; M, Laisfeldt pers. comm.
Norrbotten	C	65	100	200	*	Sundström & Olsson 2009; R. G. Gustavsson, pers. comm.
Lappland	C	75	25	75	*	H. Rune, pers. comm.
Norrland			*384*	*775*		
Närke	B	20	25	30	**	L. Johnsson, pers. comm.
Södermanland	C	3	5	10	*	P. Flodin, M. Åsberg, pers. comm.
Uppland	A,C	52	55	65	**	B. Douhan, M. Åsberg, pers. comm.
Västmanland	C	2	2	5	*	T. Pettersson, pers. comm.
Värmland	B	0	0	2	**	Carlsson 2011
Dalarna	C	2	2	5	*	U. Grenmyr, pers. comm.
Svealand			*89*	*117*		
Skåne	A	250	250	275	***	Bengtsson 2011
Blekinge	C	0	0	5	*	Artdatabanken 2013
Småland	B	4	5	10	**	Johansson 2012, C. Ljungberg, pers. comm.
Öland	B	51	55	65	**	A. Helseth, pers. comm.
Gotland	A	71	75	85	***	P. Smitterberg, pers. comm.
Halland	C	7	10	15	*	Artdatabanken 2013
Bohuslän	-	-	0	0		SOF 2002; Artdatabanken 2013
Dalsland	C	1	1	3	*	Artdatabanken 2013
Västergötland	C	188	180	250	*	P. Hedberg Fält, pers. comm.
Östergötland	B	61	60	80	**	Nygårds 2011
Götaland			*636*	*788*		
Total			1109	1680		

the variance and was used as an overall measure for winter harshness in Northern Europe. The influence of winter harshness on the number of observation-days of the two grebes at Ottenby in the following year was evaluated with regression analysis.

Result

National survey

The Swedish population of Horned Grebe 2011 was estimated to about 2000 (1812–2386) pairs (Table 1). The majority of the 835–1200 breeding pairs in Norrland were found in the coastal provinces. Unfortunately, only Gästrikland, Hälsingland and Medelpad had been surveyed properly in the region, while the result from the rest of Norrland was less well substantiated. In Svealand the population of Horned Grebes was estimated to 520–635 pairs, while the number in Götaland fell between 457 and 551 pairs. The species was most numerous in the eastern coastal provinces, was scarce to rare further west, and was almost lacking in the south-westernmost provinces.

In total about 1300 (1109–1680) pairs of Red-necked Grebes were estimated in the survey (Table 2). The 384–775 pairs in Norrland were estimates mainly based on extrapolations of historical data and should be considered with care when evaluated. The species was a scarce breeder in Svealand and only 89–117 pairs were recorded in the region, where a majority of the birds were found in Uppland. In Götaland the population of Red-necked Grebe was estimated to 636–788 pairs. The distribution in southern Sweden was rather scattered except in Västergötland and Östergötland where the lowland basins Lake Hornborga (175–180 pairs) and Lake Tåkern (about 50 pairs) held a considerable part of the regional population.

Breeding habitat

The habitat use among the observed grebes differed between the species throughout the country (Götaland: $\chi^2_{(3, N = 1031)} = 72.9$, $p < 0.001$, Svealand: $\chi^2_{(3, N = 425)} = 79.23$ $p < 0.001$, Norrland: $\chi^2_{(3, N = 605)} = 19.9$, $p < 0.001$). Within the two species habitat use differed significantly between the Swedish regions (Horned Grebe: $\chi^2_{(6, N = 1229)} = 686.6$, $p < 0.001$, Red-necked Grebe: $\chi^2_{(6, N = 832)} = 752.6$, $p < 0.001$). In Götaland, 50 % of the Horned Grebes and 80% of the Red-necked Grebes were found in artificial water bodies (Figure 2). In Svealand over 50% of the Red-necked Grebes were registered in natural inland waters, while about 60% of the Horned Grebes were observed in artificial water bodies. In Norrland the two species were mainly found in coast habitats and natural inland water bodies.

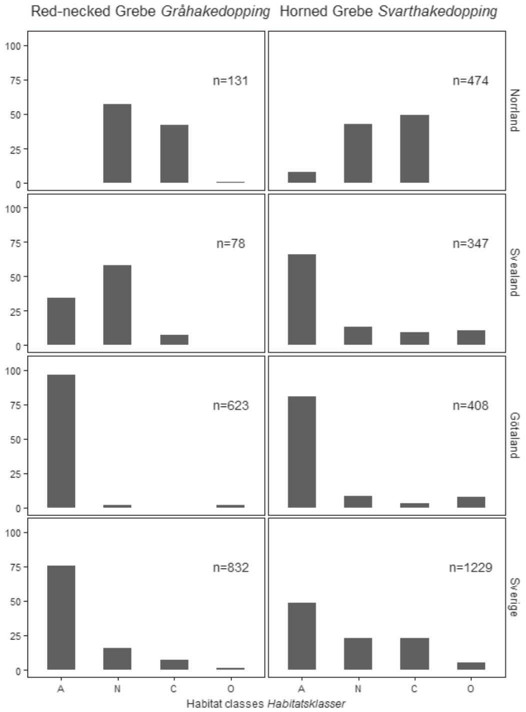

Figure 2. The percentage of Red-necked Grebe (left) and Horned Grebe (right) in artificial water bodies (A), natural inland water bodies (N), coast (C) and in other (O) habitats, in Norrland, Svealand, Götaland and Sweden (Sverige) respectively, with (n) as the number of observed breeding pairs. Note that the data is based on observed birds only, which excludes large quantities of the presumed breeders in Norrland, giving a bias to the habitat selected in the south in the national summary.

Fördelningen (%) av gråhakedopping (vänster) och svarthakedopping (höger) i konstgjorda inlandsvatten (A), naturliga inlandsvatten (N), kust (C) och övriga (O) habitat i Norrland, Svealand, Götaland och sammanlagt i Sverige med (n) som antal noterade häckningar som räknats. Notera att informationen enbart är baserad på observerade fåglar vilket utesluter en stor andel av de förmodade häckfåglarna i Norrland, och därmed ger en överrepresentation av habitatutnyttjandet hos de sydliga fåglarna i totalsummeringen.

Long-term observation data

From 1972 to 2012, Horned Grebes were at Ottenby observed on 128 days in spring and 1287 days in autumn (Figure 3). The temporal trend was best

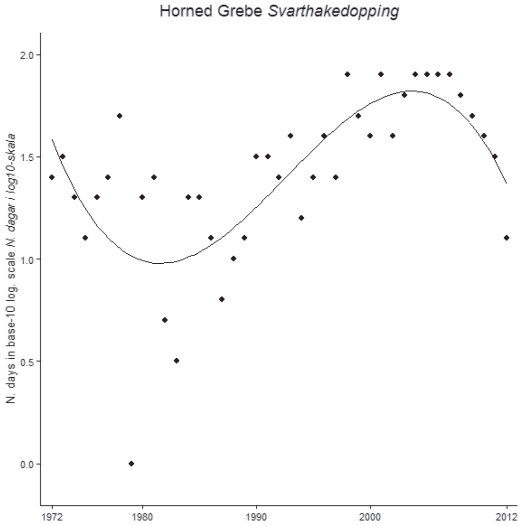

Figure 3. The annual number of days when Horned Grebe was observed at Ottenby between 1972 and 2012 presented in log10 scale. The line represents a third polynomial regression t(37) = -4.74 , $p < 0.001$, Adj. $R^2 = 0.51$.
Antalet dagar per år då svarthakedopping har observerats vid Ottenby mellan 1972 och 2012 här presenterat med log10-skala. Linjen representerar ett tredje gradens polynom t(37) = -4,74 , p < 0,001, Adj. $R^2 = 0,51$.

described by a third polynomial regression ($t_{(37)} = -4.74$, $p < 0.001$, Adj. $R^2 = 0.51$). Whereas the numbers have varied dramatically over the study period, with a low-point in the early 1980s and a peak in the early 2000s, the numbers were very similar at the start and end of the study period. In parallel with the increase of observations from the 1990s and onwards, in recent years Horned Grebes were more commonly observed in the early part of autumn than before (Figure 4 and 5).

The occurrence pattern of Red-necked Grebe at Ottenby showed a positive trend throughout the study period (linear regression $t_{(39)} = 7.47$, $p < 0.001$, Adj. $R^2 = 0.58$, Figure 6). Until the mid-1990s, Red-necked Grebes were barely seen in the springs and the majority of the 392 observation days in the season were from the second half of the study period (Figure 7). A similar pattern was found among the 1089 days with observations in autumns (Figure 8). From the late 1990s and onwards the species has been more commonly seen in the early part of the autumn.

Winter harshness

No significant relationship was found between the yearly variation in winter weather in Northern Eu-

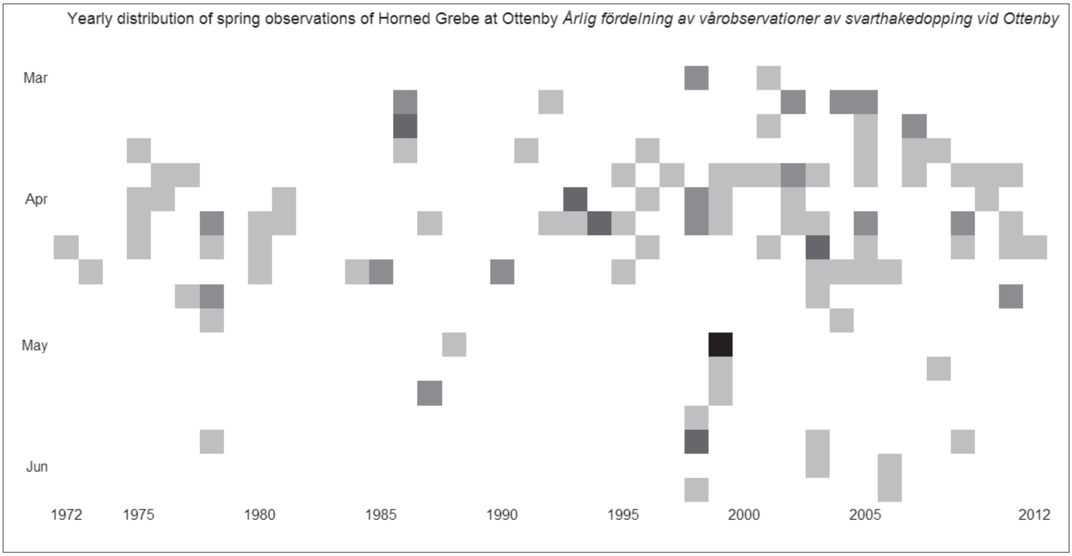

Figure 4. Schematic presentation of days with observations of Horned Grebe at Ottenby in springs 1972 to 2012. Each square represents a five-day period between 15 Mars – 15 June and the six different colours (white to black) illustrate the number of days (0–5) with observations for each five-day period.
En schematisk presentation av dagar med observationer av svarthakedoppingar vid Ottenby under vårarna 1972 till 2012. Varje ruta representerar en femdagarsperiod mellan 15 mars – 15 juni och de sex olika färgerna (vitt till svart) illustrerar antalet dagar (0–5) med observationer för varje femdagarsperiod.

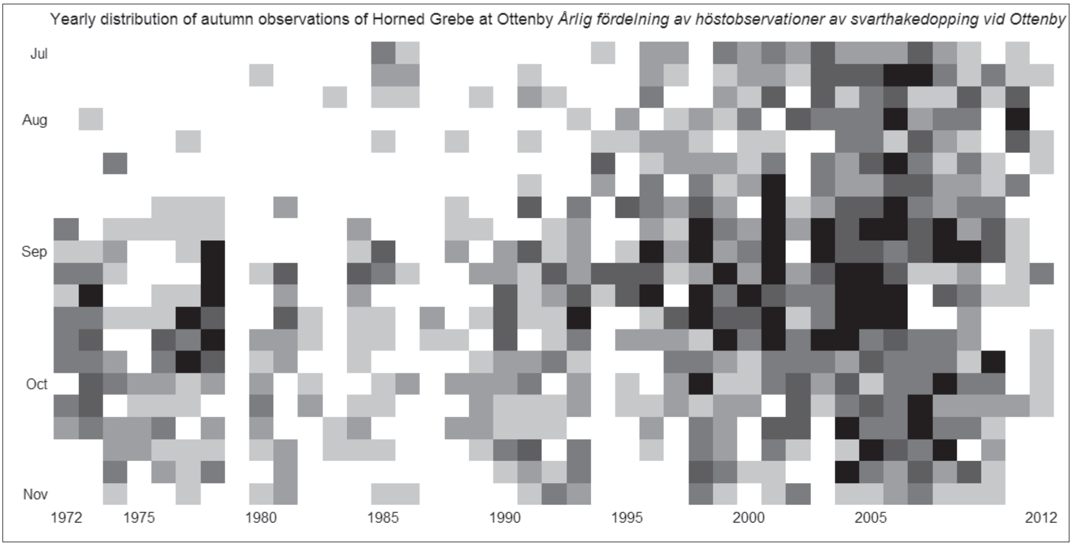

Figure 5. Schematic presentation of days with observations of Horned Grebe at Ottenby in autumns 1972 to 2012. Each square represents five-day periods between 25 July – 15 November and the six different colours (white to black) illustrate the number of days (0-5) with observations for each five-day period.
En schematisk presentation av dagar med observationer av svarthakedoppingar vid Ottenby under vårarna 1972 till 2012. Varje ruta representerar en femdagarsperiod mellan 25 juli – 15 november och de sex olika färgerna (vitt till svart) illustrerar antalet dagar (0-5) med observationer för varje femdagarsperiod.

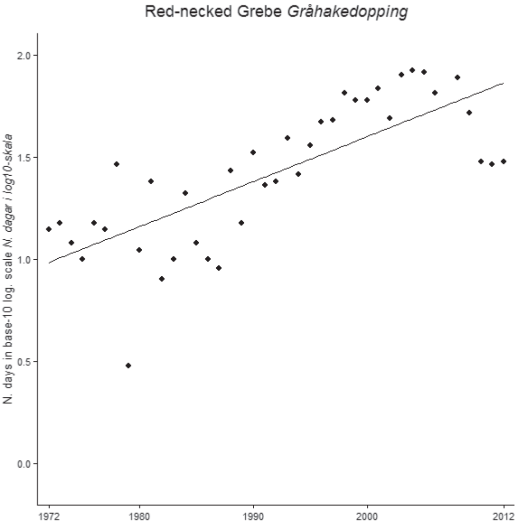

Figure 6. Annual number of days when Red-necked Grebe is observed at Ottenby between 1972 and 2012 presented with log10 scale. The line represents a linear regression t(39) = 7.47, $p < 0.001$, Adj. $R^2 = 0.58$.
Antalet dagar per år då gråhakedopping har observerats vid Ottenby mellan 1972 och 2012 presenterat med log10-skala. Linjen representerar en linjär regression t(39) = 7,47, p < 0,001, Adj. R² = 0,58.

rope and the number of days the two grebes were observed at Ottenby in the subsequent year during the period 1972–2012 (Horned Grebe: $t_{(39)} = -0.63$, $p = 0.53$, Adj. $R^2 = -0.02$; Red-necked Grebe: $t_{(39)} = -1.50$, $p = 0.14$, Adj. $R^2 = 0.03$, Figure 9). Most of the severest winters were found in the 1980s, coinciding with the suggested low-point of the Swedish population of Horned Grebe. However, except for the winters 1979 and 1982, no direct decrease was recognized for years following a harsh winter. For example, in 1996, the number of days with observations increased after the severe winter.

Discussion

Horned Grebe

The estimate of 2000 pairs of Horned Grebe in Sweden in 2011 implies an increase from about 1200 pairs in 1996 and a return towards the estimates of about 2200 pairs in 1972 (Regnell 1981b, Douhan 1998). When comparing the results with the two earlier surveys on a regional level the numbers in 2011 for Götaland and Svealand were at least 30% higher than in 1996 (Table 3). The increase in Svealand was almost 200% from 1996 and was mainly due to increases in Uppland and

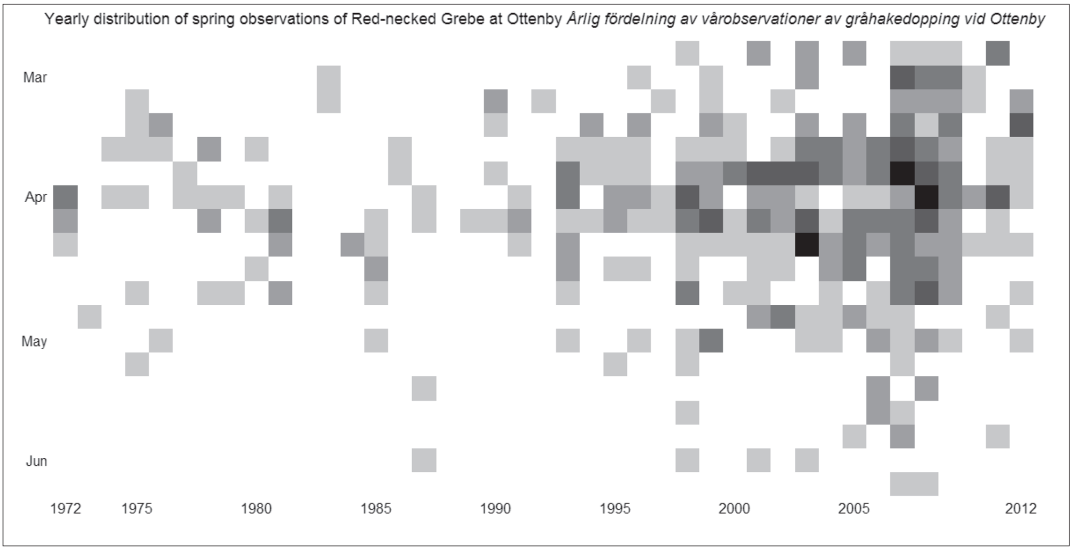

Figure 7. Schematic presentation of days with observations of Red-necked Grebe at Ottenby in springs 1972 to 2012. Each square represents five-day periods between 15 Mars – 15 June and the six different colours (white to black) illustrate the number of days (0-5) with observations for each five-day period.
En schematisk presentation av dagar med observationer av gråhakedoppingar vid Ottenby under vårarna 1972 till 2012. Varje ruta representerar en femdagarsperiod mellan 15 mars – 15 juni och de sex olika färgerna (vitt till svart) illustrerar antalet dagar (0-5) med observationer för varje femdagarsperiod.

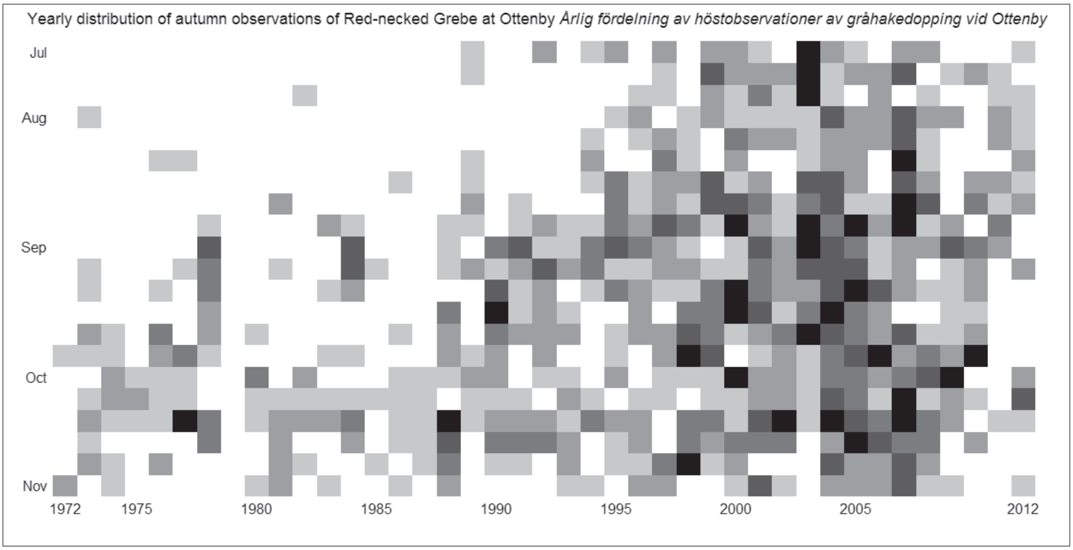

Figure 8. Schematic presentation of the days with observation of Red-necked Grebe at Ottenby in autumns 1972 to 2012. Each square represents five-day periods between 25 July – 15 November and the six different colours (white to black) illustrate the number of days (0-5) with observations for each five-day period.
En schematisk presentation av dagar med observationer av gråhakedoppingar vid Ottenby under vårarna 1972 till 2012. Varje ruta representerar en femdagarsperiod mellan 25 juli – 15 november och de sex olika färgerna (vitt till svart) illustrerar antalet dagar (0-5) med observationer för varje femdagarsperiod.

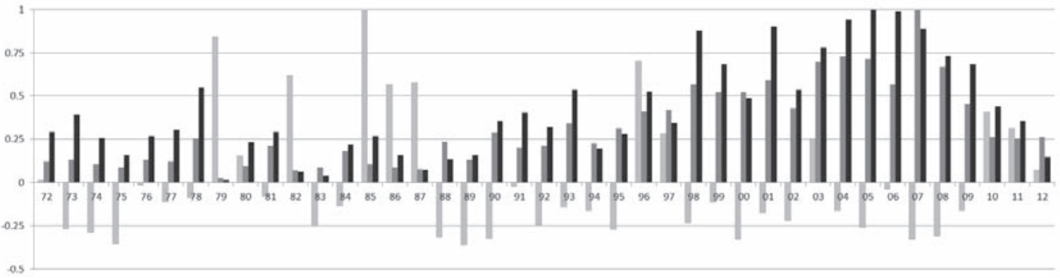

Figure 9. Total number of observation days per year at Ottenby, with maximal number of observation days set to "1" (Red-necked Grebe in dark grey, Horned Grebe in black). In medium grey is the PC1 of the Hellman index for Northern Europe for the preceding winter (see text for method); higher values illustrate more severe winters and lower values milder winters. *Totalt antal dagar med observationer av gråhakedopping (mörkgrå staplar) och svarthakedopping (svarta staplar) med maximalt antal dagar för respektive art satt till "1". I mellangrått syns PC1 för Hellmanns index för norra Europa under föregående vinter (se metod för beskrivning) där höga värden representerar kallare vintrar och lägre värden mildare vintrar.*

Södermanland, where the numbers had returned to the estimates of 1972. In Västmanland, in contrast, the values of 2011 did not recover to the same degree, and even though the species was poorly surveyed both in 1972 and in 2011, that is not likely the only explanation. In Norrland, trend evaluation was only possible for three provinces. Gästrikland and Medelpad showed an increase with at least 30% compare to 1996, while no obvious change in numbers was recorded in Hälsingland. The recorded numbers of Horned Grebe in Gästrikland had increased considerably also compared to the estimates made in 1972. Compared to 1972 the population decline was less than 10% in Svealand and at least 10% in Götaland. The observational data from Ottenby showed similar patterns in numbers over the study period. The species had gone from a rare to a rather regular bird at Ottenby during the first half of the autumn season which may indicate an increase particularly of the number of birds in the local (Swedish) population. This was also what has been seen in provinces where birds, likely to migrate via Ottenby, have shown increases in breeding numbers, like for example in Gotland, Östergötland, Södermanland and Uppland. The numbers on Öland had on the other hand decreased over the study period and has probably not been involved in the late positive trend seen at Ottenby. Of the 11 provinces where survey efforts and data allowed trend evaluation, numbers had increased with 30% or more in seven since 1996, while numbers were more or less stable in the other four. When the same comparisons were made with the survey in 1972, the corresponding picture was three and one provinces respectively, while two held numbers at least 30% lower than 1972. It is further clear that the centre of the Swedish population had moved further east, with Gotland, Södermanland, Uppland, Gästrikland and Västerbotten holding the greatest proportion of birds.

Among the neighbouring countries, Finland holds a fairly large population (Väisänen et al. 2011). The Finnish population of Horned Grebes had decreased in numbers and distribution between the two Bird Atlas surveys (1974–1989 and 2006–2010) to an estimated population of 1200–1700 pairs, with major decreases of the southern and central inlands, and local increases along the south-west and west coasts (Väisänen et al. 2011). Horned Grebe only breeds temporarily in Denmark (Grell et al. 1999). The Norwegian birds belong to the North Atlantic population, believed to have a low exchange with the Swedish birds (Fjeldså 1994). The Norwegian population was surveyed in 2007 and found to have increased slightly since the mid-1980s (Oien et al. 2008).

Red-necked Grebe

The Swedish population of Red-necked Grebe, in 2011 estimated to about 1300 pairs, has three strongholds in the country: Norrbotten/Västerbotten, Västergötland and Skåne. In the north, the numbers were likely to be about the same in 2011 as in the 1990s. Further south, the breeding numbers of Red-necked Grebe had increased steadily since 1996, in particular in Skåne and Västergötland (Bengtsson 2011, Hedberg Fält 2012). In Västergötland, the increase can be coupled to restoration efforts conducted in Lake Hornborga in the last two decades. While the area of open water has been enlarged in the basin the number of Red-

Table 3. A comparison between estimated numbers of Horned Grebe in the three national surveys together, with an estimate of survey accuracy (* = poor, ** = medium, *** = good). Where the numbers are sufficiently high and the measure of accuracy is medium or good, the trend between current survey and each of the two former is illustrated, where "--" = at least 30 % decrease, "-" = at least 10 % decrease, "=" = less than 10 % change, "+" = at least 10 % increase, and "++" = at least 30 % increase. The "?" means that a trend could not be estimated. The estimated accuracy for the two former surveys is based on the described approach along with a judgement of the discrepancy between the reported and suggested number for each province within each report (Regnell 1981b; Douhan 1998).

*En jämförelse mellan skattade antal svarthakedoppingar i de tre nationella inventeringar, med angivna precisionsmått ("prec.", * = dålig, ** = måttlig, *** = god). Där data och precision tillåter presenteras populationsutvecklingen från de båda tidigare inventeringarna till den aktuella ("--" = minst 30 % minskning, "-" minst 10 % minskning, "=" = mindre än 10 % förändring, "+" = minst 10 % ökning, "++" = minst 30 % ökning. Frågetecknet "?" betyder att trenden inte har skattats. Den skattade precisionen för de två tidigare inventeringarna baseras på beskrivna tillvägagångssätt och en tolkning av skillnaden mellan rapporterade och skattade häckningsnumerärer för respektive landskap i respektive rapport.*

	1972			1996			2011				
Province	Est. number		Acc.	Est. number		Acc.	Est. number		Acc.	Trend	Trend
Landskap	*Skattat antal*		*Prec.*	*Skattat antal*		*Prec.*	*Skattat antal*		*Prec.*	*Trend*	*Trend*
	min	max	acc.	min	max		min	Max		(72-11)	(96-11)
Gästrikland	50	75	**	65	65	***	190	215	**	++	++
Hälsingland	300	375	*(a)	140	140	***	140	160	***	?	=
Medelpad	30	70	*	35	40	***	45	55	**	?	++
Härjedalen	2	5	*	2	5	*	30	50	*	?	?
Jämtland	90	125	*	100	100	*	100	200	*	?	?
Ångermanland	70	110	*	115	130	**	120	180	*	?	?
Västerbotten	80	125	*(c)	165	170	***	150	220	*	?	?
Norrbotten	60	100	*(a)	15	15	*	10	20	*	?	?
Lappland	40	90	*	50	50	*	50	100	*	?	?
Norrland	*722*	*1075*	*(d)*	*687*	*715*		*835*	*1200*		*?*	*?*
Närke	40	60	*(a)	10	10	**	45	55	**	?	++
Södermanland	150	175	*	60	70	*	210	250	**	?	?
Uppland	225	275	*(b)	80	85	**	210	250	**	?	++
Västmanland	125	150	*	15	15	**	25	35	*	?	?
Värmland	10	15	**	10	15	**	15	20	***	++	++
Dalarna	10	20	**(b)	20	25	*	15	25	*	?	?
Svealand	*560*	*695*		*195*	*220*		*520*	*635*		=	++
Skåne	2	5	**	1	3	**	0	0	***	?	?
Blekinge	2	5	**	1	2	***	1	3	**	?	?
Småland	200	275	*	60	80	**	70	80	**	?	=
Öland	45	55	***	30	30	***	25	35	**	--	=
Gotland	45	50	**(a)	55	60	***	210	250	***	++	++
Halland	0	0		0	0		0	0		?	?
Bohuslän	0	0		0	0		0	0		?	?
Dalsland	0	2	**	0	0	**	1	3	*	?	?
Västergötland	70	80	**	70	80	***	60	70		=	=
Östergötland	250	275	**	50	50	**	90	110	**	--	++
Götaland	*614*	*747*		*267*	*305*		*457*	*551*		-	++
Totalt	1896	2517		1149	1240		1812	2386		=	++

(a) Overestimate according to Douhan (1998), (b) underestimate according to Douhan (1998), (c) underestimate according to Olsson and Wiklund (1999), (d) underestimate according to SOF (2002) and Ottosson et al. (2012)

necked Grebes has increased and more than 80 % of the breeders in the province 2011 were found in the basin. A similar dramatic increase has been seen in Skåne in the same period, most likely linked to the increase in number of created wetlands in the province (Bengtsson 2011, Naturvårdsverket 2013). The positive trend of the Swedish population was also illustrated in the steady increase in numbers of observation-days at Ottenby. One may wonder from where the birds at Ottenby are recruited, since the site is unlikely to be affected by the recent increase in Skåne. Red-necked Grebes breeding in Norrland are suggested to winter in Norway and should therefore not pass Ottenby either (Follestad et al. 1986, Fjeldså 1994). More knowledge is needed in the non-breeding movements of the species. Along with the increase, the observations in the first half of the autumn have become regular, suggesting (as for the Horned Grebe) an increase in the local (Swedish) population. In the neighbouring countries, the species has increased steadily in Denmark over the past decades, from about 300–500 pairs in the 1960s to about 1500–2000 pairs in the 2000s. It is likely that this region has acted as a source to the population in southern Sweden (Grell et al. 1999). The Danish population was suggested to have been favoured by the increased extraction of peat in the second half of the 20th century, because this has resulted in increased numbers of artificial wetlands used as breeding habitats. Eutrophication of lakes and milder winters are other suggested explanations to the positive trend of Red-necked Grebe in Denmark (Grell et al. 1999). The population in Finland has been stable between the two Bird Atlas surveys (1974–1989 and 2006–2010) and estimated to 6000–8000 pairs, mainly distributed in the southern half of the country (Väisänen et al. 2011). The potential exchange between the Finnish population and the Red-necked Grebes in northern Sweden may indicate that the trend also in Norrland could be stable. In Norway, only a few breeding records exists (Artsdatabanken 2014) and the wintering population regularly seen along the Norwegian coast is suggested to breed in northern Sweden, Finland and further east (Follestad et al. 1986).

Habitat use during breeding

In tandem with the two species' recent positive trends in Sweden, water bodies directly influenced by humans seem to have become increasingly important as breeding habitat, in particular in the southern part of the country. This might be the result of 'Thriving wetlands', one of the 16 environmental quality objectives established in 1999 (Swedish Environmental Protection Agency 2013), with the goal to increase the number of wetlands in Sweden. The area of established and restored wetlands has since then steadily increased up to 6700 hectares in 2010 as a direct effect of this quality objective with 5500 hectares in Götaland, 1200 in Svealand, but only 25 hectares in the southernmost provinces of Norrland (Naturvårdsverket 2013). This provides increased opportunities for water-birds such as the two grebes to breed succesfully. In Skåne the majority of the breeding Red-necked Grebes were found in the 1653 hectares of new or restored wetlands in the region (Bengtsson 2011). The rareness of this type of breeding habitat in Norrland may explain the small numbers of grebes found in artificial water bodies throughout the northern part of the country. An obvious concern about what this current shift to artificial water bodies might bring is that the breeding success may be directly coupled to the rate of establishment, and efforts put on management, of waters constructed by humans. The effects of this are hard to determine today, but would be of great interest if the initiatives in the assessment of wetlands in Sweden should alter in the future. Also in the northern part of the country a shift in the birds' choice of breeding habitat was seen, where breeding pairs were increasingly occurring in coastal areas, while becoming rarer in the inland. This was not a new trend, and has been noticed already in 1972 for the Horned Grebe, but the pattern has become more frequent until 2011 when prominent numbers of especially Horned Grebe were found to successfully breed in coastal areas. They seemed to show preference to bays rich in vegetation which through the eutrophication of the Baltic Sea during the latter half of the 20th century have become an increasingly common habitat along the coasts of Sweden (Andersen et al. 2011). Whether the decrease of breeders of the inland in many parts of Norrland is a direct result of this pattern or if there are other factors acting negatively on the quality of the historical breeding habitats of the species' need further investigations.

Winter harshness

Even though a number of relatively harsh winters in the 1980s coincide with the estimated low-point of the number of Horned Grebe in Sweden, winter harshness alone cannot explain shifts between subsequent years in the observations of the two species at Ottenby. Some severe winters were followed by an increase of the number of observation days, while some prominent decreases of observation days were preceded by milder winters. In the long run, the weather may still have an effect on the size of the population when periods of mild winters provide opportunities to a northerly advancement of the wintering distribution of the populations (Newton 1998). Shorter migration routes would in turn promote an allocation of energy from migration to subsequent breeding investments and increase the future recruitment into the population (Alerstam 1990, McNamara & Houston 2008). In the Mallard *Anas platyrhynchos,* such a shift of winter distribution has been recognized through ringing recoveries of Swedish ringed birds (Gunnarsson et al. 2012).

Considerations for future studies

Singles of complete surveys results in estimates that act as coarse snapshots of the population size which when repeated in a similar manner may give indication of shifts or trends in population number (Sutherland 2006). However, except the actual size of the breeding population, the results from complete surveys are sensible to several factors related to the strategies used in the survey. A complete survey will rarely result in observations of all breeding pairs in the population in target but is rather an attempt in searching for as many birds as possible to be able to estimate the total number. Grebes are particularly difficult to survey due to their stratified distribution, with groups of pairs in some water bodies while they are missing in others. Further they are rather opportunistic so they probe potential breeding habitats and do seldom return to the same pond if failing preceding breeding season (Fjeldså 2004). One approach in solving this is to in beforehand evaluate the number of water bodies potentially carrying grebes and then randomly choose a number which can be thoroughly investigated. The ratio between number of breeding localities and water bodies surveyed may then be extrapolated to the total number of water bodies potentially carrying breeding grebes. So to avoid underestimation error, follow-ups of known breeding sites needs to be combined with a systematic search of new potential breeding waters. To further complicate population estimates the two species are here shown to have increased their use of the archipelagos along the Baltic Sea for breeding. Together with the logistical complications when surveying the vast stretches of the Baltic coast that potentially holds breeding grebes, come new challenges in finding and assessing the number of pairs in the sometimes overlapping and loosely colony forming groups of breeding grebes as have been found in this survey. Many of these underestimates have probably been compensated for here through the revaluations conducted in accordance with Regnell (1981a).

For species complicated and/or costly to survey during breeding it can be useful to combine the complete survey (giving a number estimate) with a method that may give an estimate in the trend over time. Here daily absence/presence data from Ottenby, a site along the migration route of Swedish grebes, have been used to estimate the trend of the two species. The number of days the two grebes have been observed at Ottenby is likely dependent on the amount of birds passing the area each year, as well as the average time each bird spent within visual range. This is likely linked to both population sizes as well as their average breeding success when family groups migrate with lower pace and tend to spend longer time at roosting sites (Fjeldså 2004). So, the measurement used here is not necessarily directly linked to the number of birds passing Ottenby, or to the size of the populations in the recruitment areas. Nevertheless, everything else being equal, the likelihood of observation will increase with the size of the population that passes. Some other important causes of variation in the counts at Ottenby are birding effort among the personnel, the quality of technical equipment, and the knowledge of distinguishing the two species. Birding effort probably has varied throughout the study period while knowledge and equipment quite likely have improved steadily. Additionally, weather, migration and observation conditions will affect the yearly numbers of observations but not the long-term trend. However, if climate change affects relevant survival conditions along the migration route, the relative time spent in different stopovers will in turn be affected. In the backwater of current technology leaps in the mapping of the routes of many migrating species, it will become possible to more accurate connect breeding and wintering ground together with the most important migration routes (Bridge et al. 2011). Hopefully, this will help tying long-term observation data from migration sites such as Ottenby more precisely to the birds´ recruitment areas, as well as improving the efficiency in future conservation efforts on migratory birds.

Conclusion

The Swedish population of the Horned Grebe has recovered from the negative trend between the national surveys 1972 and 1996 and was in 2011 estimated to about 2000 pairs, a trend also supported in the long-term dataset of observations at Ottenby. Red-necked Grebe was for the first time in 2011 subject to a national survey in Sweden, but based on data from local surveys an increase over the past decades to the about 1300 pairs found in 2011 was evident. This pattern was also seen in the observation series from Ottenby. In Götaland, both Horned Grebe and Red-necked Grebe were most common in artificial water bodies. The two species have most likely been positively affected by the increased number of restored and newly established wetlands in southern Sweden and the increase of Red-necked Grebes in especially Skåne and Västergötland has likely been influenced by the positive trend of the species in Denmark. In Norrland, on the other hand, particularly Horned Grebe has become increasingly more common in coastal habitats, while traditional natural inland waters have been abandoned. No statistically significant relationship could be found between the measure of winter harshness in the suggested wintering area in Northern Europe and the observations at Ottenby, but an indirect effect of the Swedish population by winter weather cannot be ruled out. The results in this paper show how large-scale surveys may be combined with basic long-term presence/absence data to reveal insights in numbers and trends in two secretive breeding birds.

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Sammanfattning

Genom att med jämna mellanrum registrera storleken på en population är det möjligt att följa dess status och trend. Vanliga sätt att inventera fåglar är nationella punkt- eller linjerutter, standardiserad ringmärkning eller systematisk räkning av fåglar längs flyttleder. Vissa arter är dock så pass fåtaliga att de kräver andra tillvägagångssätt. Två sådana arter är svarthakedopping *Podiceps auritus* och gråhakedopping *Podiceps grisegena*. För att öka kunskapen om de båda arternas förekomst i landet lät Sveriges Ornitologiska Förening (SOF) göra ett upprop inför 2011 års häckningssäsong där fågelskådare och lokala fågelföreningar fick till uppgift att undersöka fåglarnas förekomst i sina närområden. Gråhakedoppingen har inte tidigare varit föremål för en nationell inventering i SOFs regi medan svarthakedoppingen har inventerats två gånger (Regnell 1981b, Douhan 1998). Första gången det begav sig var 1972 då den svenska populationen skattades till omkring 2200 par. Nästa gång arten inventerades, 1996, hamnade summan på ca 1200 par. Här presenteras nu både genomförandet och resultaten från 2011 års inventering tillsammans med observationer kring fåglarnas habitatsval. Därtill jämförs resultaten med långtidserier av observationsdata från Ottenby fågelstation i ett försök att göra en samlad bedömning av arternas utveckling och status i landet. Slutligen diskuteras temperaturförhållanden i övervintringsområden samt senare tiders åtgärder i svenska våtmarker som två möjliga faktorer som påverkar doppingarnas överlevnad och häckningsframgång.

Svarthakedopping och gråhakedopping är två medelstora dykande fågelarter med förkärlek till småvatten som grunda sjöar och reservoarer. Medan svarthakedoppingen trivs i små eutrofa sjöar och tjärnar i barrskogsregionen förknippas gråhakedoppingen vanligen med slättsjöar på lite sydligare breddgrader. Arternas övervintringsområden i Europa överlappar rejält och fåglarna kan vintertid påträffas från Nordsjön söderut till Medelhavet. Dock förekommer koncentrationer av gråhakedoppingar i danska vatten samtidigt som en viktig övervintringsplats för svarthakedoppingar återfinns i södra Östersjön. Arternas häckningsområden i Sverige överlappar betydligt i landets sydöstra och nordöstra del samtidigt som de båda allt oftare påträffas i samma typ av konstgjorda småvatten. Medan den svenska populationen av gråhakedopping har uppfattats som ökande har svarthakedoppingen visat tecken på återhämtning från artens noterade bottenår.

Inför 2011 års häckningssäsong uppmanade SOF landets fågelskådare och lokala fågelföreningar att medverka i en nationell inventering av de båda arterna. Potentiella häckplatser skulle besökas minst en gång i sökandet efter revirhävdande eller spelande doppingar, vilket var de avgörande häckningskriterierna. Resultaten sammanställdes sedan lokalt av de regionala rapportkommittéerna för att sedan skickas till undertecknad för den nationella sammanställningen. För att översiktligt presentera omfattningen av de lokala inventeringsinsatserna, och därigenom få ett mått på precisionen på efterföljande numerära uppskattningar, delades de lokala inventeringsresultaten in i tre grupper. De inventeringar som genomförts enligt instruktionerna eller på annat sätt kunde presentera tillförlitliga uppskattningar av de lokala bestånden hamnade i grupp A. B-gruppen bestod av områden med sämre täckning men där kunskapen om de båda doppingarna kunde hämtas från andra nyligen genomförda inventeringar. I grupp C hamnade slutligen de områden där de numerära uppskattningarna var mindre väl underbyggda eller där aktuella beståndsuppskattningar helt saknades. I ett försök att uppskatta numerären i grupp C hämtades information från den spontana inrapporteringen av arterna till de regionala rapportkommittéerna, historiska inventeringar i området och information från intilliggande landskap. Baserat på informationen om inventeringsinsatsen gjordes sedan en uppskattning av de lokala bestånden, inklusive ett mått på precisionen av densamma. Precisionen mättes från god (***) till dålig (*) baserat på informationen beskriven ovan. För att bli jämförbar med resultatet från tidigare nationella inventeringar av svarthakedoppingen så presenteras resultaten per landskap. När det gäller mer generella beskrivningar refereras till Götaland, Svealand och Norrland (Figur 1).

Tillsammans med fågelobservationerna ombads inventeraren att i korta ordalag redogöra för vilken typ av vatten som doppingarna påträffades i. Vid den slutliga sammanställningen arrangerades denna habitatsinformation i fyra grupper som i grova drag beskriver den allmänna preferensen hos doppingar påträffade under 2011 års inventering. De fyra grupperna var följande:

Naturliga inlandsvatten: Vatten som inte avsiktligt har modifierats av människor, exempelvis skog- och slättsjöar samt tjärnar. *Konstgjorda vatten*: Bevattningsdammar och anlagda vatten intill gårdar och golfbanor, liksom naturliga vatten som har varit föremål för omfattande restaureringsåtgärder, exempelvis Hornborgasjön och Tåkern. *Kust*: Fåglar som häckar i vikar och småöar längs Öster-

sjön. Här kan det ibland förekomma häckningar i anslutning till utlopp från floder och älvar. Övrigt: Enstaka häckande par som påträffats i andra habitat eller där habitatet på något sätt är intermediärt de ovanstående habitaten.

Ottenby, beläget på Ölands södra udde (56°12´N, 16°24´E), är känt för sin rikedom på både rastande och flyttande fåglar. På Ottenby fågelstation har personalen på daglig basis fört anteckningar över vilka arter som observerats i närområdet. Från starten av den standardiserade fångsten, 1972, finns information från perioderna 15 mars – 15 juni och 25 juli – 15 november för samtliga år. Säsongsvisa summeringar (vår respektive höst) av dessa observationstillfällen gjordes och sammanställdes för perioden 1972 – 2012.

Genom att använda dagsmedeltemperaturer hämtade från väderstationer i Rotterdam (Nederländerna), Vestervig (Danmark), Falsterbo (Sverige), Rostock och Angermunde (båda belägna i Tyskland) togs ett mått fram på temperaturförhållandena i doppingarnas förmodade övervintringsområde. Ett Hellmann index räknades ut genom att summera det absoluta värdet av samtliga negativa dagmedeltemperaturer under perioden december – februari för respektive station. I efterföljande PCA-analys förklarade den första principiella komponenten (PC1) 93.3 % av variationen. Denna användes därför som en generellt mått på vinterförhållandena i norra Europa.

Den svenska populationen av svarthakedopping skattades till ca 2000 par (intervall 1812–2386, Tabell 1). Majoriteten av de 835–1200 paren i Norrland återfanns i kustlandskapen. Det var endast Gästrikland, Hälsingland och Medelpad som blev relativt väl inventerade så numerären i övriga norrländska landskap är mer osäkra. I Svealand skattades populationen till 520–635 par medan numerären i Götaland landade på 457–551 par. Arten var talrikast längs östersjökusten, mer sällsynt i landets västligare delar och saknades nästan helt i de sydvästligaste landskapen.

Antalet gråhakedoppingar skattades till 1300 par (intervall 1109–1680, Tabell 2). De 384–775 paren i Norrland var huvudsakligen extrapoleringar av data från tidigare inventeringar vilket bör tas i beaktning när siffrorna tolkas. Arten var relativt sällsynt i Svealand med endast 89–117 par, där majoriteten återfanns i Uppland. I Götaland skattades populationen till 636–788 par. Fåglarna i södra Sverige var relativt jämt utspridda, förutom i Västergötland och Östergötland där Hornborgasjön och Tåkern höll betydande delar av totalsumman.

Fördelningen av de habitat som doppingarna påträffades i under inventeringen skiljde sig både mellan de båda arterna och mellan landets regioner. Majoriteten av de häckande fåglarna av båda arterna i Götaland återfanns i konstgjorda inlandsvatten (Figur 2). I Svealand återfanns över 50 % av gråhakedoppingarna i naturliga inlandsvatten medan svarthakedoppingen mer regelbundet påträffades i konstgjorda inlandsvatten. De båda arterna var relativt jämt fördelade mellan kusten och naturliga inlandsvatten i Norrland. Några få procent av de norrländska svarthakedoppingarna återfanns dock i konstgjorda inlandsvatten medan gråhakedoppingen helt saknades i den gruppen av habitat.

Medan antalet dagar med observationer av svarthakedopping vid Ottenby har varierat kraftigt under perioden 1972–2012 med en svacka under 1980-talet och en topp i början av 2000-talet så var antalet dagar med arten i början och slutet av perioden väldigt lika (Figur 3). Samtidigt som arten blev allt mer frekvent i fågelstationens dagboksanteckningar från 1990-talet och framåt så ökande andelen observationer gjorda under första halvan av hösten (Figur 4 och 5).

Antalet observerade gråhakedoppingar vid Ottenby ökade under perioden 1972–2012 (Figur 6). Fram till mitten av 1990-talet var gråhakedoppingen knappt årlig under vårsäsongerna (Figur 7) och huvudandelen av dagarna med observationer under både vår och höst var från andra halvan av studieperioden. Samtidigt har arten blivit allt vanligare under den första delen av hösten (Figur 8).

Inget signifikant förhållande kunde hittas mellan den årliga variationen i vintertemperatur och antalet dagar som de båda doppingarna har observerats vid Ottenby efterföljande år under perioden 1972–2012 (Figur 9). De flesta år med hårda vintrar inföll under 1980-talet och sammanföll med perioden med låga antal dagar med observationer av svarthakedopping vid Ottenby. Däremot var det endast vintrarna till 1979 och 1982 som efterföljdes av en direkt nedgång av antalet observationer av de båda arterna och för till exempel 1996 skedde en ökning av antalet observationsdagar av arterna efter en svår vinter.

Den svenska populationen av svarthakedopping 2011 skattades till ca 2000 par vilket indikerar en ökning från de ca 1200 paren 1996, men är färre än de 2200 par som uppmättes 1972. Antalet observationer vid Ottenby uppvisade liknande mönster under perioden samtidigt som arten tycktes ses mer frekvent under första halvan av hösten vilket indikerar att det var den svenska populationen som ligger bakom förändringarna. Det var också just bland de landskap som förväntas hålla svarthakedoppingar som flyttar förbi Ottenby som antalet par hade ökat. Däremot hade den öländska populationen minskat under studieperioden och var förmodligen inte involverad i det ökade antalet observationer. Av de 11 landskap där det var möjligt att utvärdera förändringar mellan inventeringarna hade numerären ökat med minst 30 % i sju av dem jämfört med 1996 medan de övriga fyra höll mer eller mindre stabila populationer. När samma jämförelse görs mot 1972 års inventeringsresultat var det tre landskap som uppvisade en ökning på minst 30 %, ett landskap höll samma numerär medan två landskap uppvisade en minskning på minst 30 %. Resultaten visar också att den svenska populationen av svarthakedopping har förskjutits mot öster med Gotland, Södermanland, Uppland, Gästrikland och Västerbotten som de viktigaste landskapen för arten. I våra grannländer är det Finland som håller den största populationen. Den finska populationen har minskat i antal och utberedning mellan de två atlasinventeringarna (1974–1989 och 2006–2010) till ca 1200–1700 par. Arten häckar endast tillfälligt i Danmark. De norska fåglarna tillhör den nordatlantiska populationen som antas ha ett lågt utbyte med den svenska populationen.

Den svenska populationen av gråhakedopping 2011 skattades till ca 1300 par och arten uppvisade tre starka fästen i landet. I norr var den fortfarande relativt vanlig i de båda kustlandskapen Västerbotten och Norrbotten medan den i söder hade blivit allt vanligare i framförallt Skåne och Västergötland. Samma positiva trend hittades också i antalet dagar med observationer av arten vid Ottenby. Precis som med svarthakedoppingen så hade antalet observationer av gråhakedoppingen blivit större under höstsäsongens första halva. I grannländerna har arten ökat stadigt i Danmark under de senaste decennierna från ca 300–500 par under 1960-talet till ca 1500–2000 par under 2000-talet och regionen kan ha fungerat som en källa till den växande sydsvenska populationen. Ökningen av den danska populationen har knutits samman med den ökade torvbrytningen i landet där fåglarna har frekventerat de småvatten som har bildats till följd av verksamheten. Den finska populationen av gråhakedopping har hållit sig stabil på 6000–8000 par mellan de båda atlasinventeringarna och beroende på utbytet mellan de finska och norrländska populationerna så skulle detsamma kunna gälla numerären i norra Sverige. Arten tycks endast häcka fåtaligt i Norge och de fåglar som uppehåller sig där vintertid antas främst komma från häckningsområdena i norra Sverige, Finland och österut.

I samband med de båda arternas sentida positiva trend i Sverige har vatten direkt påverkade av människan blivit ett allt mer viktigt häckningshabitat, framförallt i södra delarna av landet. Detta är antagligen ett resultat av ambitionen mot fler småvatten inom ”Myllrande våtmarker”, ett av Naturvårdsverkets 16 miljökvalitetsmål som etablerades 1999. Den totala ytan av nyetablerade eller restaurerade våtmarker har sedan dess stadigt ökat till 6700 hektar år 2010. Götaland (5500 hektar) höll den största ytan medan 1200 hektar fanns i Svealand. Norrland stod för 25 hektar och det var troligen bristen på denna typ av vatten i Norrland som förklarar de låga andelen häckfåglar i miljön i norra Sverige. En annan sorts habitatval har framförallt noterats i Norrland där arterna har minskat i de naturliga inlandsvattnen till förmån för kustmiljöerna. Fåglarna tycktes föredra vegetationsrika vikar vilket har blivit allt vanligt förekommande längs Sveriges kuster till följd av eutrofieringen av Östersjön under 1900-talets andra hälft.

Även om ett antal hårda vintrar sammanföll med populationsminimum hos de svenska svarthakedoppingarna under 1980-talet så kunde inte vinterförhållandena i sig förklara skillnaderna i observationsnumerär mellan efterföljande år vid Ottenby. I långa loppet kan vädret ändå ha en påverkan på populationsstorlekarna då perioder av milda vintrar ger utrymme för en nordlig förskjutning av övervintringsområdena. Detta skulle i sin tur leda till kortar flyttsträckor och därigenom möjligheter till en allokering av energibudgeten från migration till häckning och en ökning av rekryter till populationen.

När det genomförs totalinventeringar av diskreta arter som de båda doppingarna i så pass vidsträckta områden som Sverige kommer slutresultaten, trots högt ställda krav på genomförandet, generera uppskattningar förknippade med en viss osäkerhet. Utöver stor noggrannhet vid själva fältbesöket är det viktigt att tänka på hur urvalet av de potentiella häckningsplatserna går till samt att det sker en tydlig bokföring även vid de vatten som inte tycktes hålla någon dopping. Samtidigt bör man akta sig för att endast förlita sig till kända doppingvatten då arterna är opportunistiska till valet av häckningsplats. Något som däremot kan verka kompletterande till ögonblicksbilder av en fågelpopulation likt denna inventering är kontinuerlig stickprovsmätning över lång tid. Genom ett sådant arbetssätt kan en populationssumma knytas till en trend vilket tillsammans beskriver både status och utveckling, även för diskreta arter som de båda doppingarna.

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Tätheten av gransångare *Phylloscopus c. collybita* och lövsångare *Phylloscopus trochilus* i ett sydsvenskt villaområde

Density of Chiffchaffs Phylloscopus c. collybita *and Willow Warblers* Phylloscopus trochilus *in a south Swedish villa suburb*

SVEN MARLING

Abstract

The expansion of the Chiffchaff *Phylloscopus c. collybita* in southern Sweden during the last decades is well documented. Regionally the densities of the Chiffchaff now even exceed the densities of the ubiquitous Willow Warbler *Phylloscopus trochilus*. However, there are few quantitative studies on Chiffchaff densities, not least from urban areas. During spring 2013 a survey of singing Chiffchaffs and Willow Warblers, complemented by territory mapping, was conducted in three villa suburb areas (total ca 1.27 km^2) and a nearby recreational area in the southwestern parts of the city of Malmö, Sweden. The villa areas held a substantially higher number of Chiffchaffs (16.5 pairs/km^2) than Willow Warblers (6.3 pairs/km^2). In one villa sub-area, with little undergrowth and denser housing, there were no Willow Warblers at all, in contrast to the recreational area close to the villa areas, where the Willow Warbler dominated (10.9 pairs/km^2). The Chiffchaff had its highest density (18.7 pairs/km^2) in the sub-area that had the largest trees. Thus, in the investigated villa suburb, the Chiffchaff clearly outnumbered the Willow Warbler as a breeding bird.

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Inledning

Den sydliga gransångarens *Phylloscopus c. collybita* expansion i Sverige de senaste decennierna är både välkänd och väldokumenterad (Lindström et al. 2007, Ottosson et al. 2012). Gransångarens ”styltiga” sång är nu ett vanligt inslag i ljudbilden en vårmorgon i sydvästligaste Sverige och på sina håll verkar gransångaren nu till och med vara vanligare än Sveriges vanligaste fågel, lövsångaren *Phylloscopus trochilus*. För att undersöka detta mer i detalj inventerade jag under våren 2013 gransångare och lövsångare i några villaområden i sydvästra Malmö.

Metodik

Inventeringen genomfördes i stadsdelarna Bellevue (0,53 km^2), Nya Bellevue (0,43km^2) och Västervång (0,31 km^2) i sydvästra Malmö (~55°35’N, 12°57’E, Figur 1). Alla tre områdena är villaområden som bebyggts från början av 1900-talet och framåt. Flygfoton över området indikerar att i Bellevueområdet ligger villorna något glesare och mer oregelbundet placerade och trädgårdarna ser lummigare ut än i Nya Bellevue. I området Västervång, som ger det mest öppna intrycket, är villorna i ett kvarter ofta placerade med husen i täta rader längs gatorna och kvarteren har trädgårdar som vetter mot varandra. Som jämförelseområde

Figur 1. Inventeringsområden och inventeringslinjer i Malmö våren 2013.
The survey areas and line transects in Malmö, Sweden, in spring 2013.

Figur 2. Gransångarobservationer (”nålar”) och revir (röda cirklar) i studieområdet.
Observations (“pins”) and territories (red circles) of Chiffchaffs in the study area.

valdes ett anslutande område på Ribersborgsfältet (0,46 km^2). Förutom stora gräsytor inkluderar detta område en trädridå längs banvallen på den gamla nerlagda järnvägen Limhamn–Malmö, samt ett par större träddungar.

Inventeringarna genomfördes på cykel vid 8 tillfällen mellan den 28 april och den 17 maj. Vid samtliga tillfällen påbörjades inventeringen runt kl. 05.00 och den tog ungefär 2 timmar att genomföra. Avståndet mellan inventeringslinjerna (Figur 1) planerades så att hela området täcktes in. Observatören beräknades kunna höra sjungande fåglar till något över 100m avstånd från ”linjen”. Endast sjungande individer av gran- och lövsångare noterades. Då vårflyttningen inte var över vid inventeringens start, speciellt inte för lövsångaren, så utökades undersökningen till att inte bara jämföra antalet sjungande individer av gran- och lövsångare vid varje inventering, utan att också försöka beräkna antalet revir av respektive art i undersökningsområdet. Alla till synes permanenta revir (minst 3 noteringar av sjungande fågel) prickades ut på karta (Figur 2 och 3).

Figur 3. Lövsångarobservationer (”nålar”) och revir (röda cirklar) i studieområdet.
Observations (“pins”) and territories (red circles) of Willow Warblers in the study area.

För att underlätta vid revirbestämningen så noterades i alla delområdena från inventering nr 2 och framåt i vilken typ av träd den sjungande fågeln satt. Speciellt i början av perioden var trädslaget inte lätt att bestämma på avstånd, så kategorierna ”barrträd”, ”björk”,” bok” och ”annat lövträd” användes. Ibland satt den sjungande fågeln i en grupp av träd där fågeln inte kunde upptäckas eller sångplatsen var skymd av något hinder, dessa fåglar har noterats under ”sångplats ej fastställd”.

Väderbetingelserna då inventeringarna genomfördes dominerades av klart väder och vindstilla förhållanden. Ett par inventeringar genomfördes vid lätt vind, temperaturen låg generellt mellan 2 och 11 plusgrader. Medelvärden i resultatdelen presenteras med ± 1 standardavvikelse.

Resultat

Antalet sjungande gran- och lövsångare har summerats för villakvarteren var för sig och jämförelseområdet på Ribersborgsfältet för sig. Antalet gransångare i de tre villaområdena varierade mellan 11 och 18 individer per inventeringstillfälle, med ett medelvärde på 15,2 ± 2,8 (Tabell 1). Antalet sjungande lövsångare varierade mellan 4 och 20 individer (medel 7,1 ± 5,5). Endast enstaka sjungande gransångare noterades på Ribersborgs-området (medel 0,5 ± 0,5, Tabell 2). Antalet sjungande

Tabell 1. Antal sjungande gran- och lövsångare i Nya Bellevue, Bellevue och Västervång.
Number of singing Chiffchaff and Willow Warbler in the areas of Nya Bellevue, Bellevue and Västervång, in April (apr) and May (maj).

Inventering *Survey*	Datum *Date*	Gransångare *Chiffchaff*	Lövsångare *Willow Warbler*
1	28 apr	12	5
2	1 maj	14	4
3	4 maj	18	9
4	9 maj	11	20
5	12 maj	18	6
6	14 maj	16	5
7	15 maj	18	4
8	17 maj	15	4
Summa/Total		122	57

Tabell 2. Antal sjungande gran- och lövsångare i Ribersborgsområdet.
Number of singing Chiffchaff and Willow Warbler in Ribersborg area, in April (apr) and May (maj).

Inventering *Survey*	Datum *Date*	Gransångare *Chiffchaff*	Lövsångare *Willow Warble*
1	28 apr	1	1
2	1 maj	1	3
3	4 maj	0	2
4	9 maj	0	10
5	12 maj	1	2
6	14 maj	1	3
7	15 maj	0	3
8	17 maj	0	2
Summa/Total		4	26

lövsångare varierade mellan 1 och 10 individer (medel 3,3 ± 2,8).

Inventering nr 4 skiljde sig från de övriga inventeringarna genom att ha ett stort antal sjungande lövsångare (Tabell 1 och 2). Troligen rörde det sig om en rejäl påspädning av rastande fåglar på flyttning denna dag och observationerna från denna dag användes därför inte till att bestämma antalet revir.

Det totala antalet gransångarrevir i villaområdena var 21 (Tabell 3). För lövsångaren noterades totalt 8 revir i samma område, varav ett delområde, Nya Bellevue, helt saknade revir. I jämförelseområdet Ribersborg noterades inget gransångarrevir, men fem revir lövsångare (Tabell 3). För de tre villaområdena tillammans var revirtätheten 16,5 par/ km^2 för gransångaren och 6,3 par/ km^2 för lövsångaren.

Under inventeringarna så noterades också, om möjligt, var den sjungande fågeln satt (Tabell 4 och 5). För båda arterna gällde att antalet ej säkerställda sångplatser var stort, 23% för gransångare och 44% för lövsångare, så resultatet skall tolkas med viss försiktighet. Av de fastställda sångplatserna framgår dock att gransångaren använder sig av ett brett spektrum av olika lövträd som sångplats, men de påträffas även i barrträd. Lövsångaren noterades däremot inte vid något tillfälle som säkert sittande i ett barrträd.

Diskussion

Antalet revir av gransångare i det undersökta området var klart fler än antalet revir av lövsångare, nämligen 16,5 mot 6,3 par/km^2. Något tidigare motsvarande inventeringsresultat från Malmö är inte känt. Man kan dock notera att vid en inventering år 1991 i Malmös tätortsdominerade grannkommun Burlöv, fann man inte ett enda häckande par gransångare, medan lövsångartätheten var 2,2 par/km^2 (Bengtsson & Larsson 1991). Skillnaden i antalet gransångare mellan de två studierna är väl i linje med vad vi vet om artens sentida historik i Sydsverige.

I statistiken från Svensk Fågeltaxering kan den sydliga gransångarens expansion i Sverige följas från 1975 och rasen ökade i genomsnitt med 9,6 % per år under perioden (Green & Lindström 2014). Vid inventeringarna i Skåne för Svensk Fågelatlas 1974–1984 konstaterades det säkra häckningar av gransångare i bara 3% av inventeringsrutorna (Svensson m.fl. 1999) och populationen var ”säkert under 100 par” (Bengtsson & Green 2013). Den huvudsakliga utbredningen låg då i den nordvästra delen av landskapet. Vid de uppföljande inventeringarna för Skånes Fågelatlas under 2000-talet hade arten spritt sig över landskapet och noterades i 91% av de skånska rutorna och populationen uppkattades till 14 000 par (Ottosson m.fl. 2012, Bengtsson & Green 2013).

Som ytterligare jämförelse till den nu genomförda studien i Malmö kan nämnas en inventering på

Tabell 3. Antal revir respektive revirtäthet (revir/km2) av gransångare och lövsångare i de olika undersökningsområdena.
Number of territories and territory density (territories/km2) of Chiffchaff and Willow Warbler in the study areas.

	Gransångare *Chiffchaff*		Lövsångare *Willow Warbler*	
Område *Area*	Revir *Territories*	Täthet *Density*	Revir *Territories*	Täthet *Density*
Bellevue	10	18,7	3	5,6
Nya Bellevue	6	13,5	0	0
Västervång	5	16,2	5	16,2
Totalt villaområdena *Total for villa areas*	21	16,5	8	6,3
Ribersborg	0	0	5	10,9

Tabell 4. Sångplatser för gransångare, summerat för alla delområden. Sångplats noterades ej under inventering 1. *Song posts for Chiffchaffs, all areas combined (not recorded during survey 1).*

Inventering *Survey*	Datum *Date*	Björk *Birch*	Bok *Beech*	Annat lövträd *Deciduous tree*	Barrträd *Coniferous tree*	Ej fastställd *Not detectable*
2	1 maj	1	1	1	1	11
3	4 maj	5	4	3	5	1
4	9 maj	2	2	4	0	3
5	12 maj	1	3	13	0	2
6	14 maj	2	4	8	1	2
7	15 maj	1	4	7	1	5
8	17 maj	0	4	9	0	2
Summa *Total*		12	22	45	8	26

Kullaberg 2004 då man fann 10,7 par gransångare/km^2 och 10,8 par lövsångare/km^2 (Peterz & Rellmar 2007). Resultaten indikerar att gransångaren har en relativt sett större förkärlek för villakvarter än lövsångaren och att gransångartätheten i villakvarter kan vara högre än i skogsmiljö. Dessutom är de 16,5 par/km^2 som uppmättes troligen det högsta värdet funnet i Sverige på en så pass stor inventeringsyta, för någon av de två raserna (Peterz & Rellmar 2007, Ottosson m.fl. 2012).

I Centraleuropa där gransångaren är etablerad sedan länge visar inventeringsresultat att gransångaren är mycket vanlig i urbana miljöer, men tätheten varierar mycket mellan städer. Baserat på atlasarbete 2005–2009 uppskattas den generella tätheten i Hamburg till mellan 7 och 21 par/km^2, medan motsvarande siffror för Berlin bara var 0,4–1,0 par/km^2 (Gedeon et al. 2014). I undersökningar gjorda under perioden 1960–1990 i mellersta och norra Tyskland återfanns gransångaren i 96% av parkerna med en medeltäthet på 31 par/km^2. I förortsområden och villaområden med trädgårdar fanns den representerad i 74% av de undersökta områdena med ett medelvärde på 11 par/km^2 (Flade 1994). Den nu uppmätta tätheten i Malmö, 16,5 par/km^2 står sig alltså redan väl i jämförelse och man kan undra om tätheten i Malmö redan nått sin topp?

För lövsångaren anger Ottosson m.fl. (2012) att tätheten i bebyggelse i hela landet ligger på 10–20 par/km^2. I de undersökta villaområdena i Malmö var medelvärdet 6,3 par/km^2. I optimala miljöer kan dock tätheten för lövsångare vara så hög som 100–250 par/km^2 (till exempel äldre hyggen med tät björksly, Ottosson m.fl. 2012).

Vid inventeringarna i villaområdena var antalet sjungande gransångare högre än antalet sjungande lövsångare vid sju tillfällen av åtta (Tabell 1). Det enda avvikande resultatet var inventering nr 4 den 9 maj då 20 sjungande lövsångare noterades mot normala 5–6. En rimlig förklaring till det stora antalet observationer är att det rörde sig om flyttande fåglar som rastade tillfälligt. Vid nästa inventering tre dagar senare var lövsångarantalet tillbaka i nivå med tidigare inventeringar. Om inventering nr 4 exkluderas så gjordes 111 observationer av sjung-

Tabell 5. Sångplatser för lövsångare, summerat för alla delområden. Sångplats noterades ej under inventering 1. *Song posts for Willow Warblers, all areas combined (not recorded during survey 1).*

Inventering *Survey*	Datum *Date*	Björk *Birch*	Bok *Beech*	Annat lövträd *Deciduous tree*	Barrträd *Coniferous tree*	Ej fastställd *Not detectable*
2	1 maj	0	0	3	0	4
3	4 maj	3	1	1	0	6
4	9 maj	10	5	1	0	14
5	12 maj	1	2	1	0	4
6	14 maj	1	1	2	0	4
7	15 maj	1	1	5	0	0
8	17 maj	2	0	2	0	2
Summa *Total*		18	10	15	0	34

ande gransångare och 37 observationer av sjungande lövsångare under inventeringarna i villakvarteren vilket ger ett förhållande på 3 till 1.

Exemplet ovan visar att enstaka räkningar av förmodat häckande fåglar även långt fram på våren kan ge missvisande värden och att upprepade besök (revirkartering) behövs. Att fastställa revir är dock inte okomplicerat. Undersökningen genomfördes med täta inventeringar vilket skulle kunna leda till att en rastande fågel som hörs under några dagar i tät följd för att sedan ge sig av skulle kunna ge en falsk revirindikation. Fåglarna verkar också röra sig inom området en tid innan de fastställt sitt revir. I två fall så sjöng en fågel vid tre inventeringar i rad från en plats för att sedan tystna under resten av inventeringarna. Istället dök det upp en fågel på en plats ett kort avstånd från den första och sjöng därifrån under resten av inventeringarna. Speciellt gransångarna kändes rörliga under inventeringarna, kanske som en effekt av att en del av trädgårdarna är stora och också har stora öppna ytor, en förflyttning från en sångplats till nästa blir då märkbar.

Förhållandet mellan antalet gransångarrevir och lövsångarrevir beräknat på revir med tre sångmarkeringar som grund blev i villakvarteren 2,6 till 1, vilket ungefär motsvarar förhållandet baserat på antalet sjungande fåglar.

För att få en jämförelse till villakvarteren inkluderades en del av rekreationsområdet Ribersborg i undersökningen. I detta område gjordes endast 4 observationer av sjungande gransångare och totalt 26 observationer av sjungande lövsångare (Tabell 2). Inget gransångarrevir konstaterades medan det fanns 5 lövsångarrevir. Inte bara Ribersborgsområdet avviker från villaområdena utan även sinsemellan skiljer sig de olika villaområdena åt. I området Nya Bellevue fanns det av någon anledning inga lövsångarrevir alls (Tabell 3). I området Västervång var tätheten av gran- och lövsångare lika hög (Tabell 3).

I Västervång noterades på två platser att ett gransångarrevir och ett lövsångarrevir i praktiken överlappade varandra (Figur 2 och 3). Att gran- och lövsångare kan ha överlappande revir finns belagt i tidigare undersökningar. I en studie utförd i en skog av gråal i Norge konstaterar Sæther (1982) att ett revir som ett år hålls av en lövsångare nästa år mycket väl kan hållas av en gransångare och tvärt om. Han menar vidare att hur arterna fördelar reviren i ett område kan bero på många faktorer och han finner i sin studie i denna biotop inget belägg för att olika områdespreferenser kan förklara fördelningen. I de experiment med interaktioner mellan arterna som han utförde visar sig ingen av arterna dominera över den andra (Sæther 1982).

Samtidigt som inventeringsresultatet visar att de kan samexistera verkar det finnas olika faktorer som påverkar fördelningen av arterna i de olika villaområdena.

Tidpunkten på våren när fåglarna anländer till häckplatsen kan troligen vara en konkurrensfaktor både inom och mellan arter. Under den kalla våren 2013 var dock skillnaden i ankomsttid till häckplatserna mellan gran- och lövsångaren ovanligt liten (egna observationer) och skillnaden mellan antal gran- och lövsångare i inventeringen beror troligen på något annat. En möjlig förklaring till skillnaderna skulle kunna vara den urbana miljön i sig. Dessa miljöer skiljer sig ofta från naturliga skogar i det att vegetationstäcket är tunnare, lägre växtskikt kan vara reducerade eller helt saknas och vegetationsområdena är ofta mycket mer sönderbrutna. Dessutom påverkas fåglar i urbana miljöer av en mängd störningar som inte finns i naturliga miljöer.

Jokimäki (1999) konstaterade att arter som lövsångare och skata Pica pica häckade i större omfattning i parker som hade en mer begränsad skötsel jämfört med mer välskötta parker. Skillnaden uppstod troligen som en effekt av att vegetationstäcket i den mer orörda parken då var tätare. Jokimäki (1999) konstaterar också i sin undersökning att antalet närliggande byggnader påverkar tre fågelarter negativt, nämligen lövsångaren, kråkan Corvus corone och den grå flugsnapparen Muscicapa striata. Det finns indikationer i den nu genomförda undersökning som talar för att de ovan nämnda faktorerna kan vara inblandade i skillnaderna i tätheter mellan inventeringsområdena.

På Ribersborgsområdet återfanns tre av lövsångarreviren i områden med tät markvegetation, medan området Nya Bellevue, som helt saknar lövsångarrevir, är det av villaområdena där vegetationstäcket är som mest uppbrutet och där det också är relativt tätt mellan husen. Möjligen indikerar detta att lövsångaren är mer kritiskt beroende av ett ordentligt örtskikt och en mindre tät bebyggelse för att trivas.

Cramp (1992) beskriver gransångaren som mindre attraherad av yngre och tätare vegetation eller av stora skuggiga skogspartier. Arten föredrar istället gläntor och trädridåer om det i området också finns några stora välväxta träd. I de nu undersökta villaområdena är trädgårdarna gamla och det finns en hel del stora träd. I området Bellevue bedöms det finnas flest riktigt stora och mäktiga träd, och i detta område är också revirtätheten för gransångare som högst, 18,7 par/km^2.

Vid inventeringarna gjordes försök att undersöka vilka preferenser de olika arterna har då de väljer sångplats (Tabell 4 och 5). Gransångaren noterades i många olika trädslag, medan lövsångaren verkade undvika barrträd. Några riktigt säkra slutsatser kan dock inte dras eftersom antalet ej fastställda sångplatser var ganska stort och fördelningen av tillgängliga träd inte skattades. Mer systematiska undersökningar måste därför göras för att säkerställa vilka bakomliggande skillnader i miljön som orsak till skillnaden mellan arternas revirtäthet i de olika delområdena.

Under projektets gång konstaterades att inventeringsmetoden verkade fungera väl. Då alla sjungande fåglar uppsöktes konstaterades att hela inventeringsområdet täcktes av mycket väl. En erfarenhet från inventeringarna var att gransångarens styltiga sång lättare uppfattas på riktigt långt håll jämfört med lövsångarens, men lövsångarens sång bar dock tillräckligt för att bli väl avlyssnad på rutten.

Den genomförda inventeringen har, både genom att räkna antalet sjungande individer vid olika inventeringstillfällen men också genom att göra en enklare form av revirkartering, visat att gransångaren är vanligare än lövsångaren i villakvarter i sydvästra Malmö. Är det rent av så att vi kan förvänta oss att gransångaren – som invandrat från söder och som haft gott om tid att anpassa sig till urbana miljöer i Centraleuropas gamla städer – kommer att bli städernas vanligaste *Phylloscopus*? Eller är den redan det?

Tack

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Summary

The number of singing Chiffchaffs *Phylloscopus c. collybita* and Willow Warblers *Ph. trochilus* were counted in spring 2013 in a suburb of the city of Malmö, south Sweden (approx. 55°35'N, 12°57'E, Figur 1). Eight visits were paid between 28 April and 17 May to three sub-areas dominated by villas and their grown-up gardens (total area of 1.27 km^2) and a reference area with large lawns, a long row of trees and some very small woods (total area of 0.46 km^2). The censuses were carried out by bike between 05.00 and 07.00 local time. The number of territories was also estimated, based on at least three encounters at the same site during the study period. The tree species the bird was sitting in was also recorded.

The numbers of singing Chiffchaffs in the three villa areas varied between 12 and 18 per census, with an average of 15.3 and a standard deviation of ± 2.8 (Table 1, Figure 1). The corresponding values for Willow Warblers were 4 and 20 (average 7,1 ± 5,5). In the reference area there were many more Willow Warblers than Chiffchaffs (Table 2).

During census 4 there was most likely a heavy landfall of migrating Willow Warblers, and observations from this day were not included when es-

timating territories. The total number of territories in the villa areas was 21 for Chiffchaff and 8 for Willow Warbler, which is equal to a density of 16.5 and 6.3 pairs/km^2 (Table 3, Figure 2 and 3). The choice of tree species for song posts differed somewhat between the species, with Willow Warblers seemingly avoiding coniferous trees (Table 4 and 5).

The Chiffchaff density of 16.5 pairs/km^2 is probably the highest ever recorded in Sweden in such a large census plot (cf. Peter & Rellmar 2007, Ottosson et al. 2012), which is not surprising given the enormous population increase the *collybita* subspecies has had the last 40 years in south Sweden, with an average annual increase of 9.6 %/year. (Lindström et al. 2007, Green & Lindström 2014). The density found also matches well the highest found in German urban areas (Flade 1994, Gideon et al. 2014).

The Willow Warbler density of 6.3 pairs/km^2 is in line with previous values for urban areas, but much lower than the 100–250 pairs/km^2 that can be found in the most optimal habitats, such as old clear-cuts with dense stands of growing birch (Ottosson et al. 2012).

The difference in density between the two species in this villa suburb may be the Chiffchaff's relative preference for areas with large trees, interspersed by open areas with less understory.

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Species turnover in the Swedish bird fauna 1850–2009 and a forecast for 2050

Artomsättningen i den svenska fågelfaunan 1850–2009 samt en prognos för 2050

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Abstract

There is presently great concern about local, regional and global loss of species. We examined those breeding species and subspecies ("species") of birds that either established themselves or went extinct in Sweden in 1850–2009. In this period Sweden got 38 new and lost twelve breeding bird species. The average (and surprisingly steady) rate of colonization was 2.4 species per decade, which was three times higher than the rate of extinction of 0.75 species per decade. We also predict future establishments and extinctions until year 2050, based on Species Distribution Modelling and recent information from neighbouring countries. We find it *probable* that eleven new species will join the Swedish avifauna until 2050 and possible that another nine species will do so. The predicted rate of probable establishment is 2.9 species per decade. We identified seven species/subspecies to be at risk of extinction by 2050. The future in Sweden for several of these species is probably dependent on the success or failure of ongoing conservation programs. There seems to be no immediate threat of establishment of alien species.

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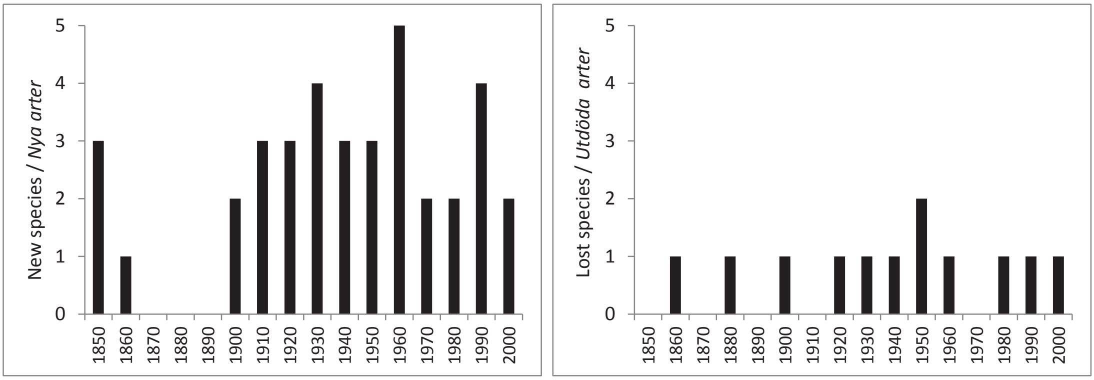
Introduction

The number of regularly breeding bird species in Sweden was recently estimated at 252 (Ottosson et al. 2012), which constitutes more than 80% of the around 300 species that nest in the Nordic countries (Asbirk et al. 1997). It is frequently argued that Sweden's flora and fauna have been impoverished in modern times, but as far as the number of bird species breeding in Sweden is concerned, this is not correct. The number of breeding bird species in Sweden rose between 1850 and 1970. During this period 27 species became established in Sweden, while nine species were lost (Järvinen & Ulfstrand 1980). Järvinen & Ulfstrand (1980) noted that the majority of changes in the avifauna could be explained by anthropogenic effects, such as increased/decreased hunting, changes in land use, and eutrophication. The aim of the present study was to update the analysis of Järvinen & Ulfstrand (1980) and to predict future establishments and extinctions in Sweden up to 2050.

New types of models (Ecological Niche Models, Species Distribution Models) have demonstrated that even when using a limited number of environmental variables it is possible to predict present species distribution with reasonably high accuracy (Huntley et al. 2007, Swenson 2008, Pigot et al. 2010, Barbet-Massin et al. 2012). These models have also been used to predict future species distributions. Huntley et al. (2007) modelled the present and future breeding distribution of 431 European bird species. Barbet-Massin et al. (2012) compared the modelled present distributions of 409 European bird species with projections of future potential breeding distributions (in 2050), based on present habitat and climate data as well as scenarios for the future. More than 70% of the species are predicted to reduce their ranges and the number of species



Figur 1. The number of new (left graph) and extinct (right graph) bird species in Sweden per decade.
Antal nyetablerade (vänster figur) och utdöda (höger figur) fågelarter i Sverige per decennium.

is predicted to decrease in southern Europe (Barbet-Massin et al. 2012). In contrast, the number of species is predicted to increase in northern Europe. A study centred on the future of species diversity of plants, which also included climate change, showed qualitatively similar results for northern Europe (Thuiller et al. 2005).

The changes predicted seem to be in progress already. In the UK, many species with southern distribution have expanded northwards (Thomas & Lennon 1999). Jiguet et al. (2010) examined how the population growth of 62 bird species in France, the Netherlands and Sweden has been affected by changes in the average temperature during the nesting season. Within a species range, populations breeding close to their thermal maximum had lower growth rates than populations breeding close to their thermal minimum. One effect of this would be that, in general, species distributions will shift northwards. In Sweden, recent studies have shown that bird communities are gradually changing to include more thermophilic southern species (Lindström et al. 2013) and especially in the north, the number of species at local level increased in parallel to warmer summers (Davey et al. 2013). In addition, Jiguet et al. (2013) found that today's bird trends in Sweden are consistent with the projections of future distribution in the country, as anticipated by Barbet-Massin et al. (2012). The species predicted to expand their distribution range by 2050 are currently increasing in numbers, and *vice versa* (Jiguet et al. 2013). Another general trend is that habitat generalists tend to have more positive population growth rates in Europe than habitat specialists (Le Viol et al. 2012).

While a fairly steady species turnover occurred already between 1850 and 1970 (Figure 1), the turnover rate may increase in the future as a consequence of global warming. Species with their southern limit in northern Sweden may eventually be lost from the breeding avifauna, while species with their northern boundary south of Sweden may establish themselves. The latter process can be expected to weigh over because species richness in the areas south of Sweden is much greater than that in northern Sweden (Huntley et al. 2007).

We have compiled data on species gains and losses in Sweden in 1970–2009. By combining these results with those presented by Järvinen & Ulfstrand (1980) we attempt a comprehensive picture of the turnover of bird species between 1850 and 2009. We briefly discuss what characterize the species that have joined or disappeared from the Swedish breeding avifauna. By combining recent modelling of future distributions of birds in Europe (Barbet-Massin et al. 2012) with information about recent changes in the bird fauna in neighbouring countries, we then predict which species may have been gained and lost, respectively, by 2050. Changes in distribution and abundance within Sweden are of course highly related processes, but are not addressed specifically here.

Methods

Changes in (1850–) 1970–2009

Data of establishments and extinctions for 1850–1970 were exclusively taken from Järvinen & Ulfstrand (1980). A few of their interpretations can be discussed, but we refrained from doing so, since changing the interpretation of a few species would not change the general picture. The same uncertainty also holds for a few of our own interpretations for the period 1970–2009. Details of the new species since 1970 have primarily been extracted from Ottosson et al. (2012). With established species we mean species that nest in Sweden annually, with reasonable certainty. This is of course not easy to determine, since many breeding attempts of rare species most certainly go undetected, and, in addition, to a varying degree between species. The principles that we have used to classify species that belong to the breeding avifauna are the same as those used by Ottosson et al. (2012). For example, Marsh Sandpiper *Tringa stagnatilis* was found to breed or attempt to breed on a few occasions between 2000 and 2009 (Species Gateway/Bird 2013). This species is likely to breed in habitats and sites in Sweden visited frequently by birdwatchers, and relatively few breeding attempts are therefore likely to have been missed. Accordingly, it has not been considered as an established breeding species. In contrast, the Red-flanked Bluetail *Tarsiger cyanurus*, which to our knowledge only has been found nesting once in Sweden (in 1996), we consider belonging to the regularly nesting species. There are several summer records of this species from its preferred habitat, i.e. near-natural state boreal forest in northernmost Sweden, despite that the probability of its detection rate must be regarded as very low.

Quail *Coturnix coturnix* and Avocet *Recurvirostra avocetta* are present in both the category “established species 1850–2009” and “extinct species 1850–2009.” Järvinen & Ulfstrand (1980) considered them as extinct, but both species later re-established themselves as breeding birds in Sweden.

To investigate whether there are differences in the degree of habitat specialization among the species that have been lost and become established in Sweden, respectively, we used the species-specific habitat specialization indices established by Le Viol et al. (2012). Low index values indicate that a species is a generalist in terms of habitat use during the breeding season, while high values indicate a habitat specialist restricted to only one or a few habitat types.

Species Distribution Models

The future potential distributions of European breeding birds (year 2050) were modelled by Barbet-Massin et al. (2012). In short, the distribution of 409 European breeding bird species (BWPi 2006) was digitized and described with a resolution of 0.5° (about 55 km in latitudinal direction) across the whole Western Palaearctic. Seabirds were excluded from the analysis. Eight variables (again with resolution 0.5°) describing the contemporary climate were retrieved from the Climate Research Unit (http://www.cru.uea.ac.uk/data). Habitat Data (nine habitat types, resolution 0.5°), both current and future (2050), came from the IMAGE 2.4 model (MNP 2006). Barbet-Massin et al. 2012 projected the future distributions of all species under climate change based on five general circulation models (GCM; BCM2, ECHAM5, HADCM3, MIROHIC3_2-HI, and MK3) and three different emission scenarios (SRES: A1B, B1, and A2) (IPCC 2007). More details can be found in Barbet-Massin et al. (2012). The predicted future distributions within Sweden are an important part of the present study.

The basic principle when using Species Distribution Models is the projection of a species’ environmental niche (climate and/or habitat) on map layers describing the distribution of relevant habitat types (for example, the proportion of coniferous forest in each 0.5°×0.5° square) and climate variables (for example average annual temperature per 0.5°×0.5° square). One then statistically determines which variables best explain a species’ distribution pattern. Barbet-Massin et al. (2012) trained a number of such models by fitting present-day values of habitat and climate on present distributions. When the models were well calibrated the authors could ask the question: given that the species X occurs in this climate and these habitats, where will it occur in 2050? Following this, predicted distribution maps (SDM50) were produced, where the species’ most likely distributions in 2050 were illustrated by differently coloured squares (55×55 km). The colours indicate the likelihood of an area being suitable for a given species. It should be emphasized that this approach presupposes niche conservatism. As a check of accuracy, models were also used to produce maps of contemporary distribution (SDM00). For species with very specific habitat requirements the models did not do very well, due to the low geographical resolution. As a consequence, the models generate more uncertain results for species strongly associated with water, such as exclusively coastal species.

Based on the SDM50 we directed our attention to two categories of species: 1) New breeding species: those who currently do not breed in Sweden, but are likely to occur in Sweden by 2050 according to SDM50, 2) Extinctions: those species who breed in Sweden today, but according to SDM50 have zero percent probability to exist in 2050.

For each of the distribution maps which suggested the establishment in Sweden of a new breeding species, we counted the number of squares that showed a future occurrence with a probability of >0.5, the number of squares that showed a future occurrence with a probability >0, and also noted the probability value for the square with the highest probability of establishment.

Establishment in 2010–2050

The final decision of whether a species is likely to breed in Sweden in 2050 was based on two main sources of information: 1) the modelling of Barbet-Massin et al. (2012) as described above, and 2) information about recent distribution and population dynamics in the neighbouring countries to Sweden (Table 1). Model forecasts are attractive to use because they are basically free from our own preconceptions. On the other hand they are not omnipotent and will sometimes give erroneous predictions (even for present and known distribution, see below). For our final predictions we have therefore balanced model outcomes with other available information.

The main focus is on a number of species that were assessed as *probable* or *possible* breeders in Sweden in 2050. We also discuss some additional species where it is *conceivable* that they will become established until 2050, but where there is a much higher uncertainty.

To be evaluated as a *probable* newcomer, a given species should have at least four squares with a probability of future occurrence of >0.5 in SDM50. There must also be other data in support, such as the species expanding in nearby countries. Included are also species that are not predicted to occur in Sweden according to the criteria above, but where other circumstances may point at a probable establishment, such as strong recent range expansion in

Table 1. Population trend data from some neighbouring countries used to evaluate the likelihood of future establishment in Sweden for bird species that do not breed regularly (see Table 4 and 5). The column Trend shows how the trends are described in this report. More details are given in note #3.
Kringliggande länders och regioners trenddata som utnyttjats som jämförelse till de modellerade prediktionerna av framtida förekomst (se tabell 4 och 5). Under Trend anges hur trenderna redovisas i denna rapport. Närmare förklaring ges i not 3.

Country *Land*	Code *Kod*	Period	Trend[3]	Source *Källa*
Germany *Tyskland*	D	1980–2005	++,+,0,-,- -	Südbeck m.fl. (2007)
Netherlands *Nederländerna*	NL	2002–2011	++,+,0,-,- -	Netwerk Ecologische Monitoring (2012)
Belgium *Belgien Vallonien*	BEVal	1990–2009	++,+,0,-,- -	Paquet m.fl. *,* (2010)
Poland *Polen*	PL	2000–2013	++,+,0,-,- -	Chodkiewicz m.fl. (2013)
UK *Storbritannien*	GB	Varying *Varierande*[1]	++,+,0,-,- -	Baillie m.fl. (2013)
France *Frankrike*	FR	1990–2010	Numerical/ *Siffervärde*	Jiguet (unpublished data)[2]
Europe *Europa*	EU	Varying *Varierande*[2]	Text	BirdLife International (2013)

[1] The start year varies between species, or is not given, but the last year is always 2011. *Startåret varierar mellan arter och/eller framgår inte, men slutåret är konsekvent 2011.*

[2] Time span not given but the data are updated continuously. *Tidsspannet framgår inte, men uppgifterna uppdateras kontinuerligt.*

[3] The symbols ++,+,-,- - indicate statistically significant trends: ++ = strong increase, + = moderate increase, - moderate decline, -- = strong decline, 0 = stable population. The actual strength of moderate and strong trends varies between studies. The European trends are given in words.
Symbolerna ++,+,--,- indikerar statistiskt säkerställda trender: ++ = kraftig ökning, + = moderat ökning, -- = kraftig minskning, - moderat minskning, 0 = stabil population. Vad som anses vara en moderat respektive kraftig trend varierar något mellan studierna. De franska data redovisas i form av lutningskoefficienten för respektive arts trend, men utan något spridningsmått. Det sammanvägda europaindexet anges, liksom det görs i källan, i textform.

Table 2. Species that established themselves as breeders in Sweden 1850–2009. The information from 1850–1969 is from Järvinen & Ulfstrand (1980). Data on later establishments are from Ottosson et al. (2012), as is information about population sizes, shown for species established from 1970 onwards. For the latter species we also show from which direction the colonization most probably took place. Habitat preference is also given (from Solonen 1994; A=Coastal, C=Farmland, F=Forest, O=Bushes and open ground, S=Beeches (*=not included in Solonen 1994). HSI is the habitat specialization index (from LeViol et al. 2012). The higher values, the more specialized a species is.
*Arter som etablerat sig i den svenska häckfågelfaunan under perioden 1850–2009. Uppgifterna för 1850–1969 är hämtade från Järvinen och Ulfstrand (1980). Senare etableringar är hämtade från Ottosson m.fl. (2012), liksom den nuvarande populationsstorleken (antal par), vilket visas för arter etablerade från 1970 och framåt. För det senare tidsspannet visas även rekryteringsområde (från vilket vädersträck etableringen troligast skett) och häckningsbiotop (efter Solonen 1994); A=arkipelag, C=kulturmark, F=skog, O=busk- och öppenmark, S=stränder. *=ej med i Solonen 1994. Habitatsspecialiseringsindex (HSI) visas för samtliga arter (hämtade från Le Viol m.fl., 2012). Ju högre värde desto mer specialiserad är arten.*

Species	Decade of establishment	No. of pairs	Colonization from	Habitat	
Art	*Decennium för etablering*	*Antal par*	*Rekryterings-område*	*Biotop*	HSI
Phalacrocorax aristotelis	2000	35	NW/NV	A	6.93
Saxicola torquata	2000	4	SW/SV	O	2.82
Coturnix coturnix	1990	1000	S	C	4.22
Locustella luscinioides	1990	30	SSE/SSO	S	6.89
Regulus ignicapillus	1990	100	SW/SV	F	3.26
Tarsiger cyanurus	1990	10	E/O	F	9.27
Locustella fluviatilis	1980	150	SE/SO	O	4.17
Acrocephalus dumetorum	1980	55	E/O	O	4.61
Carduelis flammea cabaret	1970	>1000	SW/SV	F*	
Branta leucopsis	1970	4900	NE/NO	A	2.88
Milvus migrans	1960				2.57
Rissa tridactyla	1960				6.71
Remiz pendulinus	1960				6.89
Panurus biarmicus	1960				6.89
Phylloscopus trochiloides	1960				4.72
Phylloscopus c. collybita	1960				2.89
Streptopelia decaocto	1950				2.69
Phylloscopus borealis	1950				4.65
Emberiza pusilla	1950				6.32
Phalacrocorax carbo	1940				3.63
Ficedula parva	1940				5.33
Serinus serinus	1940				2.42
Branta canadensis	1930				
Circus pygargus	1930				2.79
Oriolus oriolus	1930				2.51
Carpodacus erythrinus	1930				2.44
Podiceps nigricollis	1920				6.89
Recurvirostra avosetta	1920				3.01
Locustella naevia	1920				3.91
Sterna sandvicensis	1910				3.64
Acrocephalus arundinaceus	1910				4.91
Motacilla cinerea	1910				9.85
Alcedo atthis	1900				5.69
Phoenicurus ochruros	1900				3.40
Tyto alba	1860				2.67
Aythya ferina	1850				3.76
Gallinula chloropus	1850				4.91
Galerida cristata	1850				2.72

nearby areas.

For some species SDM00 show that current conditions in Sweden are very suitable, but the birds are clearly not present, such as Snow Finch *Montifringilla nivalis* and Alpine Accentor *Prunella collaris*. These two mainly sedentary species breed in the mountains of southern Europe and the likelihood of establishment in Sweden in the near future must be considered extremely low. For such species the predicted distribution in Sweden (SDM50) was handled with particular care.

To be a candidate for *possible* establishment by 2050, a given species should exhibit one or more squares with a probability of >0.5 in SDM50. SDM00 should show no presence in areas that are clearly outside the species' actual distribution. Other data should not speak against an establishment.

Extinction

For a species to be considered as likely to go extinct, SDM50 should predict no future distribution for a species present today in reality and according to SDM00. Nor should other information speak against extinction.

Result and discussion

New species and extinctions 1970–2009

Järvinen & Ulfstrand (1980) noted that between 1850 and 1970, 27 new species established themselves (Table 2). In addition, one subspecies, the southern Chiffchaff *Phylloscopus c. collybita* established itself in the 1960s (Bengtsson & Green 2013). During the same period nine species went extinct. Below we continue the work of Järvinen and Ulfstrand and present the results for the period 1970–2009.

In 1970–2009, nine species and one subspecies (Lesser Redpoll *Carduelis flammea cabaret*) established themselves in Sweden (Table 2). This is an establishment rate of 2.5 species per decade, which is very similar to the 2.3 (based on 27 species and one subspecies) species per decade which were added between 1850 and 1969. Accordingly, the rate of establishment of new species in Sweden has been fairly constant since 1850 (Figure 1). In addition to the ten above mentioned species and subspecies, there is now a small population of White Stork *Ciconia ciconia* in southern Sweden. This re-establishment of a previously extinct species is the result of re-introduction project starting in 1989. We have therefore chosen to exclude it from the calculations above.

There is no clear common denominator for those species that have established themselves over the past 40 years (Table 2). The species have originated predominantly from areas south of Sweden, but almost all compass directions are represented. For example, the Shag *Phalacrocorax aristotelis* most certainly came in from Norway (NW) and the Barnacle Goose *Branta leucopsis* from the Russian Arctic (NE). Three of the newly established species breed in woodland and three species breed in shrubland. Of the three shrubland species, the Stonechat *Saxicola rubicola* prefers more open habitat, whereas the River Warbler *Locustella fluviatilis* and Blyth's Reed Warbler *Acrocephalus dumetorum* prefer denser bushland. The latter two species are of eastern origin and their expansion may at least partly have benefited from the spread of bushland on abandoned farmland. The same may hold for the Booted Warbler *Iduna caligata*, a probable future breeder in Sweden (for more details, see below).

Between 1970 and 2009, three species disappeared from the Swedish breeding avifauna: Middle Spotted Woodpecker *Dendrocopus medius* (Pettersson 1985), Crested Lark *Galerida cristata* and Kentish Plover *Charadrius alexandrinus* (Swedish Species Information Centre 2011a). The rate of extinction was 0.75 species per decade in 1970–2009, as well as in 1850–1969 (Table 3). The extinction rate has thus been fairly constant over time, although it has varied between decades (Figure 2).

Both Kentish Plover and Crested Lark had very small populations in Sweden already during the past 50–60 years before extinction (Swedish Species Information Centre 2011a, 2012a). The two species have also declined over much of Europe (BirdLife International 2013). For example, the Crested Lark population decreased in Denmark by more than 80% between 1990 and 2000. In 2011, the Danish population consisted of only two pairs (DOF 2013). During the same time period also the Kentish Plover population decreased by more than 80% in Denmark. The extinction in Sweden of these two species therefore coincided with geographically large-scale reductions and sharp declines of populations in adjacent areas. The background to the extinction of the Middle Spotted Woodpecker is addressed later in this report under "Establishment probable".

Between 1850 and 1969 the ratio of new to extinct species was 3.1 (Järvinen & Ulfstrand 1980).

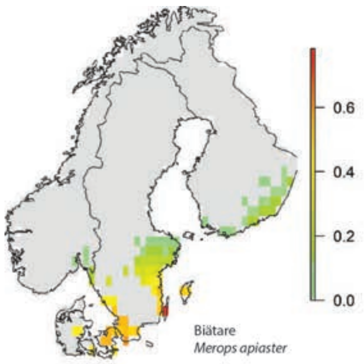
Table 3. Species that went extinct in Sweden 1850–2009. The information for 1850–1969 is from Järvinen & Ulfstrand 1980. For the species lost between 1970 and 2009 is also shown the preferred breeding habitat according to Solonen 1994; F=Forest, O=Bushes and open ground, S=Beeches (*=not included in Solonen 1994). HSI is the habitat specialization index (from LeViol et al. 2012) The higher values, the more specialized a species is.
*Arter som förlorats från den svenska häckfågelfaunan under perioden 1850–2009. Uppgifterna för 1850–1969 är hämtade från Järvinen och Ulfstrand (1980). För de arter som förlorats mellan 1970 och 2009 visas huvudsakligt häckningshabitat (efter Solonen 1994) ; F=skog, O=busk- och öppenmark, S=stränder. *=ej med i Solonen (1994). Habitatsspecialiseringsindex (HSI) visas för samtliga arter (hämtade från Le Viol m.fl., 2012). Ju högre värde desto mer specialiserad är arten.*

Species *Art*	Decade of extinction *Decennium för utdöende*	Habitat *Biotop*	HSI	Source *Källa*
Charadrius alexandrinus	2000	S	2.95	Swedish Species Information Centre (2010d)
Galerida cristata	1990	O	2.72	Swedish Species Information Centre (2010e)
Dendrocopos medius	1980	F*	4.36	Holmbring & Pettersson (1983)
Coracias garrulus	1960		2.62	
Fratercula arctica	1950		4.79	
Ciconia ciconia	1950		3.06	
Coturnix coturnix	1940		4.22	
Ciconia nigra	1930		3.11	
Upupa epops	1920		2.56	
Phalacrocorax carbo	1900		3.63	
Recurvirostra avosetta	*1880*		*3.01*	
Otis tarda	1860		5.45	

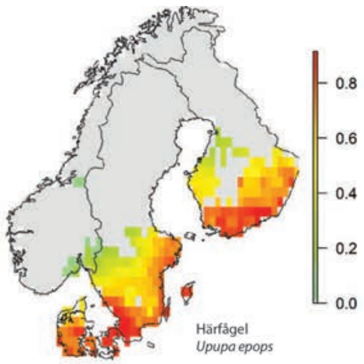
For the period 1970–2009, the ratio was 3.3. Järvinen & Ulfstrand (1980) suggested that the majority of changes in the avifauna up to 1970 could be explained by anthropogenic effects, such as increased/decreased hunting, changes in land use, and eutrophication. It is difficult to say to what extent human activities have contributed directly or indirectly to the continued colonization of Sweden in 1970–2009, but it is clear that, whatever the anthropogenic effect, the number of breeding species in Sweden has continued to rise. A contributing factor is most certainly a warmer climate, especially in recent decades, and it may become even more important in the future. Both Huntley et al. (2007) and Barbet-Massin et al. (2012) have indeed predicted that the number of bird species will increase in northern Europe in the near future.

It should not be forgotten that in addition to establishments and extinctions there have been some dramatic changes in the number of individuals of different species in the Swedish avifauna, at least partly caused by anthropogenic activities and climate change. However, these changes and their causes are outside the scope of this report (more information can be found in Ottvall et al. 2009, Ottosson et al. 2012, Lindström & Green 2013, Jiguet et al. 2013).

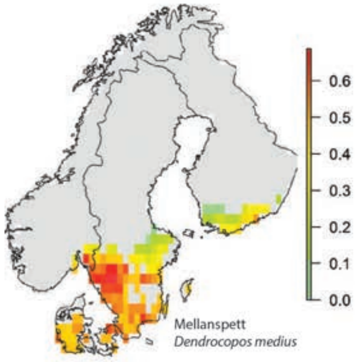
On a European scale, it has been shown that habitat generalists are overrepresented among the species exhibiting population growth and that specialist more often are declining in numbers (Le Viol et al. 2012). We tested whether this pattern holds also for new and extinct species in Sweden between 1850 and 2010. However, a comparison of the habitat specialization index (HSI) of the two groups shows the opposite (Tables 2 and 3). The mean HSI for the species that were lost was 3.54 (SD = 0.95), while for the new species it was 4.60 (SD = 1.97). The difference is significant (Welch's t-test = 2.45, df = 40, $p < 0.05$). This means that according to the HSI, the species lost are more general in their habitat choices than those established. However, this should be interpreted with caution, especially since the absolute difference in HSI between the two groups is quite small. The habitat classification basis for the index is also relatively coarse and does not take into account that different species can use different microhabitats within a given environment. With that said, with respect to local extinctions and establishment, it is clearly not as simple as saying that habitat specialists are the losers and generalists the winners.



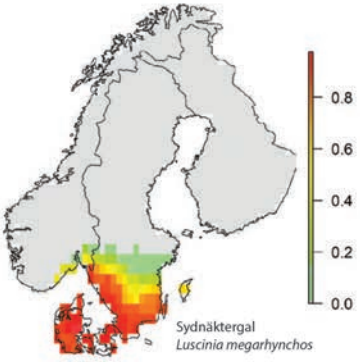
Biätare
Merops apiaster



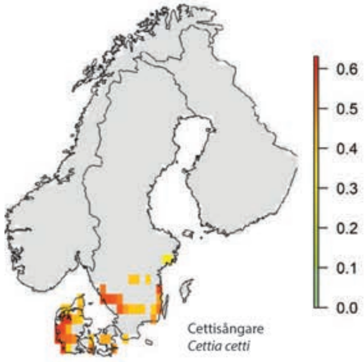
Härfågel
Upupa epops



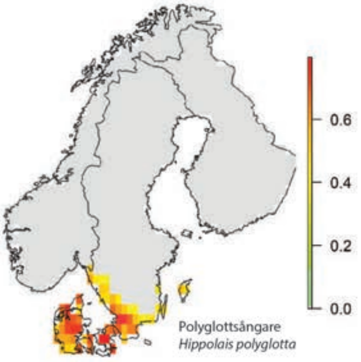
Mellanspett
Dendrocopos medius



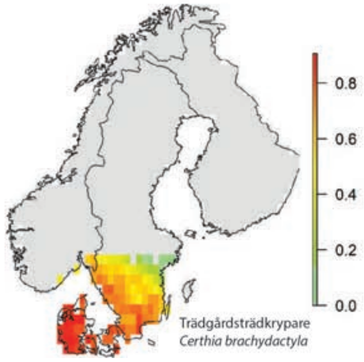
Sydnäktergal
Luscinia megarhynchos



Cettisångare
Cettia cetti



Polyglottsångare
Hippolais polyglotta



Trädgårdsträdkrypare
Certhia brachydactyla

Figure 2. The modelled likelihood of breeding in Sweden in 2050 for 7 of the 11 species considered as probable future breeders (based on Barbet-Massin et al. 2012). The four remaining species were either not modelled or we deemed the forecasted occurrence as unlikely. The colour of the squares denotes the predicted probability (0 < p < 1) of occurrence according to SDM50. The scales differ between species.
Sannolikheten för förekomst år 2050 för sju av de elva arter som vi anser vara troliga inslag i den svenska häckfågelfaunan i framtiden. För de resterande fyra arterna gäller att de antingen inte modellerades av Barbet-Massin m.fl. (2012) eller att vi bedömer de prognostiserade utbredningarna som felaktiga. Cellernas färger anger den predikterade sannolikheten (0 < p < 1) enligt SDM50 för en framtida förekomst. Notera att sannolikhetsskalorna för arterna är olika. Utbredningskartorna är baserade på Barbet-Massin m.fl. (2012).

In Denmark, 149 bird species were reported as breeding in year 1800. In 1995, the year in which the highest number of species is considered to have bred in Denmark, 178 species bred (Romdal et al. 2013). In 2012, the number of breeding species had decreased to 173 (Romdal et al. 2013). Ottosson et al. (2012) estimated that around 2010, 252 species bred in Sweden. There is no exact figure for Sweden in 1850, but if we take 252 minus the net number of species that established between 1850 and 2009, 227 species should have bred in 1850. This means that the number of species in Denmark increased by 1.5 species per decade between 1800 and 1995, while the increase in Sweden was on average 1.6 species per decade between 1850 and 2010. The similarity in rate is striking given that the countries vary widely in area and habitat. The explanation may partly be that the two neighbouring countries in many cases are affected by the same waves of colonisation.

Establishments 2010–2050

We consider it probable that the Swedish breeding bird fauna will host eleven new species by 2050 (Table 4), with another nine species as possible newcomers (Table 5). These two categories of species are given specific comments below. If we only include the group of probable colonizers this would mean an establishment rate of 2.9 species per decade. The corresponding rate when including also possible colonizers is 5.3 species per decade. In addition to the species treated under *probable* or *possible* establishment, there are another nine species worth mentioning as future breeding birds in Sweden, although the signs for colonization are much weaker than for the first two groups. These ten *conceivable* species are discussed briefly at the end of this section.

It should be kept in mind when reading the next section that SDM50 make the assumption of niche conservatism, and that some species expanding since 50 years like the Mediterranean Gull or the Great White Egret might be expanding also their niches and so their potential distribution, a phenomenon not captured by SDM.

Probable establishments 2010–2050

Little Egret *Egretta garzetta*

The Little Egret is a wetland bird which presently has its closest breeding population to Sweden in the UK, where it first bred in 1996 (Robinson 2005), and in the Netherlands, where it became established in the mid-1990s (Netwerk Ecologische Monitoring 2012). In both countries the species has expanded considerably since then. In Flanders, Belgium it has increased substantially between 2000 and 2007 (Vermeersch & Anselin 2009). Between 1990 and 2007, the Western European population increased by 7.9% annually, while the Central and Eastern European populations were considered stable from 1988 to 1998 (Wetlands International 2012).

Given that the species expands northwards in Western Europe, we consider it likely that it before 2050 will be included in the Swedish fauna. This is despite the fact that the SDM50 does not predict any breeding distribution in Sweden. Also in Denmark it is predicted as a future breeding bird (DOF 2013).

Great White Egret *Casmerodius albus*

The Great White Egret is another wetland species for which SDM50 does not predict any Swedish breeding population (Table 4), but where we for other reasons find a future establishment as highly likely. The species has expanded dramatically in the western and northern part of the European distribution area and now breeds closest to Sweden in Poland and the Baltic states (Ławicki 2014). Over the past 20 years, it has started to breed in no less than 13 European countries (Ławicki 2014). Wetlands International (2012) estimated the annual population growth rate in Europe at 3.9% between 1989 and 2006. In 2002–2012, the number of observations per year in Sweden increased steadily from 15 to 140 (Species Gateway/Bird 2013). In addition, in 2012 the first breeding in Sweden was confirmed on the Baltic island of Gotland (Strid & Eriksson 2013)). Also in Denmark it is forecasted as a future breeding bird (DOF 2013).

Mediterranean Gull *Larus melanocephalus*

The Mediterranean Gull nests in shallow lakes and coastal areas (Cramp 1998). It has expanded to the northwest from southeast Europe since the mid-1950s. It nested for the first time in the UK in 1968. The current British population is estimated to 600–700 pairs (JNCC 2013). In Denmark, the species has been a regular breeder since 1998, and in 2011 the Danish population was estimated at 11–14 pairs (DOF 2013). The species has bred in Sweden at least twice: in 2010 (Blekinge) and 2013 (Halland), on each occasion it was a single pair (Species Gateway/Bird 2013). In addition to that, it has hybridized with black-headed gull *Chroicocephalus ridibundus* a few times.

Table 4. Species that probably will establish themselves as breeders in Sweden before 2050. “Max p” is the highest probability of occurrence in a cell according to SDM50. “Cells > 0.5” is the number of cells with a probability higher than 0.5, and “Cells > 0” is the number of cells with predicted occurrence, all according to SDM50. Population trend data for a number of countries is also shown (see Table 1 for country codes and more detailed information).

Arter som troligen kommer att etablera sig i Sverige fram till 2050. ”Max p” är det högsta sannolikhetsvärdet för förekomst för en cell enligt SDM50, ”Cells > 0.5” är antalet celler som med en sannolikhet överstigande 0.5 förutspår förekomst enligt SDM50, ”Cells > 0” är antalet celler som med en sannolikhet överstigande 0.0 förutspår förekomst enligt SDM50. Trenddata för ett antal länder och regioner visas också (se Tabell 1 för land-/regionsförkortning, tidsspann för trenderna och symbolik).

Species *Art*	Max p	Cells > 0.5	Cells > 0	D	NL	BEVa1	PL	GB	FR	EU
Little Egret *Egretta garzetta*				0	+				0.048	Increasing *Ökande*
Great White Egret *Casmerodius albus*					++				0.324	?
Mediterranean Gull *Larus melanocephalus*				+	++		+		0.192	Stable *Stabil*
European Bee-eater *Merops apiaster*	0.8	11	51	+					0.067	?
Hoopoe *Upupa epops*	0.85	77	110	0			+		-0.059	Declining *Minskande*
Middle Spotted Woodpecker *Dendrocopos medius*	0.7	56	84	+	++	+	+		0.110	Moderate increase *Måttlig ökning*
Nightingale *Luscinia megarhynchos*	0.9	71	104	0	0	+	+	-	-0.014	Moderate increase *Måttlig ökning*
Cetti’s Warbler *Cettia cetti*	0.55	8	21		++			+		Strong increase *Stark ökning*
Booted Warbler *Iduna caligata*										Increasing *Ökande*
Melodious Warbler *Hippolais polyglotta*	0.8	18	33	+		+				Stable *Stabil*
Short-toed Treecreeper *Certhia brachydactyla*	0.85	60	82	0	+	0	-	0		Moderate decline *Måttlig minskning*

Again the SDM50 does not include this wetland species as a future breeder in Sweden, but considering its rapid expansion to the northwest, it is probable that it will establish itself as a breeding bird in Sweden fairly soon.

Middle Spotted Woodpecker *Dendrocopos medius*

The Middle Spotted Woodpecker nested in Sweden until 1982 (Holmbring & Pettersson 1983, Pettersson 1985). The last occurrence was in oak woodlands in Östergötland (southeast central Sweden). However, the SDM50 predicts a widespread occurrence in the southern half of Sweden (Figure 2). In addition, the species has a positive population growth across Europe (Table 4).

This is a deciduous forest specialist traditionally preferring older oak stands (Kosiński & Winiecki 2005, Müller et al. 2009). The absence of sufficiently large areas of suitable breeding habitat has been identified as the main cause of the species’ disappearance from Sweden (Holmbring & Pettersson 1983). Interestingly, a study in Belgium showed that the population increase found there was not primarily explained by the presence of old oak, but the availability of old trees of other broadleaved species (Colmant 2006).

The critical aspect of a re-establishment in Sweden is whether Sweden has enough of the habitats required by the Middle Spotted Woodpeckers. The potential dispersal barrier of the Baltic Sea is another potentially hindering factor. The species is, however, encountered twice in

Table 5. Species that possibly will establish themselves as breeders in Sweden before 2050. "Max p" is the highest probability of occurrence in a cell according to SDM50. "Cells > 0.5" is the number of cells with a probability higher than 0.5, and "Cells > 0" is the number of cells with predicted occurrence, all according to SDM50. Population trend data for a number of countries is also shown (see Table 1 for country codes and more detailed information).

Arter som möjligen kommer att etablera sig fram till 2050. Max p = det högsta sannolikhetsvärdet för förekomst för en cell enligt SDM50, Cells > 0.5 = antalet celler som med en sannolikhet överstigande 0.5 förutspår förekomst enligt SDM50, Cells > 0 = antalet celler som med en sannolikhet överstigande 0.0 förutspår förekomst enligt SDM50 och trenddata för ett antal länder och regioner (se tabell 1 för land-/regionsförkortning, tidsspann för trenderna och symbolik).

Species *Art*	Max p	Cells > 0.5	Cells > 0	D	NL	PL	GB	FR	EU
Little Bittern *Ixobrychus minutus*	0.7	52	62	--	+			0.067	Declining *Minskande*
Night heron *Nycticorax nycticorax*	0.5	1	3	--	+	+		-0.002	Declining *Minskande*
Purple Heron *Ardea purpurea*	0.5	2	12	+	+			0.034	Declining *Minskande*
Black Stork *Ciconia nigra*	0.6	18	69	+		?		0.039	?
Spoonbill *Platalea leucorodia*				+	+			0.181	?
Short-toed Eagle *Circaetus gallicus*	0.65	2	75					0.080	Stable *Stabil*
Lesser Spotted Eagle *Aquila pomarina*	0.5	2	41	0		0			?
Little Owl *Athene noctua*	0.9	76	105	0	-		--	0.031	Stable *Stabil*
Citrine Wagtail *Motacilla citreola*									Increase *Ökande*

southernmost Sweden, in 1989 and 1994 (Cederroth 1996), respectively. These birds had most probably crossed Öresund or the southern Baltic by its own efforts.

European Bee-eater *Merops apiaster*

The Bee-eater occurs in open or sparsely wooded areas (Cramp 1998). It is mainly distributed in the southern half of Europe, but also occurs in isolated populations north of this (Hagemeijer & Blair 1997). The species is increasing in Germany (Table 4) and it is also reported as increasing in Denmark, where it is on the verge of being an established breeding bird (DOF 2013). The Bee-eater has been found nesting on six occasions in Sweden until the late 1990s, with the first nesting record from 1976 (SOF 2002). SDM50 predicts a relatively limited presence in southern Sweden (Fig. 2).

Hoopoe *Upupa epops*

The Hoopoe nests over large parts of Europe and has the closest breeding population in Poland and the Baltic states (Hagemeijer & Blair 1997). It is mainly found near pasture and farmland (Cramp 1998). From 1970 until the mid-1990s it was an almost annual breeding bird in Sweden, with most records from the island of Öland. It is now considered nationally extinct (Swedish Species Information Centre 2011b). The large Polish population of 10 000–15 000 pairs is increasing (BirdLife International 2004), while the German population is stable (Table 4). A widespread occurrence in southern Sweden is to be expected according to SDM50 (Figure 2). Based on SDM50 and the population growth in Poland, we find it likely that the species will (re)establish in Sweden, despite the species' recent poor history in the country.

Nightingale *Luscinia megarhynchos*

The closest breeding populations of Nightingale are found in northern Germany and Poland (BirdLife International 2013). Just like the Thrush Nightingale *Luscinia luscinia* it breeds in lush scrub, but also in drier and more open shrub-dominated habitats (Cramp 1998). The SDM50 predicts a widespread occurrence in the southern parts of Sweden (Figure 2). The trends for individual countries vary, but the weighted European index is positive (Table 4). It is indicated by DOF (2013) to be on expansion in eastern Schleswig-Holstein and they predict a future occurrence in Denmark. Between 1982 and 2013, the Nightingale has increased in numbers also in the Czech Republic (CSO 2013).

Cetti's Warbler *Cettia cetti*

Cetti's Warbler, a non-migratory bird, is found in dense scrub. It has expanded northwards in Europe since the 1920s (Cramp 1998). The species has its closest populations in the UK and the Netherlands. The first breeding in Britain occurred in 1973 (Robinson et al. 2007) and today the population is estimated to about 2000 singing males (Baillie et al. 2013). Population growth in the UK and France seems to be largely controlled by the winter weather since this species is highly sensitive to cold winters (Robinson et al. 2007, Moussus 2010). All trend data for the Cetti's Warbler show an increase (Table 4). SDM50 predicts a limited presence in southern Sweden (Figure 2).

Booted Warbler *Iduna caligata*

The Booted Warbler appears in different types of scrubs (Cramp 1998, Shitikov et al. 2012). It has its main distribution in Russia and Kazakhstan, from where it has expanded to the west and northwest (del Hoyo et al. 2006). Shitikov et al. (2012) indicate that the expansion can be partly explained by the abandonment of agricultural land in parts of Russia. The first confirmed breeding in Finland was in 2000 (Valkama et al. 2011). The species continues to expand in Finland and the population was recently estimated to 10–50 pairs (Valkama et al. 2011). The Finnish distribution is concentrated to the southeast, especially in Karelia, but probable breeding attempts have been reported close to the Finnish west coast. The species was not modelled by Barbet-Massin et al. (2012) but by Jiguet & Barbet-Massin (2013), who predicted an increase in range size and a western range shift.

Melodious Warbler *Hippolais polyglotta*

The Melodious Warbler breeds in deciduous forest habitats (Cramp 1998). The nearest present occurrences are found in south-western Germany and Belgium (Engler et al. 2013). Along much of its northern border it hybridizes with the Icterine Warbler *Hippolais icterina*. This hybrid zone is moving northwards in favour of the Melodious (Secondi et al. 2006, Engler et al. 2013), which is an obvious signal of a large scale range expansion. Trend data from Belgium and Germany show that the species is increasing in numbers in the northern part of its range (Table 4). SDM50 suggests a future presence in southern Sweden (Figure 2).

Short-toed Treecreeper *Certhia brachydactyla*

Unlike its sister species the Treecreeper *Certhia familiaris*, the Short-toed Treecreeper occurs exclusively in deciduous forest (Cramp 1998). Its nearest occurrence is in north-eastern Zealand in Denmark, just across the narrow strait of Öresund (DOF 2013). Population trends across Europe show both growths and declines (Table 4). However, the species is increasing in Denmark, and it seems reasonable that future colonizers will originate from there. The population increase between 1990 and 2000 in Denmark is estimated at 30–50% (DOF 2013). The species has bred in Sweden once, at one site (2006 in Skåne) in a hybrid pair with Treecreeper (Strid 2007). SDM50 predicts a widespread occurrence in southern Sweden (Fig. 2).

Possible establishments 2010–2050

Little Bittern *Ixobrychus minutus*

The Little Bittern occurs in large parts of central and southern Europe. The nearest populations are found in the Baltic countries and Poland (BirdLife International 2013). It occurs in various types of wetlands with surrounding shrub or rows of trees (Cramp 1998). SDM50 predicts a widespread occurrence in Sweden, which should be compared with the relatively contradictory trend data (Table 5). Wetlands International (2012) notes that population trends in most Western European countries are either stable or increasing, but declining in the rest of Europe. However, the underlying data is generally of low quality.

Night Heron *Nycticorax nycticorax*

Night Herons breed at the closest in the Netherlands and southern parts of Poland and Germany (BirdLife International 2013). It occurs in similar environments as the Little Bittern. Trend data show both population increases and decreases (Table 5). Wetlands International (2012) classifies the European population as generally increasing. SDM50 predicts a very limited presence in southern Sweden.

Purple Heron *Ardea purpurea*

Purple Herons nest primarily in large wetlands with extensive reedbeds (Cramp 1998). They occur in large parts of southern and central Europe. The current northern boundary extends across the Netherlands, central Germany and Poland (BirdLife International 2013). Generally, population trends are positive in Western Europe, but declining in Europe overall (Wetlands International 2012 and Table 5). SDM50 predicts a limited presence in southern Sweden.

Black Stork *Ciconia nigra*

This species is found primarily in older forests with wetlands (Cramp 1998). The nearest area where the Black Stork breeds is in the Baltic countries and Poland (BirdLife International 2013). It nested regularly in Sweden during the 1800s, but ceased as a regular breeding bird in the first half of the 1900s. There are occasional records of breeding from the early 2000s (Swedish Species Information Centre 2011c). Wetlands International (2012) indicates that the western population is increasing, but the Eastern European is declining. The Estonian population is estimated to have halved from the late 1970s to early 2000s (Lõhmus & Sellis 2003). SDM50 predicts a relatively common occurrence in predominantly central Sweden.

Spoonbill *Platalea leucorodia*

This species occurs in shallow wetlands with muddy or sandy bottoms. It accepts both saline and freshwater habitats (Cramp 1998). Spoonbills nest as close as in Denmark, where the population has increased from 2 pairs in 1996 (Grell 1998) to 101 pairs in 2011 (DOF 2013). Between 1990 and 2006 the populations in the western Mediterranean and Western Europe have increased by 15% annually, while the Central and Eastern European occurrences show a moderate decline (Wetlands International 2012). The species is now seen annually in Sweden but normally only single individuals (Species Gateway/Bird 2013). SDM50 predicts no presence in Sweden.

Short-toed eagle *Circaetus gallicus*

The Short-toed Eagle has its closest and most northerly occurrence in the Baltics where it occurs sparsely. It occurs in large parts of Central and Eastern Europe, but is almost absent in Western Europe (Hagemeijer & Blair 1997). In the northern part of its range it occurs in areas with a mosaic of forest and open land (Cramp 1998). Little is known about population trends, but the weighted European index suggests a rather stable population (Table 5). The species is currently expanding northwards in France. Single individuals are found every year in Sweden, especially in summer and autumn, indicating that the Baltic Sea should not pose any serious dispersal barrier. SDM50 predicts a limited presence in southeastern Sweden.

Lesser Spotted Eagle *Aquila pomarina*

This species occurs in Central and Eastern Europe, including the Baltic countries (Hagemeijer & Blair 1997). The species prefers forest habitats that are broken up by open land (Cramp 1998). In 1991–1997 the Estonian population was estimated to 480–600 pairs (Lõhmus & Väli 2001). These authors believe that the population grew rapidly in the 10–20 years prior to the study. The explanation they put forward is that the species increasingly began to use human-influenced environments such as agricultural land in search of food. Little is known about the species' population dynamics, but there is no information that indicates dramatic changes (BirdLife International 2013). Single pairs recently bred in France and even Spain. The species occurs regularly in Sweden, in summer and autumn. SDM50 predicts a restricted population in east central Sweden.

Little Owl *Athene noctua*

The Little Owl prefers open land, and in the northern part of its range in nests in areas with agricultural land, often in farm houses (Cramp 1998). Its northernmost outpost is in Denmark, where the population is declining. Between 1970 and 2011 the breeding population has decreased from over 1000 pairs (Andersen et al. 2013) to 55 pairs (DOF 2013). During the last two centuries only occasional breeding records were confirmed in Sweden, the last in the late 1930s and early 1940s (SOF 2002). The trends for individual countries show either stable or declining populations, whereas the pan-European index indicates stability (Table 5). SDM50 predicts a widespread occurrence in the southern third of Sweden.

Citrine Wagtail *Motacilla citreola*

The Citrine Wagtail has its main distribution in Russia, but from there it has expanded westwards (Hagemeijer & Blair 1997). The species now nests regularly, albeit in low numbers, in most of the Baltic Sea countries and it increases in numbers (BirdLife International 2004). Between 2003 and 2012, about 12–27 Citrine Wagtails were observed annually in Sweden (Species Gateway/Bird 2013).

Since then, a first pure breeding was confirmed in Södermanland (south Central Sweden) in 2013, followed by another one in Uppland 2014 (Species Gateway/Bird 2014). In addition, several hybridizations with Yellow Wagtail *Motacilla flava* have been recorded (Species Gateway/Bird 2013).

Conceivable establishments 2010–2050

In this category we put ten species or subspecies that, for various reasons, we can imagine as future breeding birds of Sweden. In general the level of uncertainty is higher than for the two previous categories.

Red-creasted Pochard *Netta rufina*
The species has its nearest breeding distribution in Denmark, where the population in 2011 was estimated at eight pairs (DOF 2013). The European population, not including the eastern Mediterranean area, showed a positive growth between 1997 and 2007 (Wetlands International 2012). In 2012 a pair nested in Lake Tåkern, Östergötland, which was the first confirmed breeding in Sweden (Species Gateway/Bird 2013).

Fulmar *Fulmarus glacialis*
The nearest breeding occurrence of Fulmars is found in southern Norway. Within Norway the population trends varies, but stocks in southern (Vest-Agder) and southwestern Norway (Rogaland) show recent significant increases (SEAPOP 2014). Over the past 25 years, occasional nesting attempts occurred in Denmark (DOF 2013). The species appears to increase in several European countries, but not in the UK (BirdLife International 2004). On the Swedish west coast down to northern Skåne the species occurs fairly frequently mainly in autumn, but no observations indicating nesting have been reported (Species Gateway/Bird 2013).

Gannet *Morus bassanus*
The closest breeding sites to Sweden are in Norway and Germany (BirdLife International 2004). Population sizes are increasing in all Western European countries where it occurs (BirdLife International 2004). Given that the species now is frequenting Swedish waters, especially off the West Coast, during most of the year (Species Gateway/Bird 2013), it is not unreasonable that there will be establishment trials in Sweden. The lack of obvious suitable nesting cliffs may be a limiting factor, but it should be noted that the species has established colonies also on small low islets with bare rocks (c.f. Barrett 2008), a habitat present on the Swedish west coast.

Pallid Harrier *Circus macrourus*
This species has its main distribution in Russia where it has declined relatively sharply (BirdLife International 2013). Despite this, several nests and nesting attempts were reported in Finland during the 2000s, where it is said to be increasing (Valkama et al. 2011). In Sweden, the annual numbers of observed Pallid Harriers during 2009–2012 varied been between 42 and 200. In 2011, in the border regions of Jämtland and Lapland (northwestern Central Sweden), a summer record of a juvenile suggested a successful nearby breeding.

Little Crake *Porzana parva*
The Little Crake occurs over much of Europe and breed regularly in all the countries around the Baltic Sea, apart from Sweden (Bird Life International 2004). The populations are said to decrease somewhat. The number of records in Sweden has varied between zero and 5 in 1998–2012 (with an average of 2.6; Species Gateway/Bird 2013).

Black-winged Stilt *Himantopus himantopus*
The Black-winged Stilt occurs over much of Europe and breeds at its closest in Poland and Germany (BirdLife International 2004). Occasional nest records have been made in Denmark (DOF 2013), the last in 2013 (DOFbasen 2014). The European population is considered stable (Wetlands International 2012).

Marsh Sandpiper *Tringa stagnatilis*
This species has an eastern distribution in Europe and the majority of the population breed in Russia. Marsh Sandpiper breeds in several countries around the Baltic Sea, but in small numbers (BirdLife International 2004). The number of records in Sweden increased from 1985 to the mid-2000s and then decreased slightly. Between 2008 and 2012, the number of annual records has varied between 15 and 26 (Species Gateway/Bird 2013). The first breeding in Sweden was recorded in 2000 and after that there have been a few more nesting attempts (Species Gateway/Bird 2013).

Caspian Gull *Larus cachinnans*
The Caspian Gull has a south-eastern distribution in Europe (BirdLife International 2013). The nearest breeding population, as far as we know, is in central Poland, where it is found in various types of inland waters. In Poland the first nesting sites

were found in 1981 and it has since expanded considerably (Neubauer et al. 2006). Between 1997 and 2004 the annual population growth in Poland was estimated to 33% and in 2004 as many as 480 pairs bred (Neubauer et al. 2006). In 2007, 800 pairs breed in Poland (Gwiazda et al. 2011), and it is predicted that the population will continue to increase (Gwiazda et al. 2011). The number of records has increased significantly in Sweden in recent years. In 2012 as many as 1200 records were made in Sweden, ten of which were ringed in Poland (Species Gateway/Bird 2013). To what extent this increase is due to an actual increase in numbers or that the bird watchers learned to better identify the species, is unclear. There are no breeding records of this species in Sweden.

White-spotted Bluethroat *Luscinia svecica cyanecula*
White-spotted Bluethroats occur across Central and Western Europe, where it breeds in reedbeds, scrub areas and crop fields (Hagemeijer & Blair 1997), a strikingly different habitat preference to that of the nominate subspecies, *Luscinia s. svecica*, which breeds in subalpine birch forests and alpine willow areas. The West European population of *L. s. cyanecula* is presently increasing in numbers (BirdLife International 2004). In 1992 the first breeding record of White-spotted Bluethroat in Denmark in about 100 years was recorded. In 2007 the Danish population was estimated at 105 pairs (DOF 2013). However, over the past decade this subspecies has not even been encountered yearly in Sweden (Species Gateway/Bird 2013).

Lanceolated Warbler *Locustella lanceolata*
The Lanceolated Warbler is another eastern warbler that has expanded westwards in Europe the last decades, from breeding grounds near the Ural Mountains (Hagemeijer & Blair 1997). It has been predicted by Jiguet & Barbet-Massin (2013) to start breeding in northernmost Sweden until year 2100. There has been a slow increase in the numbers recorded in Finland, with 12 singing males in 2014 (Tarsiger 2014). In Sweden there are so far only four singing males recorded, but indeed, all have been found in the northern half of the country (Species Gateway/Bird 2013). There are no breeding records yet in either Sweden or Finland.

Establishment of new species in 1850–2050

Given that our estimates of future establishments are reasonably accurate, the rate of establishment will increase substantially. In 1850–1969, 2.3 new species per decade were established in Sweden, and from 1970 to 2009, the figure was 2.5 species per decade. The forecast for 2013–2050 is 2.9 new species per decade (based on probable colonizers) or 5.3 (based on probable and possible colonizers). An increased immigration rate of new species into northern Europe can indeed be expected (Barbet-Massin et al. 2012). However, the models used by Barbet-Massin et al. (2012) to create future distributions have their potential limitations. Obviously, the birds must be able to reach the new suitable areas. For example, montane and relatively sedentary birds of central Europe must cross vast stretches of lowland to reach the Scandinavian mountains.

Further, the expansion of a species into new areas may potentially lead to competition between species that have not co-existed before, something the models did not take into account. There are three potential scenarios: 1) stable coexistence (which the Barbet-Massin et al. models assume), 2) the colonizing species does not manage to establish itself, or 3) the colonizing species out-compete the established species. Accordingly, the future number of species in a given area may be overestimated.

Extinctions 2010–2050

We here choose a different approach compared to that used in the analysis of potential future species when presenting the results. Instead of categorizing species in different classes (for example, probably or possibly extinct in 2050), we treat a number of species individually. We first look at the SDM50 that predict extinction and then we discuss the species that today are most threatened in Sweden. Although history speaks against us, it is not obvious that any species will disappear from the Swedish breeding avifauna by 2050. The reason is that conservation measures will be taken for many of the most threatened species. The taxa we consider most at risk of extinction are the Lesser White-fronted Goose *Anser erythropus*, the Baltic Dunlin *Calidris alpina schinzii*, the White-backed Woodpecker *Dendrocopos leucotos* and the Tawny Pipit *Anthus campestris*.

Extinctions according to SDM50

According to the SDM50, eight species are threatened with extinction by the year 2050. However, we find it unlikely that any of them would be extinct in Sweden within the period. Of the eight species, five are closely tied to water (see Method for the problems associated with forecasts for these species): Great Cormorant *Phalacrocorax carbo*, Barnacle goose, Avocet *Recurvirostra avosetta*, Sandwich Tern *Sterna sandvicensis* and Little Tern *Sternula albifrons*. The first three species have expanded in Sweden during the last decades (Ottosson et al. 2012), as they have done over large parts of Europe (BirdLife International 2004), and we see no reason for the populations to collapse. The Avocet, for example, has since the mid-1940s increased its population in Western Europe fivefold (Hötker & West 2005).

The latest estimate of the Swedish population of Sandwich Tern is 460 pairs (Ottosson et al. 2012). The European population is considered to be stable (BirdLife International 2013) and in the Netherlands, which holds a large proportion of the European population, there has been a moderate increase between 1990 and 2011 (Netwerk Ecologische Monitoring 2012). In contrast, the Sandwich Tern has decreased with more than 20% in Germany between 1980 and 2005 (Südbeck et al. 2007). In Sweden the population halved between 1975 and the late 1990s, but then stabilized at 400–500 pairs (Swedish Species Information Centre, 2011d). Overall, we estimate that the future of the Sandwich tern in Sweden is uncertain, but we believe it is quite unlikely that the species is extinct in Sweden in 2050.

The Little tern breeds with some 500 pairs in Sweden (Ottosson et al. 2012), and the population appears to have been stable since the early 1970s (see Swedish Species Information Centre 2011e). Although the European population as a whole declined slightly between 1970 and 2000, it seems as if the populations in countries close to Sweden, with the exception of Poland, are stable (BirdLife International 2004).

The other three species which according to the models are predicted to disappear are Bar-tailed Godwit *Limosa lapponica*, Collared Flycatcher *Ficedula albicollis* and Arctic Redpoll *Carduelis hornemanni*. In Sweden there are about 200 pairs of Bar-tailed godwit breeding. They nest in the willow zone of the montane tundra and the species has slowly increased in both distribution area and numbers (Ottosson et al. 2012). We find it unreasonable that the habitat which Bar-tailed Godwit is connected to would be missing in already 35 years. There is also no trend data that show a decrease in northern Europe. On the contrary, the population has increased by 1.4% annually between 1989 and 2007 (Wetlands International 2012).

The Collared Flycatcher *Ficedula albicollis* is another species that SDM50 predicts to disappear from Sweden, but this seems highly unlikely given the current situation. Collared Flycatcher has its main distribution in Central Europe. From Poland we have no population trend data, but in the Czech Republic it increases in numbers (CSO 2013). Also in the joint trend for Europe it is increasing (BirdLife International 2013). And last but not least, the species is currently expanding in Sweden. For a long time it only bred on Gotland, but it is now established also on Öland, where it is increasing in numbers (Ottosson et al. 2012). However, its African wintering distribution is predicted to become greatly reduced in the 21st century as a result of climate change (Barbet-Massin et al. 2009).

The Arctic Redpoll is a rare breeder on montane tundra and in the upper mountain forest in northernmost Sweden. The population size and dynamics are poorly known, with an uncertain population estimate of some 3800 pairs (Ottosson et al. 2012). As far as known the populations in northern Fennoscandia and Arctic Russia remained stable between 1970 and 2000 (BirdLife International 2004). As in the case of Bar-tailed Godwit, we do not envision that the habitats utilized during the nesting season would be threatened already before 2050.

Critically Endangered species

Not surprisingly, the species treated in this section are those who are already recognized as threatened in Sweden. The species discussed below comprise the six taxa that are categorized as Critically Endangered (CR) in the Swedish Red List (Gärdenfors 2010) and one species, Tawny Pipit *Anthus campestris*, which is classified as Endangered (EN).

Lesser White-fronted Goose *Anser erythropus*

The Swedish population was estimated at 15–25 pairs in 2010. In Fennoscandia there were another 15–20 pairs, all in northern Norway (County Administrative Board of Norrbotten 2011). Since then, the Swedish population has declined, and the current population is estimated to 8–12 pairs (N. Liljebäck, pers. comm). The Swedish population is derived largely from the reinforcements made in 1981–1999 (County Administrative Board of Norrbotten 2011), and subsequently in 2009–2014. It therefore seems likely that the species today would have been extinct if it was not for these active measures. The Lesser White-fronted Goose has declined dramatically in many parts of its range (BirdLife

International 2013), which means that the Swedish population is considered an isolate. Considering this and the very low numbers, the species' future in the country is for the foreseeable future dependent on conservation measures.

Baltic Dunlin *Calidris alpina schinzii*

The Baltic dunlin, which was previously common in southern Sweden, has declined in numbers dramatically. Between 1990 and 2000, the Swedish population decreased by 33% and between 2000 and 2008 with a further 50–60%. In 2008 the Swedish population was down to 100 pairs, with 61 pairs on Öland (Swedish Species Information Centre 2012b). It persists today only in grazed coastal meadows. A sensitivity analysis for the breeding population of Öland stock showed that it would most likely disappear within 24 years (Betzholtz et al. 2010). It has also been shown that the small populations that exist along the Swedish West Coast are threatened by genetic depletion (Blomqvist et al. 2010). The subspecies also decreases sharply in Germany (Südbeck et al. 2007) and Denmark (DOF 2013) and it is also in decline in Poland (Chodkiewicz et al. 2013). We believe there is a real risk that this subspecies will be extinct in Sweden before 2050.

Black-tailed Godwit *Limosa limosa*

Black-tailed Godwit numbers have fallen sharply in Sweden and in 2009 the Swedish population was estimated to 90 pairs, with 33 pairs on Öland (Swedish Species Information Centre, 2011f). During censuses on Öland in 2013, 53–55 pairs were found (R. Ottvall, personal communication). There is evidence that populations outside Öland have decline further since 2009 (R. Ottvall, personal communication). The species also decreases in Europe as a whole (Wetlands International 2012). The action plan developed by the EU to improve the situation of Black-tailed Godwit indicated habitat deterioration in breeding areas as the single most important factor for the European population decrease (European Commission 2007). Given that member states comply with the recommendations given by the European Commission (2007), there should be a future for the Black-tailed Godwit in Sweden.

Barn Owl *Tyto alba*

Ottosson et al. (2012) estimated the Swedish population to 10 pairs with most pairs on Gotland. It occurs in open cultural landscape where it nests in barns and similar buildings. Cold winters can reduce the population significantly (Ottosson et al. 2012). The little stock in itself puts the species at high risk of extinction. What speaks against that the barn owl will disappear from Sweden is that the species at present is increasing in Denmark (DOF 2013), Germany (Südbeck et al 2007) and the Netherlands (Netwerk Ecologische Monitoring, 2012). The population rise in Denmark is explained by large amounts of nest boxes being offered in recent years (DOF 2013). Lack of nest sites is often given as an explanation for the species decline in some areas (Swedish Species Information Centre 2012c). Local groups of conservationists in southernmost Sweden now follow the Danes' example and put out nest boxes, but so far without any measurable results.

Snowy Owl *Bubo scandiacus*

The Snowy Owl has a circumpolar distribution. Its population density in a given area fluctuates with the occurrence of lemmings, which forms the species staple food during the breeding season (Cramp 1998). In Sweden it has been found breeding in single years since the early 1970s, most recently in 2011 when three nests were documented. In 1978 several hundred pairs bred in the Västerbotten and Norrbotten mountains (Swedish Species Information Centre, 2012d). Climate change may pose a future threat. Gilg et al. (2009) showed that the forecasted future warmer summers in the arctic environment may make lemming peaks less pronounced, that they will occur less often and that they may even be terminated. The future status of the Snowy Owl in Sweden remains uncertain.

White-backed Woodpecker *Dendrocopos leucotos*

This rare woodpecker has declined dramatically in numbers due to the decreasing number of old deciduous trees in the forests (Swedish Species Information Centre 2011g). The confirmed number of breeding pairs in Sweden was one in 2012 (Strid & Eriksson 2013) and two in 2014 (M. Svensson pers. comm.), respectively. A species conservation project currently conducts active steps to recreate suitable habitat and release captive-bred individuals (Stighäll 2011). Without continued conservation measures there is an obvious risk that the species will very soon cease to exist as a breeding bird in Sweden.

Tawny Pipit *Anthus campestris*

The Tawny Pipit is linked to sandy heaths and coastal dune areas in Sweden. It has declined sharply in both Sweden and much of Western Europe (BirdLife International 2004). The species' distribution in Sweden in recent years has been limited to Skåne and Halland (Ottosson et al. 2012). However, no breeding birds were found in Halland in 2012-2014, despite active search (Species Gateway/Bird 2014). In Skåne, the number of known territories declined from 210 to 42 between 1983 and 2008 (Bergendahl 2009). Overgrown coastal sand dunes have been identified as a reason for the sharp decline in Sweden. Restoration of such areas can certainly benefit the Tawny Pipit, but considering that the sharp decline in Sweden goes hand in hand with a greater geographic reduction, there is an obvious risk that the species will disappear from the Swedish fauna.

Of the seven taxa for which we believe there is a clear risk of extinction in Sweden until 2050, three are the subject of specific conservation measures, where captive breeding and assistance with nest sites is included. The future of these species is probably largely dependent on how enduring and successful these projects will be.

For the Lesser White-fronted Goose, Baltic Dunlin, White-backed Woodpecker and the Tawny Pipit the future in Sweden looks particularly uncertain.

Establishment of species not naturally occurring in Europe – alien species

The species discussed above all have their natural occurrence in Sweden or Europe. Below we discuss the potential establishment in Sweden of some escaped or introduced species established in Europe, which may begin to breed regularly in Sweden. We make no attempts to analyze the consequences of such establishments, but only present the species that may establish a breeding population in Sweden.

Egyptian Goose *Alopochen aegyptiaca*

This species originally breeds in Africa. The European population of Egyptian Goose originate from individuals that escaped from captivity. In Europe it has its stronghold in the UK, Belgium, Netherlands and Germany (BirdLife International, 2013). The breeding population in the UK is estimated at 1,100 pairs (Robinson 2005; updated December 2013), in Germany to between 2200 and 2600 pairs (Bauer and Woog, 2008) and in the Netherlands, where the first breeding was confirmed in 1967, to 10 000 pairs (Gyimesi & Lensink 2012). In Denmark the species bred at 7–8 sites in 2009 (DOF 2013). The total estimate for Western Europe is >26 000 pairs (Gyimesi & Lensink 2012). The rapid population growth in the Netherlands probably depends on the ample supply of fresh water adjacent to grasslands, a preferred habitat combination (Gyimesi & Lensink, 2012).

The first reported sighting of Egyptian Goose in Sweden is from 1999 (Species Gateway/Bird 2013). The first confirmed breeding was made in Skåne 2004. Subsequently, two additional breedings were confirmed (in 2006 and 2008; Species Gateway/Bird 2013). According to the same source, the numbers of spontaneous reports have decreased since the peak year of 2007. If this is due to a true reduction in birds present in Sweden or a reduced willingness to report the species is unclear. Sweden undoubtedly harbours suitable habitat to be colonized by Egyptian Goose. Whether this will happen depends on the actions performed in Sweden and Europe to prevent further expansion of the species. Notably, the exponential increase in the number of breeding pairs that have taken place in several countries after the species first was found nesting (Gyimesi & Lensink, 2012) did not occur in Sweden.

Mandarin Duck *Aix galericulata*

Since the males have a very spectacular appearance, the species has long been a popular bird in parks. The species is considered to be established as a breeder in sex European countries (van Kleunen & Lemaire 2014). The population in the UK, which is Europe's largest, was estimated in 1988 to 2300 pairs (Robinson 2005). According to NNSS (2014) it is likely that the population has increased since then. Also in Germany the species expands (Bauer & Woog 2008).

Since the early 2000s there have been around 30–60 records of Mandarin Duck yearly in Sweden and nearly every year occasional breeding attempts have been reported (Species Gateway/Bird 2013). As far as we know there are no measures taken in Europe to prevent a further spread of the species, which at least partly can be explained by the notion that the ecological risks associated with the establishment of the species are low (Owen et al. 2006). Given that no action is taken against an establishment of Mandarin Duck in Sweden or elsewhere, it seems likely that the species will become established at least on a small scale. However, since the species has been found in low numbers in Sweden for at least 15 years without any significant increase reported, there will probably not be a dramatic expansion of this species.

Ruddy Duck *Oxyura jamaicensis*
The Ruddy Duck breeds in several Western European countries, but only in larger numbers in the UK (Hagemeijer & Blair 1997). The whole of the Western European population is probably derived from seven individuals who were brought to the UK in 1948 (Munoz-Fuentes et al. 2006). The Ruddy Duck is a major threat to the European sister species the White-headed Duck *Oxyura leucocephala*. Because of this threat, intensive campaigns to minimize the number of Ruddy Ducks in Europe are in action (Hughes et al. 2006).
The years of 2003 and 2004 were the peak year in terms of the number of observations in Sweden, when six and nine individuals were reported (Species Gateway/Bird 2013). In the early 2000s even a few nesting records were made. Between 2009 and 2012, no observations were reported (Species Gateway/Bird 2013). The efforts made in Europe to minimize the number of Ruddy Ducks have possibly influenced the situation in Sweden and it presently seems unlikely that the species will establish itself in Sweden.

Rose-ringed Parakeet *Psittacula krameri*
The European populations descend from escaped individuals. The species is now well established in several southern and western European countries, where it is mainly found in parks in urban environments, and it is expanding (DAISIE 2009). The nearest occurrences are found in Germany, the Netherlands and the UK. The number of records has increased in Denmark, and it is not unlikely that the species will become established in the Copenhagen area (DOF 2013).

During the 2000s, only a handful of records have been made in Sweden (Species Gateway/Bird 2013). We do not find it likely that the species will become established in Sweden in the foreseeable future, but if it does establish in Copenhagen, future establishment in Sweden cannot be excluded.

Conclusion

Following a slow and steady increase in the number of bird species since the last ice age (Ericson & Tyrberg 2004), the number of species in the Swedish avifauna has increased continuously also from 1850 until today. During this period many species have been lost, but the number of new species established was three times as many. In addition, the rate of turnover has been rather constant during the 160 years considered, which is remarkable given the powerful changes occurring in the environment during all these years.

A significant part of this report aims at forecasting the future bird species establishments and extinctions in Sweden. We have strived to make this as objectively as possible, based on habitat and climate-based models and recent information from surrounding countries. We categorized the potential newcomers into three categories: probable, possible and conceivable. The placement of a species in a given group can of course be discussed. But the overall picture is not altered by that, or by different conclusions about some threatened species. Also in coming decades, the number of establishments will most likely exceed the number of extinctions. As mentioned earlier, there are indeed reasons to assume that the number of species in Sweden will increase at an accelerating rate due to global warming (Thuiller et al. 2005, Barbet-Massin et al. 2012).

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Sammanfattning

Utarmningen av arter på jorden, både globalt och regionalt är en stor fråga inom naturvården. Vi presenterar här vilka fågelarter och fågelraser som mellan 1850 och 2009 antingen nyetablerat sig i den svenska häckfågelfaunan eller upphört att vara svenska häckfåglar. Dessutom försöker vi förutsäga framtida etableringar och utdöenden fram till år 2050.

Vår analys av nytillkomna och utdöda arter är gjord för två tidsperioder. För perioden 1850–1970 förlitar vi oss helt på den analys som gjordes av Järvinen & Ulfstrand (1980). För perioden 1970–2009 har vi sammanställt information från olika svenska fågelfaunistiska källor, inte minst Ottosson et al. (2012).

Vad gäller förutsägelserna för tiden fram till 2050 grundar vi oss på resultat från olika modeller (s.k. Ecological Niche Models eller Species Distribution Models). Dessa modeller bygger på att man utefter en arts miljö- och klimatkrav *idag* försöker förutsäga var artens utbredningsområde kommer att ligga i *framtiden*, givet att klimatet och miljön förändras i en viss riktning. De modellvärden vi har för Sverige kommer från studien av Barbet-Massin et al. (2012). I korthet kan deras metod beskrivas enligt följande: med utgångspunkt från ett ornitologiskt uppslagsverk (BWPi 2006) digitaliserades och koordinatsattes utbredningsområdena för 409 i Europa häckande fågelarter (havsfåglar exkluderade). Upplösningen var på 0,5° longitud och latitud (0,5° latitud motsvarar ungefär 55 km). Åtta variabler (även här med upplösningen 0,5°) som beskriver det nutida klimatet hämtades från Climate Research Unit (http://www.cru.uea.ac.uk/data). Habitatuppgifter (nio habitatstyper, upplösning 0,5°), såväl nutida som framtida (år 2050), kom från IMAGE 2.4 modellen (MNP 2006). Författarna modellerade själva det framtida klimatet. Detaljer om detta finns i ursprungspublikationen (Barbet-Massin m.fl., 2012).

Utöver modellresultaten använde vi också aktuell information från våra grannländer om arter som minskar eller ökar i antal och utbredning (Tabell 1). Informationen från de båda källorna sammanvägdes när vi slutligen uppskattade de enskilda arternas sannolikhet för etablering eller utdöende i Sverige.

Mellan 1850 och 1969 etablerade det sig 28 arter/raser i Sverige (Järvinen & Ulfstrand, 1980), medan det försvann nio arter. Detta kan jämföras med de tio arter/raser som tillkom och de tre arter som dog ut under den efterkommande perioden 1970–2009 (Figur 1, Tabell 2). Det innebär att etableringstakten var 2,3 (1850–1969) respektive 2,5 (1970–2009) arter/raser per decennium. Utdöendetakten, 0,75 arter/raser per decennium, var identisk de två perioderna emellan (Figur 1, Tabell 3). Generellt överstiger alltså antalet nyetablerade fågelarter i Sverige trefalt antalet utdöda arter under perioden 1850–2009. Vi fann inga uppenbara mönster med avseende på invandringsvägar och habitatspreferenser hos de arter som etablerade sig mellan 1970 och 2009.

Framtidsscenariot sträcker sig fram till år 2050.

Fram till dess anser vi det *troligt* att elva nya arter/raser etablerar sig (Figur 2, Tabell 4). Dessa arter är silkeshäger, ägretthäger, svarthuvad mås, biätare, härfågel, mellanspett, sydnäktergal, cettisångare, stäppsångare, polyglottsångare och trädgårdsträdkrypare. För ytterligare nio arter/raser anser vi det *troligt* att de etablerar sig (Figur 2, Tabell 5). Dessa arter är dvärgrördrom, natthäger, purpurhäger, svart stork, skedstork, ormörn, mindre skrikörn, minervauggla och citronärla. Beaktas endast de troligt tillkommande arterna innebär det en framtida etableringstakt på 2,9 arter per decennium. Inkluderas även gruppen av möjligt tillkommande arter hamnar etableringstakten på 5,2 arter per decennium. Om vår prognos ligger hyggligt rätt kommer etableringstakten således att öka under de nästkommande decennierna. Det skulle i så fall vara i linje med andra, mer geografiskt storskaliga analyser som bland annat predikterar att den globala uppvärmningen kommer att resultera i ökad invandring av arter till nordliga områden (Huntley et al. 2007, Barbet-Massin et al. 2012). De totalt sju arter/raser som enligt oss riskerar att dö ut innan år 2050 är samtliga sådana som idag klassificeras som akut eller starkt hotade på rödlistan. Arterna/raserna är fjällgås, sydlig kärrsnäppa, rödspov, tornuggla, fjälluggla, vitryggig hackspett och fältpiplärka. Flera av arterna ingår i åtgärdsprogram och framtiden för dessa arter är till stor del beroende av hur framgångsrika bevarandeåtgärderna är.

Vi analyserar också sannolikheten för invandring av fyra främmande arter, som från ett svensk perspektiv är relevanta att belysa, nämligen nilgås, mandarinand, amerikansk kopparand och halsbandsparakit. Av dessa är det endast nilgåsen som vi anser ha potential att etablera sig i nämnvärda numerärer.

Våra prognoser är självfallet behäftade med stor osäkerhet. Trots detta känner vi oss övertygade om att mönstret från 1850–2009 kommer att upprepas under de närmaste decennierna, det vill säga att antalet nyetablerade arter klart kommer att överstiga antalet utdöenden.

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Fluctuations and trends in the numbers of staging waterbirds in south Sweden in September 1973–2013

Fluktuationer och trender hos rastande sjöfåglar i södra Sverige i september 1973–2013

LEIF NILSSON

Abstract

Regular September counts of staging waterbirds have been undertaken annually in south Sweden since 1973 as a complement to the International Midwinter Counts undertaken in January each year since 1967. The September counts aim to cover the population development of staging waterbirds, especially relating to species that are not wintering in the country. Between 150 and about 200 sites have been included in the calculation of the September indices, using the TRIM method. September indices were calculated for 18 species. The trends over the entire 41-year period were significantly increasing for all but five species (*Anas platyrhynchos, Somateria mollissima* and *Mergus serrator* decreasing, whereas *Podiceps cristatus* and *Fulica atra* did not show any clear long-term trend). The September indices were in good agreement with the International Midwinter Counts and the winter counts of the Swedish Bird Survey, but much less well with migration counts at Falsterbo and breeding season counts of the Swedish Bird Survey. For the last ten years of the series, six species showed a significantly increasing trend, whereas four species decreased.

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Introduction

In the mid-sixties it was realised that a coordinated international effort was needed to monitor population size and trends of waterfowl, and the location and importance of their staging and wintering areas. This led to the organization of the International Waterbird Census (IWC) with the first International Midwinter Count in January 1967 (Atkinson-Willes 1969). January was chosen for the census as the waterfowl are generally most concentrated during the winter, most of them in addition staying in the more densely populated regions of Europe, where the chances to recruit enough counters were relatively good. Sweden has taken part since the start of the counts (Nilsson 1975, Nilsson 2008).

Even if the January counts are the most suitable for monitoring the total population sizes on a continental scale they do not reflect the use of different sites in different countries during other times of the year, when important local concentrations may occur. Some countries like the UK (Austin et al. 2014, Owen et al. 1986) and the Netherlands (Hornman 2013) undertake monthly counts annually to cover this aspect. In Sweden, monthly counts were run at about 120–200 sites annually during 1959/1960–1974/1975 (Nilsson 1968, 1976).

International counts in November, March and September were introduced in 1969–1976 as a complement to the midwinter counts (Nilsson 1977, 1980a, 1980b). In Sweden, only the September counts, started in 1973, were kept to cover the changes and trends in the autumn staging populations (Nilsson 1980a). The geese were covered in a special project, see Nilsson (2013a).

In the present contribution I will analyse the first forty-one years of September counts of waterbirds in south Sweden. The main emphasis will be on the changes in numbers and especially to establish whether there are any significant trends in these populations. September indices for important waterfowl species have regularly been published in the annual reports and on the homepage of the project: http://www.zoo.ekol.lu.se/waterfowl/index.htm).

Material and Methods

The International Waterbird Counts in Sweden as in the other countries rely on voluntary counters, which cover one or more counting units at the specified dates. Volunteers were originally recruited by contacting large numbers of bird watchers and other people that could be interested, but also via local bird clubs, bird magazines etc. In this way a network of observers was built up, some sites being covered by one or a few observers, whereas bird clubs or other groups of counters together covered other areas. The national September counts are organized in the same way as the International Midwinter Counts (cf. Nilsson 2008 and references therein).

The September counts cover a subset of the sites and reference areas used in the midwinter count. During the first years of the midwinter counts, the observers freely selected the sites to be covered but from 1986/1987 the counts for index calculations were standardized and a representative selection of larger coastal and inland areas (reference areas) was covered each year to give the basis for index calculations. These areas were built up of a number of smaller counting units, which were counted separately. In addition to the reference areas, counts from smaller sites spread over the country were also collected for the index calculations. About 20–25 percent of the midwinter sites are included in the September counts.

The September counts are organized on the weekend with the Sunday closest to 15 September. The week after is used as reserve period in case of bad weather conditions during the main counting date.

During the shore-based counts the observer covered the counting sector(s) either by walking the shore line or from vantage points using telescope, moving between vantage points as fast as possible to minimize the effects of movements of the birds. The counting sectors were normally covered within the same day.

Population trends were calculated using TRIM (TRends and Indices for Monitoring data; Pannekoek & van Strien 2001), a statistical package developed especially for monitoring data of the kind we have. TRIM analyses time series of counts with missing observations using Poisson regression taking serial correlation and over-dispersion into account. We used the ”time-effect model” to estimate overall trends as well as yearly indices. For more information, see Pannekoek & van Strien (2001). The index value was set to 1 for the year 2000. Trends were calculated both for the whole forty-one year period (called long-term trend) and for the most recent ten years (called short-term trend).

The number of sites covered in different years during the September counts is shown in Table 1.

Table 1. Number of sites covered at the September counts in different years, 1973–2013.
Antal lokaler inventerade vid Septemberinventeringarna under olika år, 1973–2013.

Year *År*	Total number of sites counted *Antal inventerade lokaler*		
	Coast	Inland	Total
1973	120	162	282
1974	327	717	1044
1975	333	231	564
1976	289	188	477
1977	283	185	468
1978	292	123	415
1979	177	111	288
1980	168	93	261
1981	168	65	233
1982	167	65	232
1983	130	80	210
1984	171	68	239
1985	164	64	228
1986	156	55	211
1987	136	58	194
1988	133	75	208
1989	142	61	203
1990	108	60	168
1991	118	57	175
1992	137	66	203
1993	147	72	219
1994	117	71	188
1995	124	62	186
1996	115	66	181
1997	108	65	173
1998	117	75	192
1999	110	63	173
2000	138	53	191
2001	116	72	188
2002	128	62	190
2003	130	57	187
2004	121	55	176
2005	125	61	186
2006	109	55	164
2007	116	45	161
2008	130	54	184
2009	135	48	183
2010	124	52	176
2011	137	34	171
2012	139	42	181
2013	108	16	124

During the first years a high number of sites were covered, especially in 1974, when aerial surveys were undertaken in some areas (cf. Nilsson 1980a), but during the last 30 years 161–239 sites have been covered annually. The sites have been distributed over the southern part of the country as shown

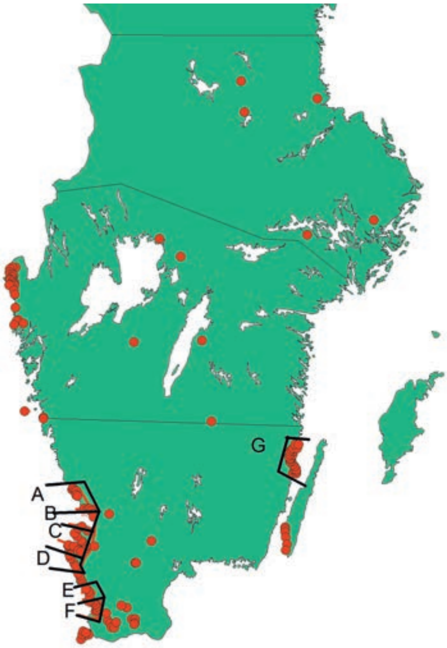


Figure 1. Map of south Sweden showing the sites included in the calculation of September indices. Areas marked with black (A–G) represent reference areas which have been counted in the same way during the years.
A = Tylön – Falkenberg, B = Laholmsbukten, C = Skälderviken, D = N Öresund, E = Lundåkrabukten, F = Lommabukten and G = N Kalmarsund.
Karta över södra Sverige utvisande de lokaler som ingår i beräkningarna av Septemberindex. De med svart markerade områdena A–G representerar referensområden, vilka räknats på samma sätt genom åren.

in Figure 1. Seven reference areas from the midwinter counts (six on the west coast and Öresund and one on the east coast) have been covered in the same way in September as at the midwinter counts.

The number of sites included in the index calculations has varied between 136 and 192 for the last thirty years (Table 1), being somewhat higher during the first years of the survey. After 1982 the proportion of index sites that were common with the previous year has been lower than 80% in only a few years.

Results

Below the trends and changes in numbers will be presented and discussed separately for each species. Indices are calculated for the whole of south Sweden for eighteen of twenty species analyzed in this paper. For two species, the marine offshore scoters *Melanitta*, the actual counts in the six reference areas on the west coast are given instead of an index. For some common species, totals for some or all of the seven reference areas are presented separately to elucidate regional variation. Separate total counts are also given for three species that have particularly impressive September populations in the two big bird-lakes Hornborgasjön and Tåkern.

For information on total numbers counted of the different species in different years see the annual reports that can be downloaded from the homepage http://www.zoo.ekol.lu.se/waterfowl/index.htm

Great Crested Grebe Podiceps cristatus (Figure 2)
In September, the Great crested Grebe is mostly found on the inland lakes, but smaller numbers are also found at the coasts. The species has normally been quite well spread. There was no significant long-term trend. During the first fifteen years there was a decrease to an all-time low in 1987 followed by fluctuations around a more or less stable level, and after 2000 an increase to peak levels in 2004–2006. For the last ten years the trend was significantly decreasing, in 2013 reaching almost the same low level as in 1987.

Cormorant Phalacrocorax carbo (Figure 3)
The September indices for the Cormorant are most representative for the west coast of Sweden including the Öresund as the majority of Baltic Cormo-

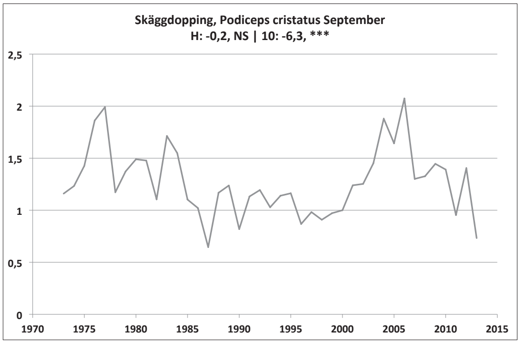


Figure 2. September indices for the Great crested Grebe *Podiceps cristatus* 1973–2013. The figures under the species name gives trend data, H = whole series, 10 = last decade, annual change in per cent over the period is given followed by information on significance levels for the trends, NS = not significant.
September index för skäggdopping 1973–2013. Siffrorna under namnet ger trenddata H för hela perioden, 10 = för den senaste tioårsperioden; därefter följer procentförändringen under resp. period samt signifikansnivån för trenden, NS = inte signifikant.

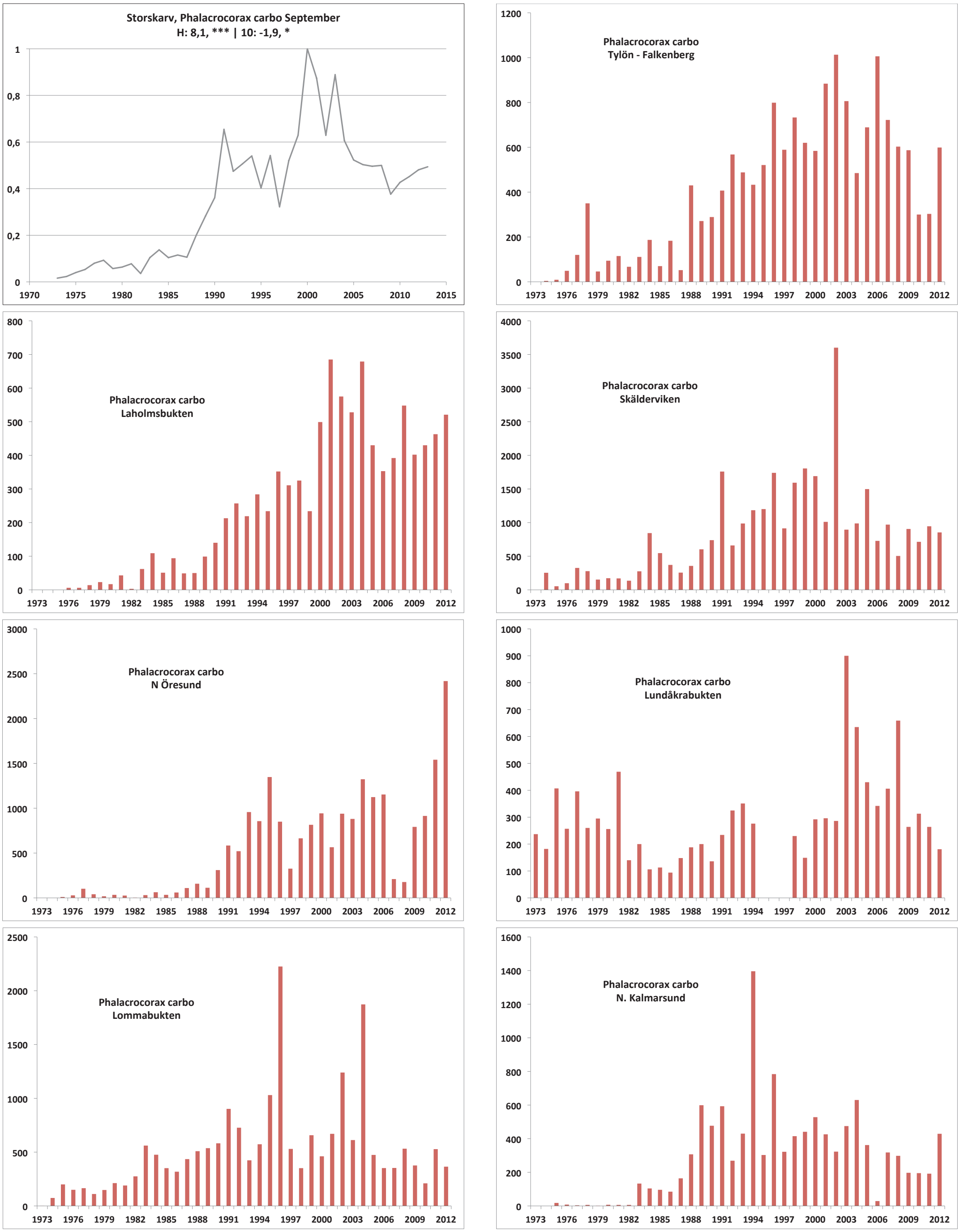


Figure 3. September indices for the Cormorant *Phalacrocorax carbo* 1973–2013 and the numbers counted in some reference areas (Figure 1) 1973 – 2012. The figures under the species name in the index diagram gives trend data, H = whole series, 10 = last decade, annual change in per cent over the period is given followed by information on significance levels for the trends, NS = not significant.

September index för storskarv 1973–2013 samt antalet inräknade i några referensområden (Figur 1) 1973–2012. Siffrorna under namnet ger trenddata H för hela perioden, 10 = för den senaste tioårsperioden; därefter följer procentförändringen under resp. period samt signifikansnivån för trenden, NS = inte signifikant.

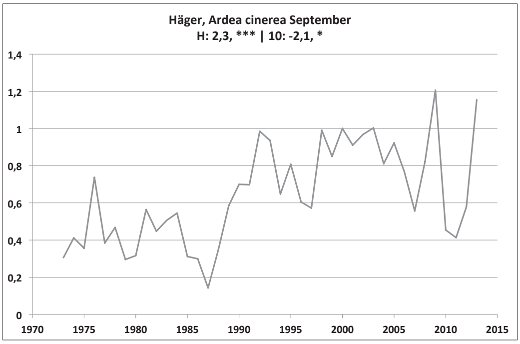


Figure 4. September indices for the Heron *Ardea cinerea* 1973–2013. For more information see Figure 2.
September index för häger 1973–2013. Se vidare Figur2.

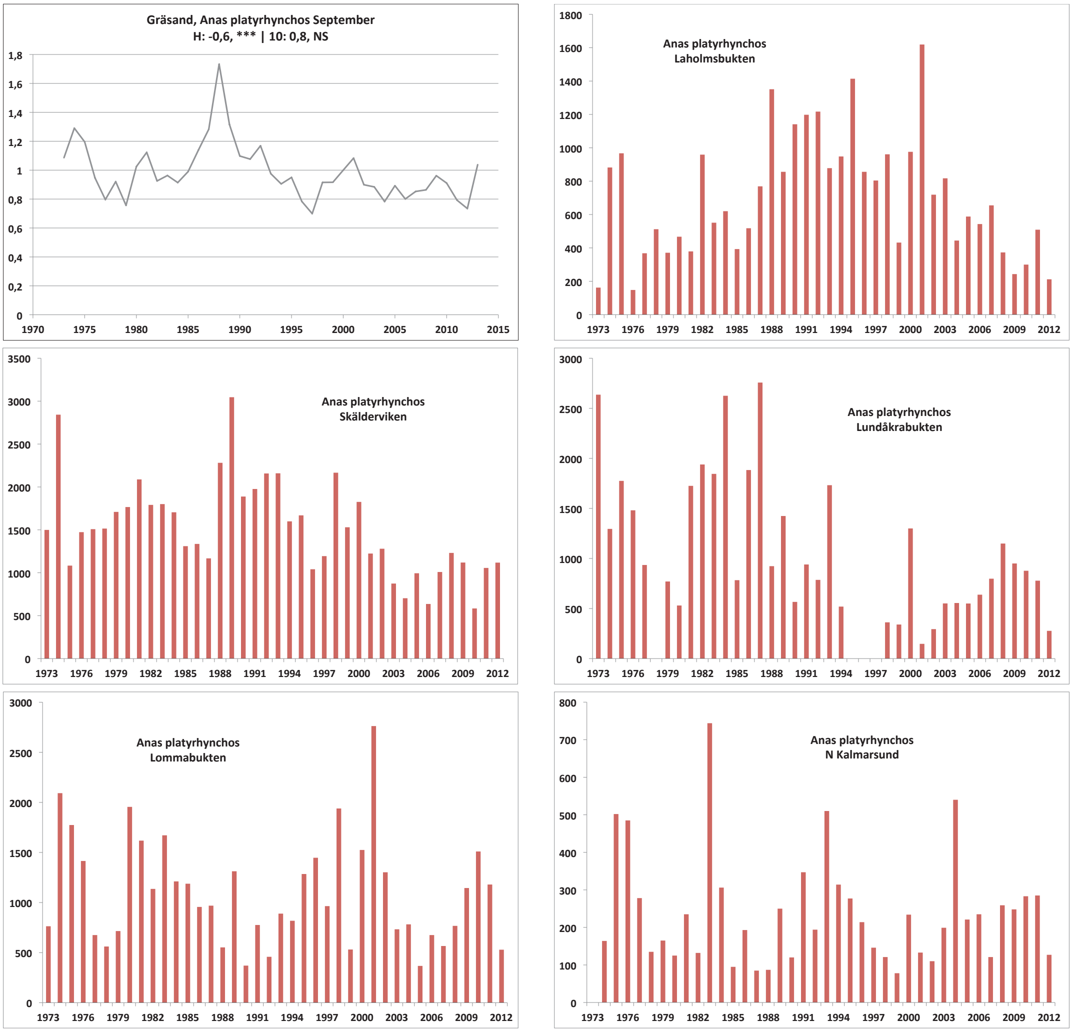


Figure 5. September indices for the Mallard *Anas platyrhynchos* 1973–2013 and the numbers counted in some reference areas. For more information see Figure 3.
September index för gräsand 1973–2013 samt antalet inräknade i några referensområden. Se vidare Figur 3.

rants occur in the archipelagoes which were not adequately covered. The long-term trend showed a significant increase, but the trend for the last decade was decreasing after a peak around year 2000. The Cormorant was common in the reference areas on the west coast. In all areas except Lundåkrabukten, the numbers were low at the start of the counting period and increased over the years. Lommabukten showed a similar picture but the increase levelled off earlier. Lundåkrabukten did not show any trend but only marked fluctuations. In the only reference area studied on the east coast, very few Cormorants were found during the first fifteen years. Numbers during the last twenty years of the series varied between 200 and 600 with one larger count.

Grey Heron Ardea cinerea (Figure 4)
The indices for the Heron show a significantly increasing long-term trend, whereas the trend for the last decade was decreasing and significant. The Heron indices started to increase during the mild winters after the cold winter in 1987 (before that we had a period of shifting hard and mild winters). After 1990 the numbers have fluctuated about a rather steady level but with particularly low indices in 2010 and 2011, which followed after two other hard winters. 2009 had the highest index for the species, after a mild winter, but the index for 2013 was nearly as high.

Mallard Anas platyrhynchos (Figure 5)
The long-term September trend was significantly decreasing. There was no clear trend during the last decade. The number of Mallards counted in four reference areas on the west coast and the one on the east coast showed much variation between the years. There was a clear decrease during later years in three of them but not in the other two. September 1985 had a very high index due to unusually large numbers counted on three different inland lakes in south Sweden.

Teal Anas crecca (Figure 6)
In contrast to the Mallard, the Teal showed a significantly increasing trend both over the entire counting period and during the last decade. However, the significance of the long-term trend depends exclusively on the increase during the last decade. Large numbers of Teal were counted in three of the reference areas, two in Öresund and one in Skäldervikken. Numbers in all three areas showed much variation between years, and there was no significant

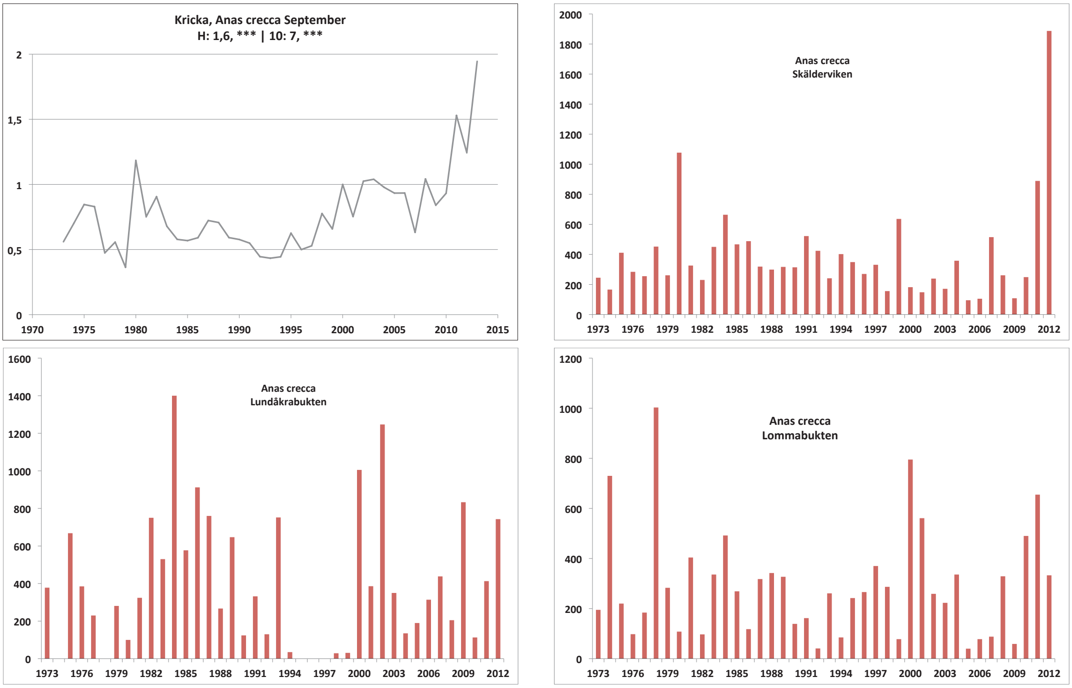


Figure 6. September indices for the Teal *Anas crecca* 1973–2013 and the numbers counted in some reference areas. For more information see Figure 3.
September index för kricka 1973–2013 samt antalet inräknade i några referensområden. Se vidare Figur 3.

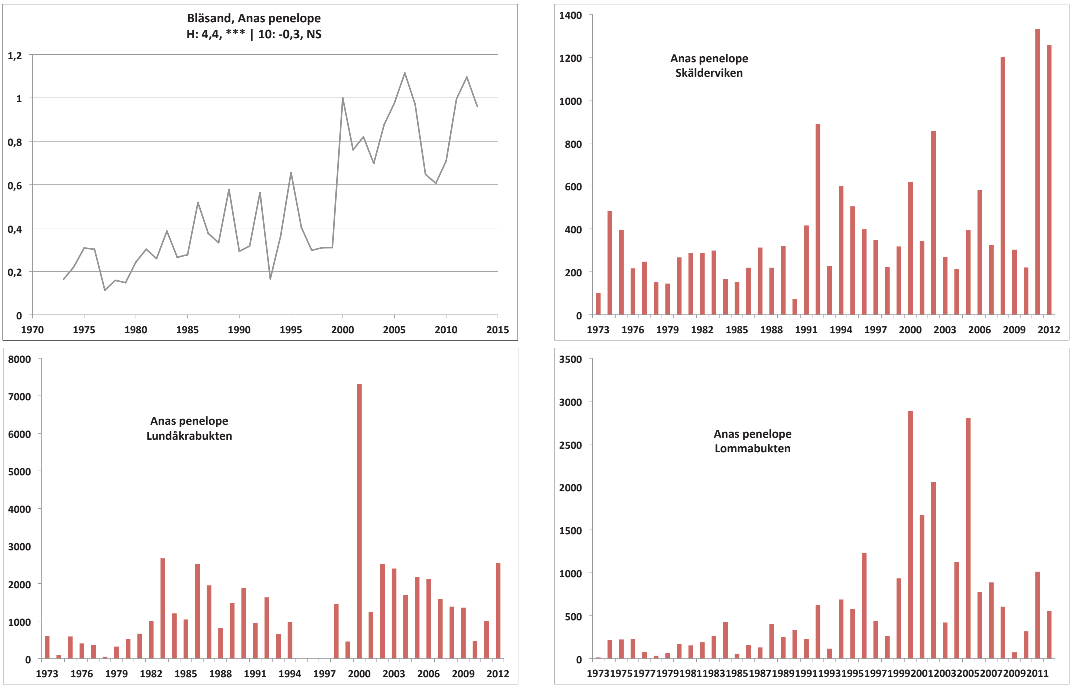


Figure 7. September indices for the Wiegon *Anas penelope* 1973–2013 and the numbers counted in some reference areas. For more information see Figure 3.
September index för bläsand 1973–2013 samt antalet inräknade i några referensområden. Se vidare Figur 3

trend in any of them. There were several aberrantly high peak counts in all three areas.

Wigeon Anas Penelope (Figure 7)

In contrast to the Mallard but similar to the Teal, there was a significantly increasing long-term trend in the numbers of staging Wigeons. For the last decade there were marked fluctuations between years but no significant trend. Larg numbers of Wigeon were counted in three of the reference areas, in Skälderviken and in Lommabukten and Lundåkrabukten in Öresund. In all three areas, there was a marked fluctuation between years but in general counts were higher in the latter part of the series both for Skälderviken and Lommabukten, whereas no such tendency was found for Lundåkrabukten.

Gadwall Anas strepera (Figure 8)

During the first twenty five years, the Gadwall was a rare species in the protocols from the Septem-

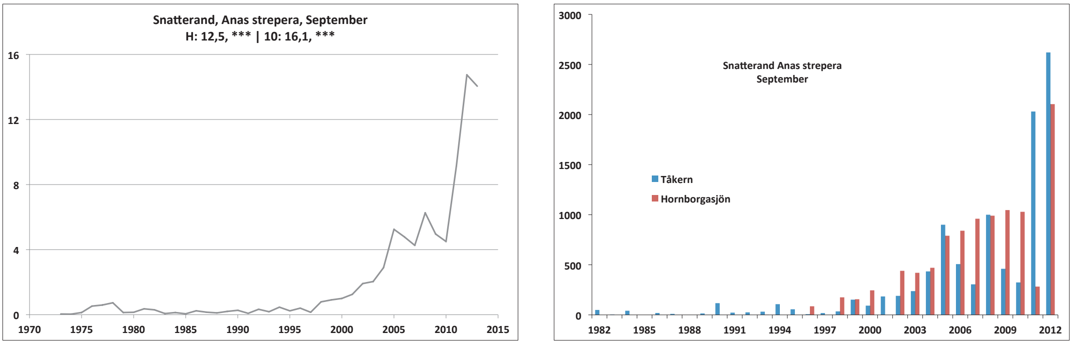


Figure 8. September indices for the Gadwall *Anas strepera* 1973–2013 and the numbers counted in two important bird lakes. For more information see Figure 3.
September index för snatterand 1973–2013 samt antalet inräknade i två viktiga fågelsjöar. Se vidare Figur 3.

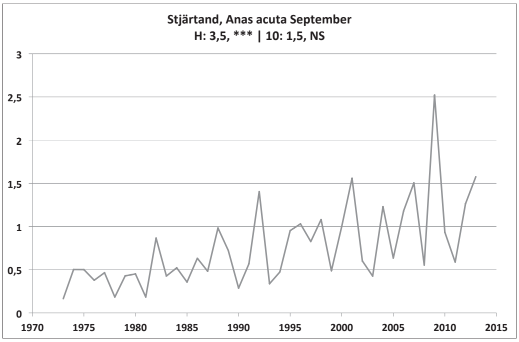


Figure 9. September indices for the Pintail *Anas acuta* 1973–2013. For more information see Figure 2.
September index för stjärtand 1973–2013. Se vidare Figur 2.

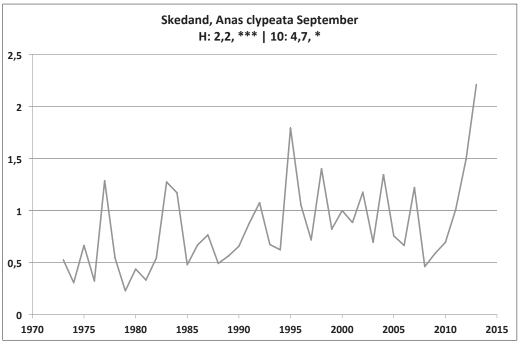


Figure 10. September indices for the Shoveler *Anas clypeata* 1973–2013. For more information see Figure.2.
September index för skedand 1973–2013. Se vidare Figur 2.

ber counts, but during the last fifteen years a very marked increase was recorded, and both the long-term trend and the trend for the last decade were increasing and highly significant. This was especially marked at the two bird-lakes Hornborgasjön and Tåkern, where hardly any were seen during the first decades and no less than 2100 and 2600 were counted in September in 2012, respectively. The species was also more common on other sites in the counts but numbers here were much lower.

Pintail Anas acuta (Figure 9)

Pintails were regularly found mostly in small numbers on a number of counting sites. In general less than 100 Pintails were counted on the west coast reference areas taken together, but there was much variation between years. The maximum total for these areas was 450. The long-term trend for south Sweden was increasing and significant. No significant trend was found for the last ten years.

Shoveler Anas clypeata (Figure 10)

The Shoveler was regularly found on the west coast reference areas, mostly with annual totals less than 50 individuals for the five areas together. Totals of more than 200 were noted in two years during the entire series of counts. The indices showed a significantly increasing trend both for the entire series and for the last decade. However, the significance of the ten year trend is exclusively due to the value of 2013.

Tufted Duck Aythya fuligula (Figure 11)

Tufted duck were well distributed over the inland sites and east coast areas. Marked fluctuations were found between different years, but the long-term trend was significant and increasing. Numbers were small in the reference areas on the west coast, but between 500 and >4000 were counted in different years in the reference area in northern Kalmarsund.

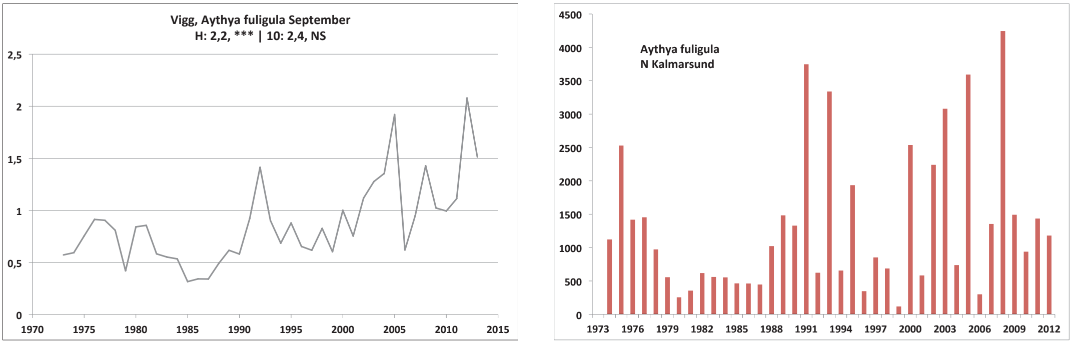


Figure 11. September indices for the Tufted Duck *Aythya fuligula* 1973–2013 and the numbers counted in a reference area in Kalmarsund. For more information see Figure 3.
September index för vigg 1973–2013 samt antalet inräknade i ett referensområde i Kalmarsund. Se vidare Figur 3.

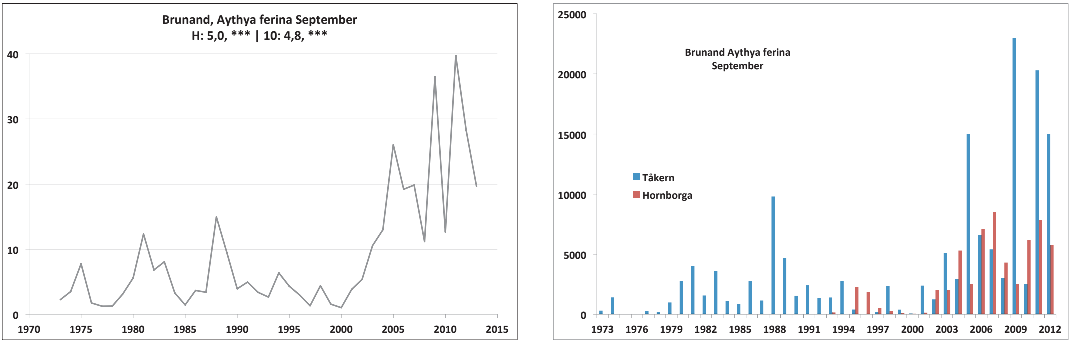


Figure 12. September indices for the Pochard *Aythya ferina* 1973–2013 and the numbers counted in two important bird lakes. For more information see Figure 3.
September index för brunand 1973–2013 samt antalet inräknade i två viktiga fågelsjöar. Se vidare Figur 3.

Pochard Aythya ferina (Figure 12)
The trends were increasing and significant both for the long-term period and, particularly, the last decade. The Pochards were mostly concentrated to a few (often one or two) sites with huge flocks in later years in addition to smaller numbers found in a number of other lakes and coastal sites. During the years before 2000, the large flocks were found in Lake Tåkern, maximum totals normally being less than 5000. During the last decade large flocks also appeared at Lake Hornborgasjön in some years. In two years more than 20 000 were counted in Lake Tåkern, whereas peak totals at Lake Hornborgasjön were between 7000 and 8000 in two years. Rather than as a linear increase the changes of this species can more correctly be described as fluctuations around a more or less steady level until a marked increase started around year 2000.

Goldeneye Bucephala clangula (Figure 13)
The Goldeneye is a well spread species on both inland and coastal waters in September. The overall indices show a significant increase over the entire series. The trend for the last ten years was also significantly increasing but it is markedly influenced by one year with a very high index value. The counts in the reference areas do not show any clear trend over the period but only marked fluctuations between years. Skälderviken showed a slight tendency to a decrease but the fluctuations between years were quite marked also for this area.

Velvet Scoter Melanitta fusca *& Common Scoter* Melanitta nigra (Figure 14)
The two scoters are mostly to be found in offshore waters and are normally seen only in small numbers in the counts undertaken from the shoreline. One exception is the southern part of the Kattegat, where large flocks of both species are found within distances that normally can be covered from the shore in Laholmsbukten and to a smaller extent in Skälderviken. During the early years of the September counts large flocks were found in Laholmsbukten. In the following years numbers were much smaller, but during the last few years more scoters were once again found in the area. The Velvet Scoter was the most common species during the first years, whereas the Common Scoter was the most common species in the later years.

Eider Somateria mollissima (Figure 15)
The Eider indices showed a significantly decreasing long-term trend. If different time periods are considered there was an increase during the first ten to twelve years followed by a marked decrease. The indices for the last ten years do not show any significant change. The Eider totals for the seven reference areas show much variation between years but in general there is a decreasing tendency in all of them with the exception of Lundåkrabukten.

Red-breasted Merganser Mergus serrator (Figure 16)
During the first years until 2004, the indices for the Red-breasted Merganser indicated marked fluctuations around a decreasing trend, and the trend for the entire period is also significantly negative. No significant trend was found for the last ten years.

Goosander Mergus merganser (Figure 17)
The overall indices show a weak but significantly increasing long-term trend. There was no significant trend for the last decade.

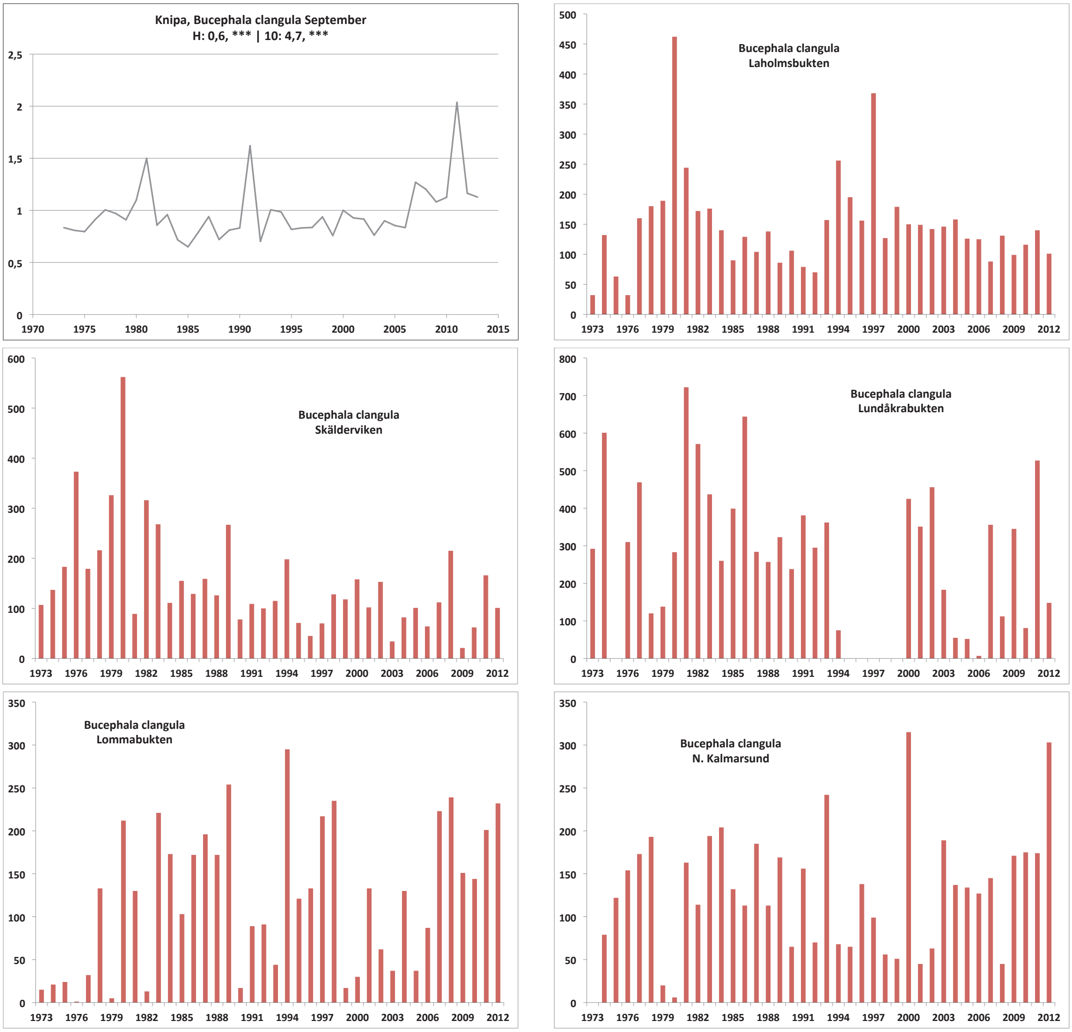


Figure 13. September indices for the Goldeneye *Bucephala clangula* 1973–2013 and the numbers counted in some reference areas. For more information see Figure 3.
September index för knipa 1973–2013 samt antalet inräknade i några referensområden. Se vidare Figur 3.

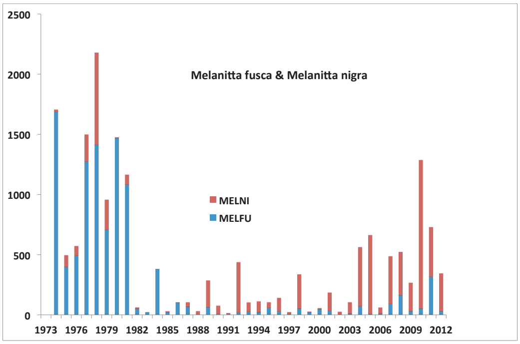


Figure 14. Total number of Velvet Scoters *Melanitta fusca* and Common Scoters *Melanitta nigra* counted on the reference areas of the west coast during the September counts in 1974–2012.
Totalantalet inräknade svärtor och sjöorrar i referensområdena på västkusten vid septemberinventeringarna 1974–2012.

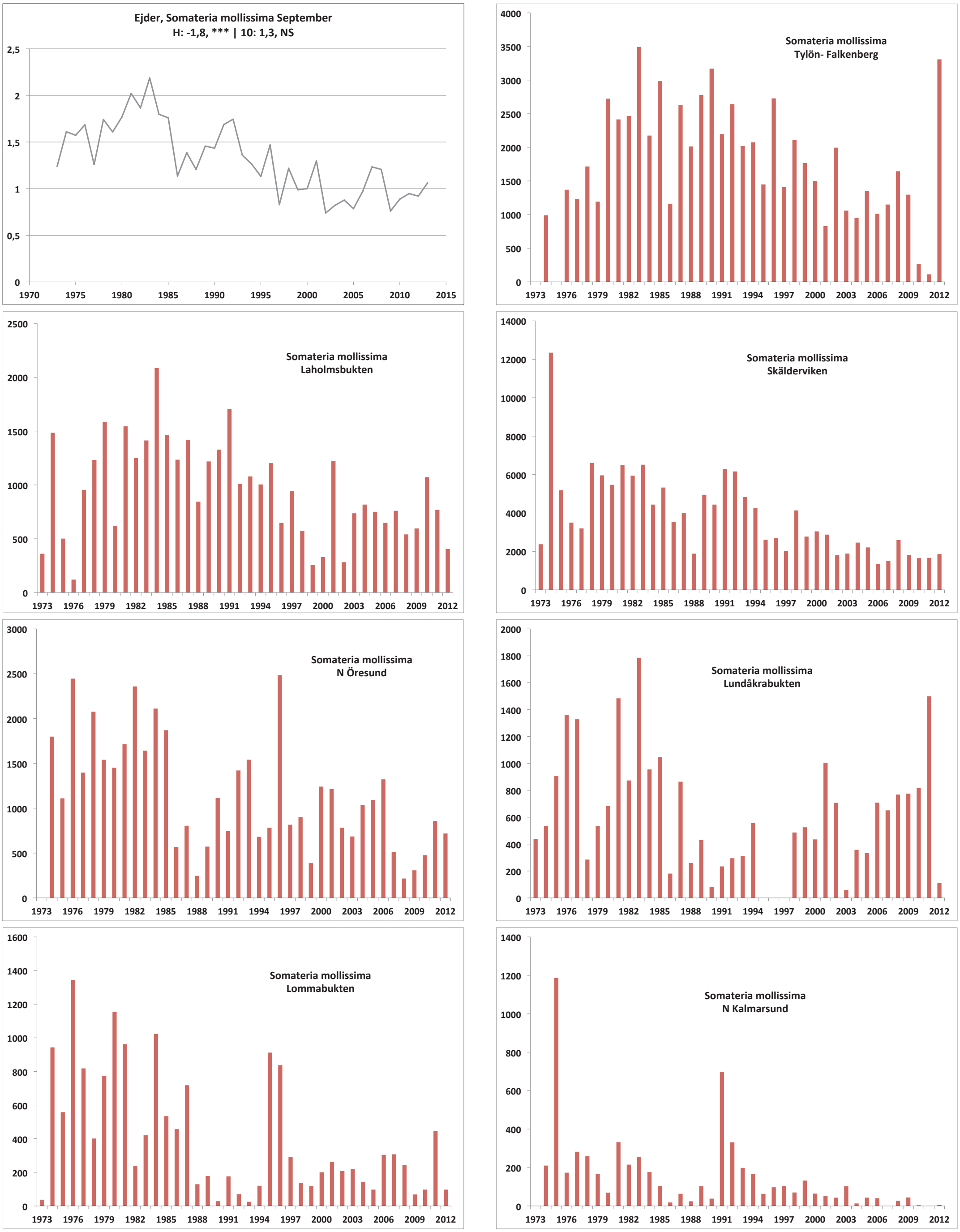


Figure 15. September indices for the Eider *Somateria mollissima* 1973–2013 and the numbers counted in some reference areas. For more information see Figure 3.

September index för ejder 1973–2013 samt antalet inräknade i några referensområden. Se vidare Figur 3.

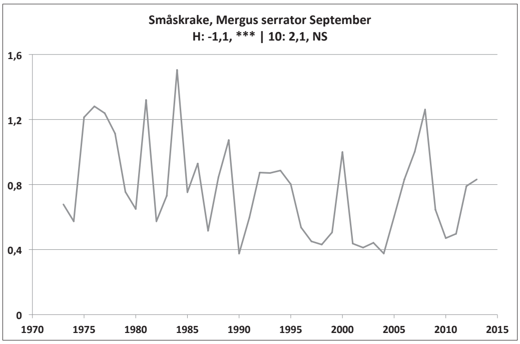


Figure 16. September indices for the Red-breasted merganser *Mergus serrator* 1973–2013. For more information see Figure 2.
September index för småskrake 1973–2013. Se vidare Figur 2.

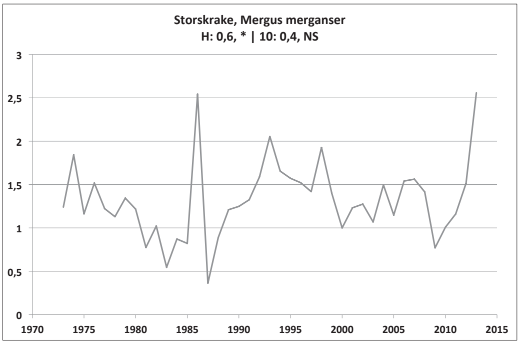
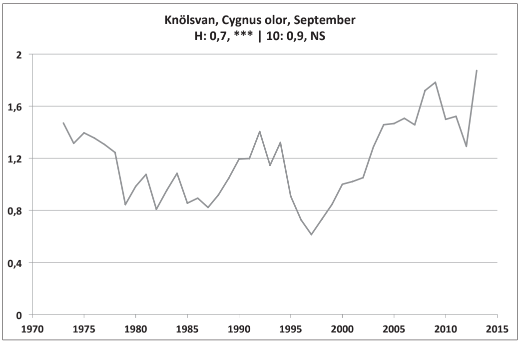
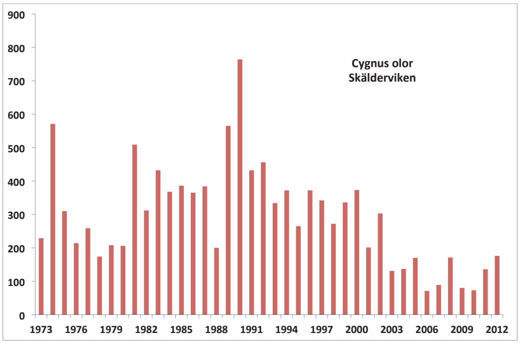
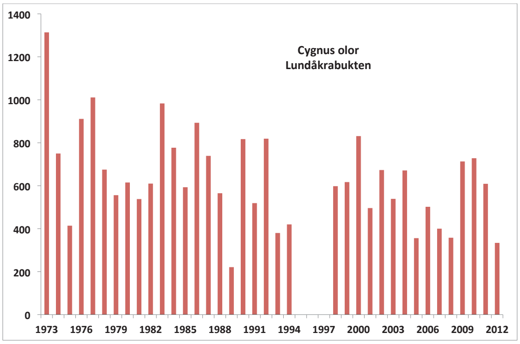
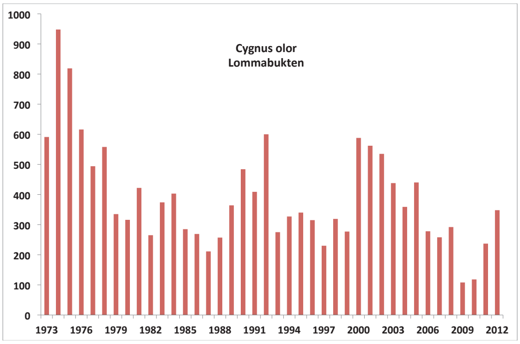


Figure 17. September indices for the Goosander *Mergus merganser* 1973–2013. For more information see Figure 2.
September index för storskrake 1973–2013. Se vidare Figur 2.









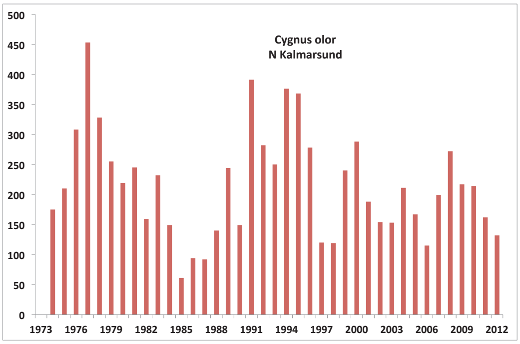


Figure 18. September indices for the Mute Swan *Cygnus olor* 1973–2013 and the numbers counted in some reference areas. For more information see Figure. 3.
September index för knölsvan 1973–2013 samt antalet inräknade i några referensområden. Se vidare Figur 3.

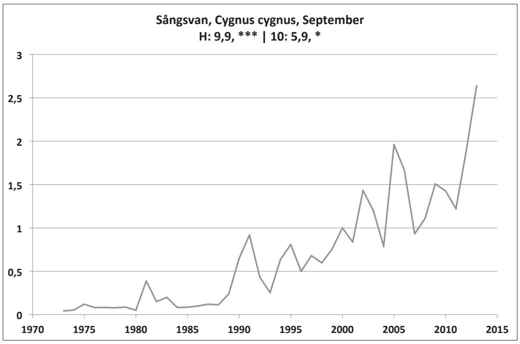


Figure 19. September indices for the Whooper Swan *Cygnus cygnus* 1973–2013. For more information see Figure 2.
September index för sångsvan 1973–2013. Se vidare Figur 2.

Mute Swan Cygnus olor (Figure 18)

The overall indices show a significantly increasing trend over the entire series, whereas the counts during the last ten years show no significant change. In the reference areas the counts show marked annual fluctuations. A decreasing tendency is seen for the latter part of the period in Skälderviken and for the entire period in Lundåkrabukten.

Whooper Swan Cygnus cygnus (Figure 19)

The Whooper Swan showed a significantly increasing trend both for the entire series and for the last decade. The increase started after the cold 1987 winter and before that the indices showed a low and more or less steady level.

Coot Fulica atra (Figure 20)

Large concentrations of Coot have been found in early autumn on Lake Tåkern with between 25 000 and 30 000 counted in September 1973. Large concentrations of Coot have been a regular feature in this lake over the years even if there is a large variation between years. During the latter part of the period, the newly restored Lake Hornborgasjön also was the site for large concentrations. The counts on these two lakes are very sensitive to wind conditions. In years with hard winds on the days with counts, a large proportion of the Coots can be overlooked behind vegetation. The national indices do not show any significant long-term trend. During the first years of the series the indices were high, followed by a marked drop to a very low level in 1985–1988 related to the very cold winters 19709, 1982, 1985 and 1987, when there

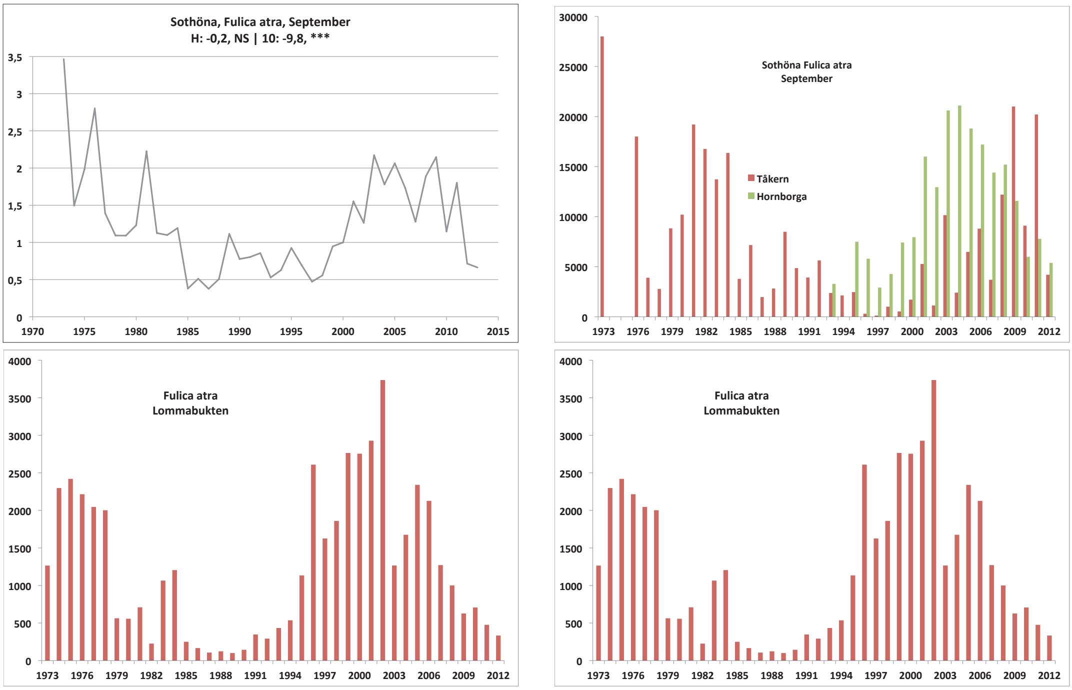


Figure 20. September indices for the Coot *Fulica atra* 1973–2013 and the numbers counted in some reference areas. For more information see Figure 3.
September index för sothöna 1973–2013 samt antalet inräknade i några referensområden. Se vidare Figur 3.

was a high mortality among wintering Coot. The level for the indices remained low for a number of years, but then there was a recovery starting in the late 1990s. However, the population has declined again in recent years, so the trend for the last ten years was significantly decreasing. Large numbers of Coot were found in two of the reference areas in Öresund, Lommabukten and Lundåkrabukten. In both areas high numbers were counted during the first years followed by a marked decrease and low counts for a number of years. In Lommabukten there was a marked increase again to high counts for a number of years followed by a decrease during the last few counts. This increase was not so marked in Lundåkrabukten, but there were some years with somewhat higher counts during the last few years.

Discussion

September indices have been calculated for 18 different waterbird species. Of these species 13 showed a significantly increasing trend over the whole series of 41 years of counts, whereas three species showed significant decreases. In the short term (the last 10 years) six species showed significantly increasing trends, four were decreasing and the others did not show any clear trend. For both the Cormorant and the Heron the long-term trends were significantly increasing but the short-term trends were decreasing.

The trends in a large proportion of the staging waterbird populations as shown in the September indices presented here indicate either a genuine change in numbers in the populations from which the early autumn staging flocks emanate or changes in the staging pattern that might be related to changes in the migration pattern of waterbirds as a response to climate change and a general warming in northern Europe. The effects of climate change on the distribution of wintering waterbirds are well established through the analysis of the results of the International Midwinter Counts (Lehikoinen et al. 2013, Nilsson 2008). The general warming of northern Europe can also affect the timing of migration and the use of different staging areas as has been established for different goose species (Nilsson, 2011, 2013a, Nilsson et al 2013). If there are such changes in the timing of the autumn migration also in the waterbirds discussed here, this could influence the number of staging birds counted in south Sweden during the September counts and thus influence the indices discussed here.

Besides the September waterbird counts presented here (and the International Midwinter Counts discussed in detail by Nilsson 2008, see also Nilsson 2014 and Table 2) there are two other monitoring programs that provide trend data for the species discussed here. The Swedish Bird Survey (SBS) provides three sets of indices, i.e. point counts and fixed-route counts for breeding birds and point counts for wintering birds (Green & Lindström 2014; see also www.zoo.ekol.lu.se/birdmonitoring) and Falsterbo Bird Observatory provides counts of migratory birds at Falsterbo in the autumn (Kjellén 2013; also http://www.falsterbofagelstation.se). The September trends for staging waterbirds as presented here are compared with the trends from these other sets of trend data (Table 2).

The comparison of the long term trends with the other monitoring programs gave the following result. The comparison with the migration counts at Falsterbo could be made for 14 species. The trends agreed for five species and disagreed for one species (Goldeneye) whereas in the other eight species the trends were non-significant in one or both of the series. The comparison with the SBS breeding season point counts could be made for 15 species with agreement of trends in five and disagreement in two (Mallard and Tufted Duck) whereas one or both trends for the other eight species were non-significant. With the IWC midwinter counts 15 species could be compared with ten trends that agreed and three that disagreed (Mallard, Eider and Red-breasted Merganser) whereas two trends were non-significant in September. In the comparison, with the SBS winter point counts, 12 species could be included. Trend agreement was found for nine and disagreement for two species (Mallard and Eider); two species had non-significant trends in one of the series. In conclusion, the best agreements were found with the two midwinter counts whereas the agreement with the two breeding bird counts and the migration count was less good. One species, the Mallard, stands out as the September index disagreed with that from all the other series. The Eider index disagreed with both the other winter counts.

Among the species discussed here, two species, the Mallard and the Tufted Duck, showed different long-term trends for the September counts and the SFT breeding season point counts, whereas this was the case for one species, the Goldeneye, in the comparison with the Falsterbo migration counts. In these cases changes in the migration pattern might be involved. In contrast to these differences five species for both comparisons showed similar trends indicating that the indices reflect real changes in the populations.

Table 2. Trends in the number of waterbirds in Sweden according to different monitoring programs: (1) the International Waterbird Counts (IWC) in September (present contribution), (2) the IWC midwinter counts (Nilsson 2014), (3) the counts of autumn migration at Falsterbo Bird Observatory (Kjellén 2013), (4) the point counts of breeding birds in the Swedish Bird Survey (SBS; Green & Lindström 2014), (5) the SBS fixed route counts of breeding birds, and the SBS point counts of wintering birds. Increasing (+) and decreasing (-) trends are marked with a sign if significant. * P<0.05, ** P<0.01 and *** P<0.001, NS = no significant trend.
*Jämförelser av trender i antalet vattenfåglar i Sverige enligt olika inventeringsprogram: (1) Internationella sjöfågelinventeringen (IWC) i september (denna uppsats), (2) midvinterinventeringen inom IWC (Nilsson 2014), (3) räkningar av höstflyttande fåglar vid Falsterbo fågelstation (Kjellén 2013), (4) inventering av punktrutter under häckningstid inom Svensk Fågeltaxering (SFT; Green & Lindström 2014), (5) inventering av standardrutter under häckningstid inom SFT) och (6) inventering av punktrutter vintertid inom SFT. Ökande (+) och minskande (-) trender markeras med tecken om signifikanta. . * P<0.05, ** P<0.01 och *** P<0.001, NS = inte signifikant.*

	Long-term trends					Short-term trends	
	September IWC 1975-2013	Autumn migration 1973-2012	Breeding point counts 1975-2013	Midwinter IWC 1967-2014	Midwinter point counts 1975-2013	September IWC 2004-2013	Breeding fixed routes 2000-2013
Podiceps cristatus	NS		NS	+***		-**	NS
Phalacrocorax carbo	+***		+***	+***	+***	-*	+***
Ardea cinerea	+***		+*	+***	+***	-*	-***
Anas platyrhynchos	-***	NS	+***	+***	+***	NS	+*
Anas crecca	+***	NS	NS	+***		+***	-*
Anas penelope	+***	+***	NS	+***	NS	NS	-**
Anas strepera	+***	+***				+***	
Anas acuta	+***	+***				NS	
Anas clypeata	+***	+***				+*	
Aythya fuligula	+***	NS	-*	+***	+***	NS	-**
Aythya ferina	+***	NS	NS	+***	+*	+***	
Bucephala clangula	+***	-***	NS	+***	+***	+***	-*
Melanitta fusca		+*		-*			NS
Melanitta nigra		+***		+***			NS
Somateria mollissima	-***	NS	-***	+***	+*	NS	NS
Mergus serrator	-***	NS	NS	+***	NS	NS	NS
Mergus merganser	+*	NS	NS	+***	+***	NS	NS
Cygnus olor	+***	NS	+**	+***	+***	NS	NS
Cygnus cygnus	+***	+***	+***	+***	+***	+*	+**
Fulica atra	NS		NS	+***	NS	-***	NS

The short term trends are less well in agreement than the long-term ones. Fourteen species can be compared. Nine of them show non-significant trends in one of the series. The trends that are significant in both series agree in two and disagree in three species. It is likely that ten years is a period that is too short for the large inter-annual variations to permit revelation of significant trends unless they are very dramatic.

In the Cormorant and the Heron, both the long-term September indices and the point counts show significantly increasing trends. On the other hand, the short-term September trends were decreasing as was the trend from the Fixed-routes for breeding herons. For the Heron at least this could probably be related to the cold winters in 2010 and 2011, the species being sensitive to cold winters. The trends for the Cormorant reflect the general increase of the Cormorant populations in Sweden and other countries.

In the dabbling ducks, significantly increasing trends were found both for the long-term September indices and in the number of migrants at Falsterbo for the Wigeon, Pintail, Shoveler and Gadwall. In the Wigeon and the Pintail there were no clear trends in the short-term indices. The Mallard showed a significant decrease in the long-term September indices, whereas the Teal showed increasing trends both long-term and short-term. There was no clear tendency in the Falsterbo counts for these two species. The breeding bird indices showed an increase in the Mallard for both the Point counts and the Fixed-routes, whereas there was a decrease in the Fixed-route index for the Teal.

The general tendency for the Mallard in the region is an increase (Dalby et al. 2013). The staging Mallards in south Sweden may be of both local origin and from areas further to the northeast. It is possible that the general tendencies to an earlier spring have changed the timing of breeding and indirectly the timing of autumn migration thus causing the observed trend in staging September numbers.

For the smaller diving ducks, the long-term September trends were significantly increasing as were the short-term trends except for the Tufted Duck. The number of Goldeneyes passing Falsterbo on migration showed an opposite trend, which might be related to changes in the migration pattern, a higher proportion of the Goldeneyes staying for a longer period in the country. It was expected that the increasing trend for the Goldeneye in the September counts should also be reflected in the breeding bird surveys, but the long-term Point-counts did not show any trend, whereas the Fixed-routes showed a decrease.

The Eider was one of the three species showing a significantly decreasing long-term trend. The same trend was found in the Point counts (Table 2). These trends reflect the general trend of a marked decrease in the Eider populations of the Baltic region (Ekroos et al. 2012). No short-term trends were found for the Eider.

Both swan species show increasing trends, the Whooper Swan for all indices shown in the comparison in Table 2, whereas increasing trends were found in the long-term September indices and the Point counts for the Mute Swan. Another species covered by both the September counts and the breeding bird surveys is the Coot. This species shows a similar picture both during the breeding season and in the September counts..

The January indices on the other hand mostly show significantly increasing trends (Nilsson 2008, 2013b, 2014). The winter point counts in Sweden (Green & Lindström 2014) show a similar picture for the waterbirds. The increases in January totals for a number of waterbirds is mostly due to changes in the distribution in relation to milder winters (Lehikoinen et.al. 2013), but the increases can of course also be a combination of changed winter distribution in relation to milder winters and a genuine population increase.

Acknowledgements

The counts were all undertaken by voluntary observers who covered their areas year by year during an often very long time. Without all those hundreds of observers this study could not have been done, so my sincere thanks go to all duck counters that go out to our water areas year after year both during autumn and winter.

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Sammanfattning

Under mitten av 1960-talet insåg man att det krävdes samordnade insatser för att följa trenderna i de olika andfågelbestånden samt för att fastställa viktiga områden för de olika arterna, varför man startade de internationella midvinterinventeringarna i januari 1967 (Atkinson-Willes 1969). Januari valdes för att andfåglarna under denna månad vistades i de tättbefolkade delarna av Europa och var som mest koncentrerade, vilket underlättade inventeringarna. Sverige har varit med i dessa inventeringar sedan starten 1967 (Nilsson 1975, 2008, 2013b).

För att täcka situationen under andra delar av säsongen organiserades också under några år räkningar i november, mars och september (svenska referenser se Nilsson 1977, 1980a, 1980b). Septemberinventeringarna, som startade 1973, har sedan fortsatts varje år för att ge underlag för att följa de rastande sjöfågelbestånden i landet under den tidiga hösten. Ursprungligen omfattade de internationella sjöfågelinventeringarna änder och svanar, men arturvalet utökades senare till att också omfatta lommar, doppingar, häger, storskarv och sothöna. Alla dessa arter ingår i septemberinventeringen. Gässen ingår också i de internationella midvinterinventeringarna och är dessutom föremål för speciella gåsinventeringar under hösten. Resultaten från dessa inventeringar har publicerats tidigare (Nilsson 2013a).

I denna uppsats analyseras de första fyrtioen årens inventeringar av rastande sjöfåglar i Sverige i september. Huvudvikten är att belysa förändringarna i antal mellan olika år och speciellt att belysa den ev. förekomsten av långtids (hela perioden) och korttidstrender i bestånden av olika rastande sjöfågelarter i södra Sverige. Septemberindex för olika arter publiceras regelbundet i årliga rapporter som bl.a. går ut till deltagarna och kan också återfinnas på projektets hemsida med detaljer från de årliga inventeringarna: http://www.zoo.ekol.lu.se/waterfowl/index.htm

Material och metoder

Andfågelinventeringarna i Sverige liksom i övriga länder baseras helt på frivilliga observatörer, som täcker en eller flera räkningsenheter vid de aktuella inventeringarna. Genom åren har det byggts upp ett nätverk av observatörer och grupper av observatörer som varje år täcker sina inventeringsområden. Septemberinventeringen genomförs veckoslutet närmast den 15:e med de närmaste dagarna som reservtid.

Efter de första årens inventeringar delades den svenska kusten in i räkningssektorer som var så valda att de lätt kunde återfinnas i fält och inte var större än att man kunde räkna dem fullständigt under en och samma dag. Vanligen kunde en inventerare täcka flera enheter. I samband med midvinterinventeringarna på 1980-talet etablerades ett antal referensområden, vilka täcktes på ett standardiserat sätt varje år. Sju av dessa områden inventeras också i september vartill kommer ett antal mer spridda inventeringslokaler (Figur 1).

Populationsindex för de olika arterna har beräknats enligt TRIM-metoden (Pannekoek & van Strien (2001). Metoden är densamma som används av Svensk Fågeltaxering (Green & Lindström 2014). I tidigare rapporter och publikationer beräknades index som kedje-index, varför en del skillnader kan föreligga, mellan denna publikation och tidigare.

Inventeringarnas täckning under senare år visas i Figur 1, medan antalet inventerade lokaler under olika år framgår av tabell 1. Under de första åren inventerades något fler lokaler än senare, speciellt 1974 (Nilsson 1980a), då vissa delar flyginventerades.

Resultat

Septemberindex för södra Sverige har kunnat beräknas för 18 olika arter och presenteras i en serie diagram för de olika arterna både för hela serien (41 år) och för de senaste 10 åren Totalt sett visade 13 arter signifikanta ökande trender i långtidsindex för september, medan tre arter visade signifikanta nedåtgående trender för samma period. När det gäller korttidstrenden var sex arter ökande, medan fyra arter visade en minskande trend.

Långtidsserien visar ingen klar trend för skäggdoppingen (Figur 2), medan arten minskat under den senaste tioårsperioden. Storskarv och häger (Figur 3, 4) visade ökande trender för hela serien, medan båda arterna minskade den senaste tioårsperioden. För hägern torde detta förmodligen kunna hänföras till de kalla vintrarna 2010 och 2011.

Samtliga simänder utom gräsanden visade signifikanta ökande långtids trender (Figur 5 - 10), medan korttidstrenderna ökade för tre av arterna. Ökningen var mest markant för snatteranden som endast noterades i enstaka individ vid de första septemberinventeringarna, men som från år 2000 ökat markant som rastare, särskilt på de stora fågelsjöarna Tåkern och Hornborgasjön (Figur 8).

De tre små dykänderna vigg, brunand och knipa visade alla signifikant ökande långtidstrender (Figur 11–13). Ökningen var särskilt markant för brunanden, där septembersummor om mer än 20000 individ noterats vid Tåkern vissa år (Figur 12).

Båda de havslevande dykänderna, ejder (Figur 15) och småskrake (Figur 16), visade signifikant minskande långtids trender, medan korttidstrenderna inte visade någon klar bild. Däremot förekom svärta och sjöorre i någorlunda antal endast i Laholmsbukten och i viss mån Skälderviken. Antalet rastare varierade markant mellan olika år (Figur 14).

Både knölsvan och sångsvan visade signifikant ökande långtidstrender (Figur 18, 19). Däremot visade sothönan ingen klar långtidstrend (Figur 20).

Diskussion

Som framgått ovan visade 13 av de 18 undersökta arterna signifikant ökande långtids trender, medan tre arter minskade och två inte visade någon klar långtidstrend. för tre arter visade korttidstrenden en nedgång, som troligen kan förklaras av ett par kalla vintrar under perioden.

De trender som diskuterats här kan jämföras med trenderna för samma arter från två andra övervakningsprogram. 1) Svensk Fågeltaxering med punktinventeringar sommar och vinter samt standardrutter under häckningstiden ((Green & Lindström 2014 se också www.zoo.ekol.lu.se/birdmonitoring) samt 2) de regelbundna flyttfågelräkningarna vid Falsterbo (Kjellén 2013, http://www.falsterbofagelstation.se). I flertalet fall visar jämförelserna mellan septemberindex och de andra programmen liknande trender även om det förekommer en del skillnader (Tabell 2). Sålunda minskar gräsandens septemberindex, medan någon sådan tendens inte finns i sträcksiffrorna. Däremot visar index från punktinventeringarna på sommaren en signifikant ökning. Denna skillnad mellan de båda dataserierna kan kanske förklaras av ändrade flyttningsvanor i samband med att klimatet under vintern och våren blivit varmare.

Vinterindex (både sjöfågelinventeringarna och punktrutterna) visar för de flesta arter signifikant ökande trender, vilket torde kunna relateras till de mildare vintrarna under senare år.

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Hybrids between Bar-headed Goose *Anser indicus* and Snow Goose *Anser caerulescens*

Hybrider mellan stripgås Anser indicus *och snögås* Anser caerulescens

JÖRN LEHMHUS & C. G. GUSTAVSSON

Abstract

Very few hybrids between Bar-headed Goose *Anser indicus* and Snow Goose *Anser caerulescens* have been described in the literature. In this article we give a morphological description of such hybrids, based on 35 individuals which we either observed ourselves or found pictures of on the Internet. Some hybrids were rather similar to Bar-headed Geese and others more closely resembled intermediate phase Snow Geese. General colouration, details and distinguishing features are described in the text together with photos. The yearly numbers of hybrids increased over time. This may be due to an actual increase in number of individuals, but may also reflect an increased interest in observing and reporting hybrids. Many hybrids were initially reported as something else, and there is therefore presumably under-reporting also in registers without photographs. We hope the information in this article will facilitate correct reporting.

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Introduction

Hybridization between bird species has been thought to be uncommon, but several publications in the last decades have demonstrated that this is not true (e.g. Grant & Grant 1992, McCarthy 2006, Randler 2000, 2004, Gillham & Gillham 1996, 2002, Kampe-Persson & Lerner 2007). In fact, according to an overview by Grant & Grant (1992) about every tenth bird species has produced hybrids, and more than 40% of the species in the order Anseriformes have produced at least one hybrid. The detectability of hybrids differs depending on the species involved and may influence the number of observations of individual hybrid combinations (Randler 2004). Hybrid geese are often not easily identified and may even pass undetected, especially if plumage traits are close to one of the parent species. This applies also to the hybrid combination we intend to discuss in the following.

It is our impression that images of hybrids between Bar-headed Goose *Anser indicus* and Snow Goose *Anser caerulescens* have become increasingly common on the Internet over the recent few years. As already indicated, these birds were however often classified as something else, usually as either of the parent species. This points to the problem that the reference literature on this type of hybrid is scarce. The existence of hybrids between Bar-headed Goose and Snow Goose has been reported by some authors (McCarthy 2006, Kampe-Persson & Lerner 2007, Rowell et al. 2004, International Zoo Yearbook 1970, 1973, 1976 and 1979), but we are aware of only one article which describes a proven hybrid, in that case the female offspring of a male blue phase Snow Goose and a female Bar-headed Goose (Tornelli 1984). That article also includes a black and white photograph of the hybrid.

The aim of this article is to give an overall morphological description of what we consider to be hybrids between Bar-headed Goose and Snow Goose and to compare the number of observations of such birds to some general reporting parameters.

Material and methods

The material comprises our own observations together with all "presumed" hybrids between Bar-headed Goose and Snow Goose which we could find on the Internet. The term "presumed" is here used in the sense that there were clear signs of the involvement of both Bar-headed Goose and Snow Goose, but no indication of alternative parent species being involved. The photo archives of Artportalen (http://www.artportalen.se/birds/default.asp, http://www.club300.se/Gallery/Gallery.aspx), Rapporteringssystem for fugler (http://artsobservasjoner.no/fugler), Tarsiger (http://www.tarsiger.com/home/index.php?lang=eng), and Netfugl (http://www.netfugl.dk/pictures.php?) were systematically checked for pictures of such birds under the headings "Hybrids" (any), "Bar-headed Goose", "Snow Goose" and "Oddies".

All 35 birds which we considered to be hybrids between Bar-headed Goose and Snow Goose (and when applicable also the Internet source) are presented in Appendix 1 in a way which will allow the readers to form their own opinions on them and also expand the number of accessible illustrations beyond what can be enclosed in this article.

A number of photographers kindly allowed us to use their photographs. Together with our own pictures these are used to illustrate the typical features of these presumed hybrids between Snow Goose and Bar-headed Goose.

Results

Description of the hybrids – General colouration

The colouration and pattern of the presumed hybrids between Bar-headed Goose and Snow Goose is very variable, but in general they exhibit some resemblance to Bar-headed Geese and to so-called blue phase, or intermediate Snow Geese. An example is the hybrid between male blue phase Snow Goose and female Bar-headed Goose from Italy (Tornielli 1984), but as the Snow Goose parent was a blue phase bird this is not surprising. Also, this is a single example and does not describe the full variability. However, there are other birds with extensive white colouration on flanks, neck or scapulars indicating that the Snow Goose involved may have been a white phase bird (Figures 1–5). Nevertheless, these birds still show greyish areas on the body and coloured tertials with some resemblance to the tertials of blue phase Snow Geese (Figures 1–5). This indicates that also hybrids involving white phase Snow Geese may resemble blue phase Snow Geese, a point that will be addressed in the discussion.

Greater coverts and tertials

Greater coverts and tertials in Bar-headed Geese are broad, straight and uniformly light grey with a thin whitish fringe (Figure 6). In Snow Geese, these feathers are slender and more pointed, the greater coverts also down-curving. In white phase Snow Geese the tertials and greater coverts are all-white. In blue phase Snow Geese these feathers show a dark, blackish centre and a broad white or grey edge (Figure 7).

Tertials and greater coverts of presumed hybrids between Bar-headed Goose and Snow Goose resemble the tertials and greater coverts of blue phase Snow Goose in pattern and colouration, although the pattern may be slightly more blurred. Greater coverts and tertials both show a broad white or grey fringe and a darker centre in the hybrids, similar to blue phase Snow Geese (Figure 1–5 and 8–14). The dark centre of the greater coverts, and sometimes also the tertials, can be less dark than in blue phase Snow Geese tertials (Figures 1, 4 and 8–9 (the lighter bird in the latter two figures)). Greater coverts and tertials are more slender and more pointed than in Bar-headed Geese, though in many cases still broader than in Snow Geese (Figures 1–3, 5 and 10). Another difference to pure Snow Geese is that in most hybrids the greater coverts are only slightly down-curving, or not down-curving at all (Figures 1–5 and 8–11). But exceptions with strongly down-curving greater coverts are also known to occur (Figure 12).

Mostly the hybrids' tertials and greater coverts are very long (e.g. Figures 1–5 and 12), covering the secondaries and therefore resembling both Snow Geese and Bar-headed Goose in this regard. In a few cases, only the tips of the secondaries may be visible (Figures 8 and 11). In other *Anser* geese, like Greylag Goose *Anser anser* or Greater White-fronted Goose *Anser albifrons*, the secondaries are less completely covered by the greater coverts.

Scapulars

In blue phase Snow Geese, scapulars are dark grey and slightly darker towards the tip (Figure 7). In Bar-headed Geese these feathers are light grey with a white edge (Figure 6).

In most hybrids these feathers are intermediate grey, in general lighter than in blue phase Snow Geese and darker than in Bar-headed Geese (Figures 1–5 and 8–11). Unlike blue phase Snow Geese, the scapulars have a pale edge (Figures 1–5 and 8–11), but not always as white as in Bar-headed Geese. This results in a more obvious scaly pattern in these hybrids, unlike the more uniformly dark grey blue phase Snow Geese, and the more uniformly pale grey Bar-headed Geese. Very rarely dark birds show no pale edges to the scapulars (Figures 8–9).

Undertail coverts

In Bar-headed Geese, white phase Snow Geese and also in many blue phase Snow Geese undertail coverts are white, similar to those of other *Anser* geese except Emperor Goose *Anser canagicus*. In the hybrids, the undertail coverts are also generally white (Figures 1–5 and 10–12). However, in some blue phase Snow Geese the undertail coverts are dark grey. This is occasionally also found in some dark hybrids (Figure 9), indicating that in such cases the Snow Goose parent most likely was a blue phase bird.

Head and neck pattern

The typical head and neck pattern of Bar-headed Goose is seen in Figure 6. In white phase Snow Geese, head and neck are all-white, whereas in blue phase Snow Geese dark feathers are found on the neck, sometimes reaching the crown. The amount of dark feathers on head and neck is variable.

The head and neck are all-white in some hybrids like in white phase Snow Geese (Figures 2–3). In others the pattern is close to some blue phase Snow Geese, with some dark feathers on the crown and the hindneck (for example Figures 13 and 17). But there are also birds that show a Bar-headed Goose-like pattern with well developed bars (Figures 5, 8–9 and 16). Several birds have the white stripe typical for Bar-headed Geese running down the sides of the neck (Figures 4–5 and 8–11). In some hybrids the white stripe down the sides of the neck is markedly shortened and does not reach as far down (Figure 12) as in Bar-headed Goose.

Bare parts – bill

In Bar-headed Geese, the bill is yellowish orange and has a black nail. There is no “grinning patch” (Figure 6). In Snow Geese, the bill is pink and shows a pronounced grinning patch with black cutting edges of the mandibles (Figure 7). Towards the base, the bill of Snow Geese can have a slight orange hue.

In most hybrids, the bill is pale orange or yellow orange, often becoming pinkish towards the tip (Figures 3–5, 8 and 16). A few hybrids have a more orange bill colouration close to that in Bar-headed Goose, e.g. the bird in Figures 10 and 17. In many birds no obvious grinning patch is visible (e.g. Figure 18), or only a weak grinning patch can be seen (e.g. Figure 16). Only in a few birds a grinning patch is slightly more pronounced (e.g. Figure 17), but never as pronounced as in Snow Geese. In all birds observed so far, the cutting edges of the mandibles are at least partly black (e.g. Figures 1, 4, 9, 11–12 and 16–18), but this is often not visible in birds with closed bills. The nail can be pale as in Snow Goose (Figure 18), black as in Bar-headed Goose (Figure 17) or partly pale and partly black (Figure 16).

Bare parts - legs and feet

The legs are yellowish orange in Bar-headed Geese and pink in Snow Geese. Depending on light, the leg colour in hybrids may show many shades between the pink of the Snow Goose and the yellowish orange of the Bar-headed Goose (Figures 1–4 and 8). In some hybrids the legs may look more pink than orange (Figure 13), but they can also appear pale orange (Figure 14). There are even hybrids with legs appearing darker and deeper orange than the yellowish orange legs of Bar-headed Goose (Figures 12 and 15).

Numbers of birds

The hybrids in this material are presented in Appendix 1, which also includes observation date, location, primary classification and Internet addresses of pictures. There has been an increasing number of hybrid pictures during the last two years and when our own observations are added, there was a substantial increase in 2011.

Discussion

Hybrids between Bar-headed Goose and Snow Goose should be rare according to the literature. McCarthy (2006) gives reference to one bird which reached juvenile age (Steklenev 1993) and to a few reports on breeding in captivity (five more references including Tornielli 1984 and International Zoo Yearbook 1970, 1973, 1976 and 1979). In four articles that count the numbers of goose hybrids, the total numbers of this species combination were estimated to be 1 individual among 210 hybrids in Great Britain 2000 (Rowell et al. 2004) and 1 individual among totally 310–327 hybrids in Sweden

2005 (Kampe-Persson & Lerner 2007), whereas two other studies reported no such hybrid in Great Britain 1991 (Delany 1993) and in Germany 1998 (Randler 2000).

The 35 individuals which we have listed in Appendix 1 should therefore be regarded as a large material. Nonetheless, there seem to be additional hybrids which are not photo-documented and/or reported as something else. One indication that under-reporting should be suspected in not photo-documented birds is the rather high rate of initial misclassifications (Appendix 1). This underlines the value of pictures to substantiate field observations.

The number of hybrids included in Appendix 1 increased over time. This may have several reasons, such as that the number of hybrid individuals has increased, but also that the interest to observe and report hybrids may have increased (Randler 1999, Kampe-Persson & Lerner 2007). The markedly increased number of hybrids in 2011 was largely driven by our own observations.

Comparison with other hybrid geese

The presumed hybrids between Bar-headed Goose and Snow Goose described here show very high variability in colouration and pattern. Higher variability in hybrids than in the parent species is known also from other goose hybrids, e.g. Greylag Goose with Barnacle Goose *Branta leucopsis* (Gustavsson 2009), Greylag Goose with Canada Goose *Branta canadensis* (Lehmhus 2010) and other hybrid Anatidae (e.g. hybrids between two *Anas* species, (Lehmhus 2011)). In this cross between Bar-headed Goose and Snow Goose, the variability may be further increased due to the fact that the Snow Goose has two colour phases, the blue and the white phase.

The hybrids resemble blue phase Snow Geese, as they have greyish areas on the body and greater coverts, and tertials with a blue phase Snow Goose-like pattern, something that is not present in other geese (except the rare blue phase Ross's Goose *Anser rossii*) (compare e.g. Madge and Burn 1988). But in several cases extensive areas of white are shown on flanks, belly or back. Such hybrids may well have had a white phase Snow Goose as parent, or a bird that had the alleles for the white phase colouration. Cooke and Coach (1968) studied Snow Goose colour morphs, their interaction and the inheritance of colouration. Mainly assortative mating occurred, but there was the possibility of a white colour phase bird pairing with a blue colour phase phenotype, resulting in intermediate birds showing white areas on the body (Cooke & Cooch 1968). The same phenomenon occurs also in other hybrids of white phase geese (Snow Geese or Ross's Geese) with none-white geese of the genera *Anser* and *Branta* (e.g. Shoffner et al. 1979, and some photos from the web). Such hybrids often show some resemblance to blue phase Snow Geese or intermediate Snow Geese. This indicates that the white colouration seems to be partly overcome by genes for dark colouration from the other species. In Lesser Snow Goose (*Anser c. caerulescens*), the plumage polymorphism is associated with variation in the melanocortin-1 receptor (MC1R) gene with the degree of melanism correlating to the number of copies of variant MC1R alleles (Mundy et al. 2004). Already Cooke and Coach (1968) and later Mundy et al. (2004) note that there are not only the two phases described as blue and white, but also different intermediate birds with varying amounts of white on the body. The mechanism in hybrids can not be clarified here, but it may be assumed that the general mechanism is similar in other, non polymorphic geese, even though no white variants exist in those. However, this may explain the occurrence of dark feathers in hybrids even if the snow goose involved was a white phase, but not why tertial pattern and greater covert pattern resemble Snow Geese in the hybrids.

Especially tertial pattern and pattern of greater coverts of the hybrids indicate that some information on the pattern of Blue Geese must be present also in white phase birds. The juvenile pattern of tertials and greater coverts of pure white phase Ross's Geese or Snow Geese also suggests this, as it is a pale shadow of the Blue Goose tertial and greater covert pattern (compare e.g. Madge and Burn 1988, Sibley 2003). Tertials and greater coverts of hybrids from a white phase Snow Goose or Ross's Goose with a coloured species often resemble tertials of blue phase geese in that these tertials have white or pale grey edges and a dark centre. Ross's Geese are nearly exclusively white phase birds and the closest relative to Snow Goose. One example of a hybrid expressing a Blue Goose tertial and greater covert pattern is a hybrid of Ross's Goose and Barnacle Goose observed at Cley, England (Figure 19). Another example is a hybridisation of Ross's Goose and Emperor Goose in captivity, described by Shoffner et al. (1979). Those birds also showed a Blue Goose tertial and greater covert pattern and various patches of white over the body. In the authors' experience in crosses of white phase Snow Goose or Ross's Goose with *Anser* geese, the blue phase-like colour pattern in the tertials, and additionally in the greater coverts, is even more marked than in crosses with *Branta* geese. As the presumed Bar-headed x Snow Goose hybrids also show this pattern with the dark centre and the pale edges in their tertials, it is likely that Snow Goose or Ross's Goose parentage is involved. Many of the hybrids show at least a weak grinning patch and they have some degree of black cutting edges of the mandibles. In our opinion, this only leaves the conclusion that the hybrids involve Snow Goose as one parent.

The Bar-headed Goose influence is also observed in varying combinations with Snow Goose traits, as the detailed descriptions have shown. Apart from the head pattern in some birds, there is the white stripe running down the neck sides, the pale orange tones in bare part colouration and the black bill nail. Bar-headed Goose is the only species showing an orange bill with a black nail. Other *Anser* geese have either a coloured bill with pale nail, a partially black bill (the Bean Goose *Anser fabalis* group), or an all black bill (compare e.g. Madge and Burn 1988). Moreover, the coloured feathers of these hybrid birds appear in shades of grey, and are not brownish as most other *Anser* geese are (compare e.g. Madge and Burn 1988). This is a further indication that Snow Goose (dark grey in the blue phase) and Bar-headed Goose (pale grey) are the parent species.

But sometimes other *Anser* goose hybrids are observed that clearly also show a Bar-headed Goose parentage by their characteristic head pattern. These hybrids differ from the hybrid type described above in that they never show the rather long, more pointed tertials (resembling those of Snow Geese) and never show white or partially white flanks. One such other hybrid type is described here for comparison. We consider these geese to be probable hybrids between Bar-headed Goose and Greylag Goose. Such birds are darker grey than Bar-headed Geese, but paler and greyer than Greylag Geese. Three different birds presumed to be this cross are shown in Figures 20–22. The leg colour varies from a pinkish orange (Figure 20) to bright orange (Figures 21–22). The bill is orange (Figures 21–22), in some birds changing to a pinkish colouration shortly before the bill tip (Figure 20). The nail is black (Figures 20–22), similar to Bar-headed Geese. The bill is often stronger than in Bar-headed Geese, but not as massive as in Greylag Geese. The head and neck pattern is dark grey, or grey-brown and dirty white, and therefore less bright and less contrasty than in Bar-headed Geese (Figures 20–22). The front can be white, grey or with mixed whitish and grey feathers. The extension of white onto the neck varies between individuals (Figures 20–22). The forewing is paler than the body colouration, similar to Greylag Geese (Figure 20). The tertials are shaped like in Greylag Geese and Bar-headed Geese and are grey-brown with a thin white edge (Figure 22).

Conservation aspects

Species of the genus *Anser* are closely related according to several authors (Gonzalez et al. 2009, Ruokonen et al. 2000). Therefore, even in the wild the occurrence of hybrids in *Anser* geese is not surprising. Hybrids of the Snow Goose with the closely related Ross's Goose have been observed in the wild and described in detail and mixed pairs have been reported (Trauger et al. 1971). Hybrids of the Bar-headed Goose with grey *Anser* geese have been occasionally reported from the wild range of the species (Hornskov 2008: http://www.netfugl.dk/trip_reports/asia/OBC2008report_JHornskov.pdf).

Hybrids between Bar-headed Goose and Snow Goose are intrageneric *Anser* hybrids and should as such be suspected to be fertile. This possibility is supported by the observation in Kiel (Germany) of a pair of one hybrid and one apparently pure Bar-headed Goose accompanied by a third bird (Figures 23–24) which was rather similar to Bar-headed Geese, but which still had some features which seemed to be derived from Snow Goose and which therefore was suspected to be a backcross Bar-headed Goose × (Bar-headed Goose × Snow Goose). At the same location, also other hybrids occurred which were compatible with what one would expect in trigen hybrids between a Bar-headed Goose × Snow Goose hybrid and a domestic Swan Goose *Anser cygnoides f. domesticus* (Lehmhus 2011; http://www.flickr.com/groups/hybridbirds/discuss/72157602197084567). Fertility of hybrids between Bar-headed Goose and Snow Goose would also be in line with our observations of other fertile intrageneric *Anser* goose hybrids, such as Emperor Goose × blue phase Snow Goose producing backcrosses with Emperor Goose (Figure 25 and Lehmhus J. 2009–2012 (http://www.flickr.com/groups/hybridbirds/discuss/72157622611286979) and a fertile presumed Swan Goose *Anser cygnoides* × Snow Goose hybrid which had a gosling in pair with a Barnacle Goose (Dreyer & Gustavsson 2010). A presumed hybrid between Bar-headed Goose and Greylag Goose is also believed to be

Figure 1. Hybrid between Bar-headed Goose and Snow Goose, in several aspects resembling the blue phase Snow Goose in Figure 7. The grey colouration is darker than in Bar-headed Geese but lighter than in blue phase Snow Geese. The neck has dark and white feathers mixed, except for a stripe of white feathers down the neck at each side. White flanks, indicating the Snow Goose involved was the white phase or an intermediate phase. One partner of pair A. 16 August 2011, Schrevenpark, Kiel, Germany. Photo: Jörn Lehmhus.
Hybrid mellan stripgås och snögås som i flera avseenden påminner om blå morf av snögås. Den grå färgen är mörkare än på stripgås men ändå ljusare än på blå morf av snögås. Halsen har en blandning av mörka och vita fjädrar med undantag för ett stråk av vita fjädrar längs halsens sidor. Vita flanker indikerar att den inblandade snögåsen kan ha varit av vit eller intermediär morf. Ena partnern i par A. 16/8 2011, Schrevenpark, Kiel, Tyskland.

Figure 2. Hybrid between Bar-headed Goose and Snow Goose. The grey colouration is darker than in Bar-headed Goose but still lighter coloured than in blue phase Snow Goose. The bill has a black nail as in Bar-headed Goose and some black on cutting edges of mandibles. The tertials and greater coverts have a pattern resembling those of blue phase Snow Geese, but are broader. White flanks, indicating the Snow Goose involved was the white phase or an intermediate phase. 16 August 2011, Schrevenpark, Kiel, Germany. Photo: Jörn Lehmhus.
Hybrid mellan stripgås och snögås. Den grå färgen är mörkare än hos stripgås men ljusare än hos blå fas av snögås. Näbbnageln är svart som hos stripgås och det finns ett inslag av svart längs näbbkanterna. Tertialer och större täckare påminner om blå fas av snögås, men är bredare. Vita flanker tyder på att snögåsföräldern var av vit eller intermediär fas. 16/8 2011, Schrevenpark, Kiel, Tyskland.

Figure 3. Hybrid between Bar-headed Goose and Snow Goose. This is the whitest of the hybrids in our material and it was part of one of two pairs consisting of two hybrids. At that location alltogether eight hybrids occurred. 16 August 2011, Schrevenpark, Kiel, Germany. Photo: Jörn Lehmhus.
Detta är den vitaste av hybriderna mellan stripgås och snögås i vårt material och den ingick i det andra paret bestående av två hybrider i Kiel, Tyskland. Sammantaget fanns på denna lokal åtta hybrider. 16/8 2011.

Figure 4. Hybrids between Bar-headed Goose and Snow Goose. Two birds from Bavaria with an appearance closer to Snow Goose at a first glance, but too pale grey and with the white stripe along the sides of the neck which is part of the Bar-headed Goose pattern. 15 November 2011, Stempflesee, Augsburg-Haunstetten, Germany. Photo: Gunter Hasler.
Två hybrider mellan stripgås och snögås från Bayern med utseende närmre snögåsens, men alltför blekgrå och med den vita rand längs halsens sidor, som är en del av stripgåsmönstret. 15/11 2011, Stempflesee, Augsburg-Haunstetten, Tyskland.

Figure 5. Hybrid between Bar-headed Goose and Snow Goose. Here the head and neck pattern is very Bar-headed Goose-like, but the black stripes are mixed with white feathers. Also the flank is partly white and the tertials and greater coverts resemble a blue phase Snow Goose. 21 March 2010, Rainbow Point, Holt Bay, Blagdon Lake, United Kingdom. Photo: Nigel Milbourne.

Hybrid mellan stripgås och snögås. Huvudets teckning liknar här mycket stripgåsens men de svarta striporna är blandade med vita fjädrar. Flankerna är delvis vita och tertialer och större täckare liknar blå morf av snögås. 21/3 2010, Rainbow Point, Holt Bay, Blagdon Lake, Storbritanien.

Figure 6. Bar-headed Geese, 16 August 2011, Schrevenpark, Kiel, Germany. Photo: Jörn Lehmhus.

Stripgäss, 16/8 2011, Schrevenpark, Kiel, Tyskland.

Figure 7. Blue phase Snow Goose, 16 August 2011, Schrevenpark, Kiel, Germany. Photo: Jörn Lehmhus.

Blå morf av snögås, 16/8 2011, Schrevenpark, Kiel, Tyskland.

Figure 8. Two hybrids between Bar-headed Goose and Snow Goose which seem to be pair bonded. One of these is the darkest hybrid in this material, similar in darkness to blue phase Snow Geese. The head of the dark bird is Bar-headed Goose like but with fairly broad bars. The tertials have a blue phase Snow Goose like pattern, but more washed out. The bill colouration and the long white stripe down the sides of the neck indicate Bar-headed Goose genes. 18 March 2012, Weston-in-Gordano, North Somerset, United Kingdom. Photo: Paul Chapman.

Två hybrider mellan stripgås och snögås som verkar ha bildat par. En av dessa är den mörkaste av hybriderna i detta material, lika mörk som blå fas av snögås. Huvudet på den mörka fågeln är stripgåsliknande men med ganska breda stripor. Tertialerna har mönster som hos blå fas av snögås men mera urtvättat. Näbbfärgen och den långa vita randen längs halsens sidor tyder på stripgåsursprung. 18/3 2012, Weston-in-Gordano, North Somerset, Storbritannien.

Figure 9. The same two hybrids between Bar-headed Goose and Snow Goose as in Figure 8. The dark hybrid shows grey undertail coverts, a feature only shown in Emperor Goose and in some blue phase Snow Geese. Also this is the only bird in the material without pale trailing edges to the scapulars. 18 March 2012, Weston-in-Gordano, North Somerset, United Kingdom. Photo: Paul Chapman.
Samma två hybrider mellan stripgås och snögås som i Figure 8. Den mörka hybriden har gråa undre stjärttäckare, ett drag som bara ses hos kejsargås och blå fas av snögås. Detta är också den enda fågeln i materialet som inte har ljusa kanter på skapularerna. 18/3 2012, Weston-in-Gordano, North Somerset, Storbritannien.

Figure 10. Hybrid between Bar-headed Goose and Snow Goose. This is a rather dark hybrid but with white flanks. No bars in the head pattern but the white stripe on the neck sides that is typical for Bar-headed Goose. June 2005, Schleswig, Germany. Photo: Sönke Morsch.
Hybrid mellan stripgås och snögås. Detta är en ganska mörk hybrid men med vita flanker. Inga stripor på huvudet men det vita stråket på halsens sida är typiskt för stripgås. Juni 2005, Schleswig, Tyskland.

Figure 11. Hybrid between Bar-headed Goose and Snow Goose. One of the darker hybrids in this material. It has from some distance an extremely Bar-headed Goose like head and neck pattern but also tertials with a Snow Goose like pattern and a darker appearance than Bar-headed Geese as well as deep orange feet. 26 January 2012, Åhus, Sweden. Photo: Carl Gunnar Gustavsson.
Hybrid mellan stripgås och snögås. En av de mörkaste av hybriderna i detta material. Den har på lite avstånd extremt stripgåsliknande huvud och hals men även tertialer med snögåsliknande mönster och ett mörkare intryck än stripgås samt djupt orange fötter. 26/1 2012, Åhus, Sverige.

Figure 12. This picture shows tertials and greater coverts of a hybrid between Bar-headed Goose and Snow Goose in comparison to those in Greylag Geese. The tertials and greater coverts of this hybrid are strongly curved, very Snow Goose like. In this bird the legs are bright orange. 27 December 2011, Velp, De Bronkhorst, the Netherlands. Photo: André den Ouden.
Denna bild visar tertialer och större täckare på en hybrid mellan stripgås och snögås i jämförelse med dem på grågäss. På denna hybrid är tertialer och större täckare starkt krökta och mycket snögåsliknande. Benen är på denna fågel klart orange. 27/12 2011, Velp, De Bronkhorst, Nederländerna.

Figure 13. Hybrid between Bar-headed Goose and Snow Goose. The leg colour in this hybrid is clearly pinkish, contrasting with a mainly pale orange bill. 15 November 2011, Stempflesee, Augsburg-Haunstetten, Germany. Photo: Gunter Hasler.
Hybrid mellan stripgås och snögås. Benen är på denna hybrid tydligt skära i motsats till den huvudsakligen orange näbben. 15/11 2011, Stempflesee, Augsburg-Haunstetten, Tyskland.

Figure 14. One of the Bar-headed with Snow Goose hybrid pairs. In both birds from this pair legs and bill appear pale pinkish orange. In one bird the nail is pale, in the rear bird the nail is partly black. Tertials and greater coverts are very long with a pattern like blue phase Snow Goose. 16 August 2011, Kiel, Germany. Photo: Jörn Lehmhus.
Ett av stripgås-snögås-hybridparen. Båda fåglarna i detta par har blekt rosa-orange ben och näbb. Den ena fågel har blek näbbnagel, den andra (bakre) delvis svart näbbnagel. Tertialer och större täckare är mycket långa med en teckning liknande blå fas av snögås. 16/11 2011, Kiel, Tyskland.

Figure 15. Hybrid between Bar-headed Goose and Snow Goose. The leg colour in this hybrid is rather orange, mallard-like. 24th January Åhus, Sweden. Photo: Carl Gunnar Gustavsson.
Hybrid mellan stripgås och snögås. Benfärgen är på denna hybrid ganska orange och gräsandlik. 24/1 2012, Åhus, Sverige.

Figure 16. Hybrid between Bar-headed Goose and Snow Goose. The same bird as in Figure 11 and 15. The bill has a very much reduced grinning patch, but black cutting edges and a partly pale nail as a heritage from the Snow Goose parent. The upper mandible is mainly pale pink, but with a pale yellow orange area around and behind the nostrils. 26 January 2012, Ahus, Sweden. Photo: Carl Gunnar Gustavsson.
Hybrid mellan stripgås och snögås. Samma fågel som på Figure 11 och 15. Näbben har en mycket reducerad "grinning patch" men svarta näbbkanter och delvis blek näbbnagel som arv från snögåsföräldern. Övre näbbhalvan är huvudsakligen rosa men med blekt gulorange område omkring och bakom näsborrarna. 26/1 2012, Åhus, Sverige.

Figure 17. The same hybrid between Bar-headed Goose and Snow Goose as in Figure 10. The bill has a reduced grinning patch and black cutting edges as a heritage from the Snow Goose parent and orange bill and black nail from the Bar-Headed Goose parent. Schleswig, Germany. Photo: Sönke Morsch.

Samma hybrid mellan stripgås och snögås som på Figure 10. Näbben har en reducerad "grinning patch" som arv från snögåsföräldern och näbbkanterna är svarta. Schleswig, Tyskland.

Figure 18. This is the same hybrid between Bar-headed Goose and Snow Goose as in Figure 3. It has no grinning patch, pale nail, but edges of lower and upper mandible show some black. Kiel, Germany, August 2011. Photo: Jörn Lehmhus.

Samma hybrid mellan stripgås och snögås som i Figure 3. Den har ingen "grinning patch", blek näbbnagel men lite svart på näbbkanterna. Kiel, Tyskland, augusti 2011.

Figure 19. Probable hybrid between Ross's Goose and Barnacle Goose with presumed parents. 3 January 2011, Cley, United Kingdom. Photo: Dave Appleton.

Trolig hybrid mellan dvärgsnögås och vitkindad gås med föräldrar. 3/1 2011, Cley, Storbritannien.

Figure 20. For comparison a hybrid between Greylag Goose and Bar-headed Goose. Uniform greyish bird with pale forewing as in Greylag Goose and a pattern resembling Bar-headed Goose on head and neck, but grey fronted. 21 May 2009, Darmstadt Vivarium, Germany. Photo: Joachim S. Müller.

För jämförelse en hybrid mellan grågås och stripgås. Jämnt gråaktig fågel med ljus framvinge som på grågås och ett mönster som påminner om stripgås på huvud och hals, men fronten är grå. 21/05 2009, Darmstadt Vivarium, Tyskland.

Figure 21. For comparison another hybrid between Greylag Goose and Bar-headed Goose. Pale grey with brownish tinge, but clearly darker than Bar-headed Goose. Tertials shaped like in Greylag Goose and Bar-headed Goose, grey-brown with a thin white edge. Head and neck pattern resembling Bar-headed Goose. 8 March 2010, Lent, Nijmegen, Netherlands. Photo: Jolanda Wannet.
För jämförelse en annan hybrid mellan grågås och stripgås. Blekt grå med brun anstrykning men klart mörkare än stripgås. Tertialerna formade som hos grågås och stripgås, gråbruna med smal vit kant. Huvud- och halsmönster påminner om stripgås. 8/3 2010, Lent, Nijmegen, Nederländerna.

Figure 22. For comparison a third hybrid between Greylag Goose and Bar-headed Goose. Pale grey with slight brownish tinge, but darker than Bar-headed Goose. Tertials shaped like in Greylag Goose and Bar-headed Goose, grey-brown with a thin white edge. Head pattern resembling Bar-headed Goose, but no white stripe running down the sides of the neck. 28 July 2003, Münster, Germany. Drawing: Jörn Lehmhus.
För jämförelse en tredje hybrid mellan grågås och stripgås. Blekt grå med lätt brun anstrykning men mörkare än stripgås. Tertialerna är formade som hos grågås och stripgås, gråbruna med smal vit kant. Huvud- och halsmönster påminner om stripgås, men utan vit rand längs halsens sidor. 28/7 2003, Münster, Tyskland.

Figure 23. Probable backcross (Snow Goose x Bar-headed Goose) x Bar-headed Goose on the right, with its presumed parents, a male Snow Goose x Bar-headed Goose on the left and a female Bar-headed Goose in the middle. The bird is darker than Bar-headed Goose. Tertials are shaped and patterned like the tertials of the hybrid father, but the centre is of the feathers is lighter grey in the backcross. Leg colour deeper orange than in Bar-headed Goose.18 November 2012, Kiel, Germany. Photo: Jörn Lehmhus.
Trolig återkorsning mellan hybrid snögås x stripgås och stripgås till höger, med dess förmodade föräldrar, en hane snögås x stripgås till vänster och hona stripgås i mitten. Denna fågel är mörkare än stripgås. På återkorsnings-exemplaret har tertialerna en form och mönster liknande tertialerna hos hybridfadern, men centrum i fjädrarna är ljusare grå. Benfärgen är djupare orange än på stripgås. 18/11 2012, Kiel, Tyskland.

Figure 24. Probable backcross (Snow Goose x Bar-headed Goose) x Bar-headed Goose. Same bird as in Figure 23. The bird is darker than all Bar-headed Geese at this site. Tertials are shaped like in hybrids Snow Goose x Bar-headed Goose, head and neck pattern close to Bar-headed Goose but the borders between black and white more diffuse and some white feathers in the dark hindneck. Tail partly with wholly white feathers. Legs deeper orange than in Bar-headed Goose. 18 November 2012, Kiel, Germany. Photo: Jörn Lehmhus.
Trolig återkorsning mellan hybrid snögås x stripgås och stripgås. Samma exemplar som på Figure 23. Denna fågel är mörkare än alla stripgäss på lokalen. Tertialerna är formade som på hybrider snögås x stripgås. Huvudets och halsens teckning nära stripgåsens men gränserna mellan svart och vitt är mera diffusa och med en del vita fjädrar på det mörka bakhuvudet. Stjärten har delvis helvita fjädrar. Benen är mörkare orange än på stripgås. 18/11 2012, Kiel, Tyskland.

Figure 25. Backcross (Emperor Goose x Blue Snow Goose) x Emperor Goose with its Emperor Goose mother in the background. Only obvious differences to Emperor Goose are the white chin and the slightly down-curved greater coverts in the hybrid. More pictures of the backcross, its siblings and the hybrid father at http://www.flickr.com/groups/hybridbirds/discuss/72157622611286979. Photo: Jörn Lehmhus
Återkorsning mellan hybrid kejsargås x blågås och artren kejsargås med kejsargåsmodern i bakgrunden. De enda uppenbara skillnaderna gentemot kejsargås är den vita kinden och de lätt nedåtböjda större täckarna på hybriden. Fler bilder av återkorsningen, dess syskon och hybridfadern finns på http://www.flickr.com/groups/hybridbirds/discuss/72157622611286979

fertile (Reufenheuser 2011 (http://www.flickr.com/photos/pelikan1939/6821439476). F1 hybrids of Ross's Goose x Emperor Goose were also fertile among themselves and produced an F2 offspring (Shoffner et al. 1979), though fertility of the F1 was reduced. A further example of fertile hybrids between *Anser* geese comes from domestic geese. The Steinbach Fighting Goose or Steinbacher Goose, a German domestic goose breed, has Chinese Goose (domestic Swan Goose) and domestic Greylag Goose as ancestors (e.g. Schmidt & Proll 2011). The mixed ancestry is still visible in the unique bill pattern of this breed. Fertility of Lesser White-fronted Goose *Anser erythropus* × Greater White-fronted Goose *Anser albifrons* hybrids has also been proven, though indirectly. Analyses of mtDNA and nuclear microsatellite markers of the captive Lesser White-fronted Goose stock used for reintroduction in Scandinavia revealed that a substantial part of the captive population had a hybrid ancestry with Greater White-fronted Goose (Ruokonen et al. 2007). It was assumed that the hybridisation had occurred in the captive population, as no mtDNA of other goose species was found in samples from wild Lesser White-fronted Geese in the study. But two individuals collected in the wild in wintering areas in England 1936 and in Holland 1966 also proved to be hybrids between Lesser and Greater White-fronted Goose (Nijman et al. 2010). The presence of Greater White-fronted Goose mtDNA haplotypes in Lesser White-fronted Goose could therefore also be a result of naturally occurring hybridisation.

Therefore fertility of *Anser* sp. × *Anser* sp. goose hybrids may be considered relatively common and a potential risk of introgression of genes from these non-native species should be at hand. Such cases are already known from ducks. The most prominent examples are the problem of feral Ruddy Ducks *Oxyura jamaicensis* producing fertile hybrids with the rare and endangered White-headed Duck *Oxyura leucocephala* in Spain (Munoz-Fuentes et al. 2007), and the massive introgression of introduced Mallards *Anas platyrhynchus* into the Pacific Black Duck *Anas superciliosa* in New Zealand (Gillespie 1985, Rhymer et al. 1994), which threatens this species existence on the island. In *Branta* geese, apparently fertile hybrids and possible introgression have been observed between the introduced Canada Goose *Branta canadensis* and the Barnacle Goose *Branta leucopsis* in Europe (Lehmhus 2010). That could also be relevant to our native *Anser* species and to the Snow Geese and Bar-headed Geese themselves when they are now beginning to establish wild breeding populations in Europe.

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Sammanfattning

Bilder av hybrider mellan stripgås och snögås verkar bli allt vanligare på Internet, men fåglarna är ofta felklassificerade, i regel som endera föräldraarten. Detta kan delvis bero på att det finns så få referensartiklar om denna hybridtyp. Att hybrider mellan stripgås och snögås existerar har rapporterats av några författare (McCarthy 2006, Kampe-Persson & Lerner 2007, Rowell et al. 2004, International Zoo Yearbook 1970, 1973, 1976 och 1979) men vi känner bara till en enda artikel som beskriver en bevisad hybrid, i det fallet en honfågelavkomma till en blågåshane (blå fas av snögås) och en stripgåshona (Tornelli 1984). Den artikeln innehåller också ett svartvitt foto av hybriden.

Målet med vår artikel här är att ge en generell morfologisk beskrivning av vad vi uppfattar vara hybrider mellan stripgås och snögås samt att redovisa hur antalet inkluderade observationer utvecklats över tid.

Material och metoder

Materialet omfattar våra egna observationer tillsammans med alla fåglar vi kunde hitta på Internet, där det fanns klara hållpunkter för hybrid med inblandning av både stripgås och snögås men inga tecken på alternativa föräldraarter. Vi fann 35 sådana exemplar, som presenteras i Appendix 1 på ett sätt som låter läsaren bilda sig en egen uppfattning och även utvidga antalet tillgängliga illustrationer utöver vad som innefattas i denna artikel.

Ett antal fotografer lät oss vänligen använda deras fotografier (se Acknowledgements). Tillsammans med våra egna bilder användes dessa för att illustrera de typiska aspekterna hos de förmodade hybriderna mellan snögås och stripgås.

Beskrivning av hybriderna

Hybriderna varierar i färg och teckning men har viss likhet med både stripgås och blågås. Det finns exemplar med utbredd vit teckning på flanker, hals eller skuldror som tyder på att snögåsföräldern kan ha varit av vit fas (Figur 1–5). Men samma fåglar har även gråa områden på kroppen och färgade tertialer som har viss likhet med tertialerna hos blågås (Figur 1–5). Vi tolkar detta som att även hybrider med vit fas av snögås kan visa likheter med den blå fasen.

Större täckare och tertialer

De större täckarna och tertialerna är på stripgås breda, raka och jämnt ljusgrå med en smal vitaktig kant (Figur 6) och på snögås smala och mera tillspetsade, de större täckarna också nedåtböjda. På vit snögås är tertialer och större täckare helvita och på blågås har de ett nästan svart mittparti och bred vit eller grå kant (Figur 7).

På hybriderna har de större täckarna och tertialerna en bred vit eller grå periferi och ett mörkare centralparti – de liknar blågåsens (Figur 1–5 och 8–14) fast teckningen kan vara lite suddigare och det mörka centralpartiet på de större täckarna och ibland även tertialerna kan vara mindre mörkt än hos blågås (Figur 1, 4 och 8–9 (den ljusare fågeln i de två senare figurerna)). Större täckare och tertialer är på hybriderna smalare och spetsigare än på stripgås men i många fall ändå bredare än på snögås (Figur 1–3, 5 och 10). En annan skillnad gentemot rena snögäss är att på de flesta hybriderna är de större täckarna bara lätt eller inte alls nedåtböjda (Figur 1–5 och 8–11), men det finns undantag med starkt nedåtböjda större täckare (Figur 12).

Oftast är hybridernas tertialer och större täckare mycket långa (e.g. Figur 1–5 och 12) och täcker armpennorna – de liknar därmed både snögås och stripgås i detta avseende. I några fall kan spetsarna på armpennorna vara synliga i vissa situationer (Figur 8 och 11). På andra *Anser* gäss som t ex grågås och bläsgås, täcks armpennorna i mindre grad av de större täckarna.

Skapularer (skulderfjädrar)

Skapularerna är på blågås mörkt grå och t o m antytt mörkare mot spetsen (Figur 7) och på stripgås ljusgrå med vit kant (Figur 6). På flertalet hybrider är dessa fjädrar mellangrå, i regel ljusare än på blågås men mörkare än på stripgås (Figur 1–5 och 8–11). Till skillnad mot blågås har hybridernas skapularer blek kant (Figur 1–5 och 8–11), fast inte alltid lika vit som hos stripgås. Detta medför en mera tydligt fjällig teckning hos hybriderna jämfört med den mera jämnmörka blågåsen och den mera jämnt ljusgrå stripgåsen. I enstaka fall kan mörka hybrider sakna de ljusa kanterna på skapularerna (Figur 8–9).

Undre stjärttäckare

På stripgås, vit snögås och även många blågäss är de undre stjärttäckarna vita, i likhet med de flesta *Anser* gåsarterna med undantag för kejsargås. Även på hybriderna är de undre stjärttäckarna i regel vita (Figur 1–5 och 10–12). Men en del blågäss har istället mörkgrå undre stjärttäckare och detta kan någon gång ses även på mörka hybrider (Figur 9). Vi tolkar detta som att snögåsföräldern i dessa fall bör ha varit av blå fas (blågås).

Näbb och ben

På stripgås är näbb och ben gulaktigt orange, näbbnageln svart och näbben har ingen ”grinning patch” (Figur 6). På snögås är näbb och ben rosa och näbben har den artkaraktäristiska ”leende” form som kallas ”grinning patch”, med svarta kanter på båda näbbhalvorna (Figur 7). Mot basen kan snögåsens näbb även ha en lätt orange anstrykning.

På hybriderna varierar benens färg (Figur 1–2, 4, 8, 12–15) och kan på en del exemplar verka mer rosa än orange (Figur 13), men på andra exemplar verka blekorange (Figur 14). Det finns även hybrider vars ben verkar vara mörkare och djupare orange än de gulaktigt orange benen hos stripgås (Figur 12 och 15). Näbben är hos de flesta hybriderna blekorange eller gulorange och blir ofta rosa ut mot näbbspetsen (Figur 3–5, 8 och 16). Ett mindre antal hybrider har en mer orange näbbfärg som ligger nära den hos stripgås, t ex fågeln på Figur 10 och 17. På många fåglar ses ingen tydlig ”grinning patch” (t ex Figur 18) eller bara en svag sådan (t ex Figur 16). Bara enstaka fåglar har en tydligare ”grinning patch” (t ex Figur 17), men aldrig lika uttalad som hos snögås. På alla fåglar vi sett hittills har näbbens kanter på näbbhalvorna varit åtminstone delvis svarta (t ex Figur 1, 4, 9, 11–12, 16–18), men detta kan vara svårt att se på fåglar med sluten näbb. Näbbnageln kan vara blek som på snögås (Figur 18), svart som på stripgås (Figur 17) eller blandat ljus och svart (Figur 16).

Huvud och hals

Den typiska teckningen på stripgåsens huvud och hals kan ses i Figur 6. Hos snögås har den vita fasen helvitt huvud och hals medan blågåsen har mörka fjädrar på halsen och ibland även på huvudet. Mängden mörka fjädrar på huvud och hals varierar.

Bland hybriderna har en del individer helvitt huvud och hals som hos vit snögås (Figur 2–3). På andra ligger teckningen närmre blågåsens, med en del mörka fjädrar på huvud och nacke (exempelvis Figur 13 och 17). Men det finns också fåglar som visar ett stripgåsliknande mönster med väl utvecklade tvärgående stripor (Figur 5, 8–9 och 16). Många hybrider har den för stripgåsen typiska vita randen längs halsens sidor (Figur 4–5 och 8–11) men på en del av dem är denna rand tydligt förkortad och räcker inte lika långt ner som på stripgås (Figur 12).

Antalet hybrider

Hybriderna i materialet redovisas i Appendix 1, som innehåller observationsdatum, lokaler, primär klassifikation och Internetadresser till bilder av fåglarna. Antalet fotograferade hybrider mellan stripgås och snögås har således ökat under de senaste åren och när man adderar våra egna observationer märks en påtaglig ökning under 2011. Detta kan tala för att hybrider mellan stripgås och snögås har blivit vanligare, men det kan finnas andra bidragande förklaringar.

Diskussion

Hybrider mellan stripgås och snögås borde enligt litteraturen vara sällsynta. McCarthy’s referenssamling (2006) hänvisar till ett exemplar som nådde juvenil ålder (Steklenev 1993) och till några rapporter om häckningar i fångenskap (ytterligare fem referenser inklusive Tornielli 1984 och International Zoo Yearbook 1970, 1973, 1976 och 1979). Fyra artiklar som räknat antal gåshybrider redovisar bara en stripgås x snögås bland 210 hybrider i Storbritannien 2000 (Rowell et al. 2004) och en stripgås x snögås bland 310–327 hybrider i Sverige 2005 (Kampe-Persson & Lerner 2007) medan två andra studier inte rapporterar någon enda sådan hybrid i Storbritannien 1991 (Delany 1993) eller i Tyskland 1998 (Randler 2000).

De totalt 35 individerna som ligger till grund för den här artikeln bör därför ses som ett stort material. Ändå verkar det finnas fler hybrider som inte fotodokumenterats och som rapporterats som något annat. Ett tecken på detta är den ganska höga andelen initiala felklassificeringar i Appendix 1, vilket understryker värdet av att man till rapporter även bifogar bilder.

Appendix 1 visar hur antalet hybrider i vårt material har ökat under de senaste åren, i enlighet med vårt ursprungliga intryck. Detta kan bero på att antalet hybrider verkligen har ökat, men också ha andra orsaker som exempelvis att intresset att observera och rapportera hybrider har ökat (Randler 1999, Kampe-Persson & Lerner 2007).

Morfologisk jämförelse med några andra gåshybrider

Hybriderna mellan stripgås och snögås uppvisar stor variation i färg och teckning. Högre variation mellan hybrider än hos föräldraarterna är känt också från andra gåshybrider t ex grågås x vitkindad gås (Gustavsson 2009), grågås x kanadagås (Lehmhus 2010) och andra *Anatidae*-hybrider (till exempel hybrider mellan två *Anas* arter (Lehmhus 2011)). I den här korsningen mellan stripgås och snögås kan variationen öka ytterligare genom att snögåsen har två faser, den blå och den vita fasen.

Hybriderna påminner om den blå fasen av snögås (blågås) genom att de har gråa områden på kroppen och genom att större täckare och tertialer har en blågås-liknande teckning, något som inte ses hos andra gåsarter förutom den sällsynta blå fasen av dvärgsnögås (jämför med t ex Madge och Burn 1988). Men många hybrider har utbredda vita områden på flanker, buk och rygg. Dessa kan mycket väl ha en vit snögås som förälder. Samma fenomen dyker upp också på intermediär fas av snögås, som har ett anlag för vit och ett anlag för blå fas, men även på andra hybrider mellan vit fas av snögås eller dvärgsnögås och icke-vita gäss av genera *Anser* och *Branta*. Dessa visar också ofta viss likhet med blågås eller intermediär fas av snögås. Särskilt teckningen hos tertialer och större täckare tyder på att någon form av information om teckningen hos den blå fasen av snögås verkar finnas även hos den vita fasen, något som för övrigt även ses på 1k-fåglar av den vita fasen. Tertialer och större täckare hos hybrider mellan vit fas av snögås eller dvärgsnögås och färgade arter liknar ofta tertialerna hos den blå fasen genom att dessa har vita eller blekgråa kanter och mörkt centrum. Dvärgsnögäss är nästan uteslutande av vit fas och närmast släkt med snögäss. Ett exempel på en hybrid som uttrycker blå fas-liknande teckning på tertialer och större täckare är en hybrid mellan dvärgsnögås och vitkindad gås från Cley i England (Figur 19). Ett annat exempel är de hybrider mellan dvärgsnögås och kejsargås i fångenskap som beskrivits av Shoffner et al. (1979) – de hade också blågås-liknande teckning på tertialer och större täckare samt vita fläckar på kroppen. Eftersom de förmodade hybriderna mellan stripgås och snögås också visar denna typ av teckning med mörkt centrum och bleka kanter på tertialerna anser vi att detta är ett tecken på att snögås (eller dvärgsnögås) verkligen är inblandad.

Många av hybriderna uppvisar åtminstone en svag ”grinning patch” och svarta näbbkanter. Detta visar att den ena föräldraarten rimligen är snögås. Påverkan av stripgås ses i varierande omfattning tillsammans med drag av snögås, som detaljbeskrivningarna visar. Frånsett den stripgåsliknande teckningen på huvudet hos vissa fåglar kan man se en vit rand längs halsens sidor, blekorange färgtoner på näbb och ben och svart näbbnagel. Stripgåsen är den enda gåsart som har orange näbb med svart näbbnagel. Andra *Anser* gäss har antingen färgad näbb med blek näbbnagel, delvis svart näbb (sädgås-gruppen) eller helsvart näbb (se t ex Madge och Burn 1988). Vidare visar de färgade fjädrarna hos hybriderna olika grader av grått men de är inte brunaktiga som hos de flesta andra *Anser* gässen (se t ex Madge och Burn 1988). Detta är ytterligare ett tecken på att snögås (mörkt grå hos den blåa fasen) och stripgås (blekgrå) är föräldraarterna.

Ibland ser man andra *Anser*-gås-hybrider vars huvuden har en teckning som tyder på stripgås-inblandning, men de skiljer sig från hybriderna med snögås genom att de enligt vår erfarenhet aldrig har dessas snögåsliknande ganska långa och mera tillspetsade tertialer och inte heller har vita eller delvis vita flanker. För jämförelse beskriver vi här en sådan hybridtyp, som vi uppfattar som hybrider mellan stripgås och grågås. Dessa fåglar är mörkare grå än stripgäss och gråare än grågäss. Tre olika exemplar visas i Figur 20–22. Benens färg varierar mellan rosa-orange (Figur 20) och ljust orange (Figur 21–22). Näbben är orange (Figur 21–22), på en del exemplar övergående till rosa kort före näbbspetsen (Figur 20). Näbbnageln är svart (Figur 20–22) som hos stripgås. Näbben är ofta kraftigare än hos stripgäss men inte lika massiv som på grågäss. Huvud och hals är mörkt grå eller grå-bruna och smutsgrå och därför mindre ljusa och mindre kontrastrika jämfört med stripgäss (Figur 20–22). Fronten kan vara vit, grå eller med blandning av vita och gråa fjädrar. Utbredningen av vitt på halsen varierar mellan olika individer. Framvingen är blekare än kroppen, liksom hos grågäss (Figur 20). Tertialerna har samma form som hos grågäss och stripgäss och är gråbruna med smal vit kant (Figur 22).

Artbevarandeaspekter

Hybrider mellan stripgås och snögås är intrageneriska hybrider och bör som sådana misstänkas vara fertila. Den möjligheten stöds av observationen i Kiel av ett par bestående av en hybrid och en till synes artren stripgås åtföljda av en tredje fågel (Figur 23–24) som var ganska lik en stripgås men ändå hade vissa drag som verkade härstamma från snögås och som därför misstänktes vara en återkorsning mellan en stripgås-snögås-hybrid och en stripgås. På samma lokal fanns också fåglar som uppfattades som trigena hybrider mellan en stripgås-snögås-hybrid och en knölgås (Lehmhus 2011 (http://www.flickr.com/groups/hybridbirds/discuss/72157602197084567). Fertilitet hos hybrider mellan stripgås och snögås skulle också vara i överensstämmelse med våra iakttagelser av andra fertila intrageneriska *Anser* gås hybrider som kejsargås x blågås med återkorsningar med kejsargås (Figur 25 och Lehmhus J. 2009–2012 (www) http://www.flickr.com/groups/hybridbirds/discuss/72157622611286979) och en fertil svangås-snögås-hybrid som fick en gässling i par med en vitkindad gås (Dreyer & Gustavsson 2010). En förmodad hybrid mellan stripgås och grågås verkade också vara fertil (Reufenheuser 2011 (http://www.flickr.com/photos/pelikan1939/6821439476). F1-hybrider mellan dvärgsnögås och kejsargås var likaså fertila mellan varandra och producerade en F2-hybrid (Shoffner et al. 1979), men fertiliteten var reducerad hos F1-generationen. Ännu ett exempel på fertila hybrider mellan *Anser* gäss kommer från tamgässen. Steinbach Fighting Goose eller Steinbachergåsen är en tysk tamgåssort som härstammar från både knölgås och tamvarianter av grågås (Schmidt & Proll 2011). Den blandade härstamningen syns på den unika näbbteckningen. Fertilitet hos hybrider mellan olika *Anser* arter får därför anses vara ganska vanlig och en potentiell risk för introgression av gener från sådana främmande gåsarter föreligger. Detta kan vara relevant för våra inhemska *Anser* arter men även för snögås och stripgås när dessa arter nu börjar etablera vildhäckande populationer i Europa.

Appendix 1. The study population. *Studiepopulationen.*

Nr	Web address *Web-sida*	Primary classification *Primär klassificering*	Location *Lokal*	Date *Datum*
1	http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=2850	Snow Goose x Bar-headed Goose	Göteborg, Sweden	28 October 2005
2	http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=14913 http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=13380	Bar-headed Goose	Lövsund, Södermanland, Sweden	6 May 2006 16 May 2006
3	http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=20285	Greylag Goose x Bar-headed Goose	Norra Hyn, Värmland, Sweden	10 October 2006 + earlier
4	http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=103870	Greylag Goose x Bar-headed Goose	Trönninge, Halland, Sweden	15 October 2008
5-6	http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=295531	Bar-headed Goose	Blentarp, Skåne, Sweden	27 May 2011
7*	http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=349088 http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=349271 http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=345650 http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=325051 http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=358431 http://www.artportalen.se/birds/gallery_imageinfo.asp?obsid=24350942 http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=370449 http://www.artportalen.se/birds/gallery_imageinfo.asp?imageID=370718 Presumably the same bird in all pictures but two "Bar-headed Geese" were reported 4-5 June 2011 *Troligen samma fågel på alla bilderna men två "stripgäss" rapporterades 4-5 juni 2011*	Bar-headed Goose Bar-headed x Snow Goose	Åhus, Skåne, Sweden	27 October 2011 7 August 2011 6 August 2011 5 August 2011 28 December 2011 24 January 2012 26 February 2012 28 February 2012
8	http://www.milbourne.net/HOSTEDSITES/blagdonlakebirds/mar10news.html http://www.milbourne.net/HOSTEDSITES/blagdonlakebirds/Assets/images/1DS07462%20Bar-headed%20Goose,%20Rainbow%20Point.JPG	Bar-headed Goose	Rainbow Point, Blagdon Lake, England	21 March 2010
9	http://subhumanfreak.blogspot.com/2010/01/central-asia.html http://3.bp.blogspot.com/_t20nYP_aeuE/S0XM4kXBDqI/AAAAAAAABSI/FbJPUus7jq4/s1600-h/bar-headed+goose+-+slimbridge+wetland+centre.jpg	Bar-headed Goose	Slimbridge, England	1 September 2009
10	http://www.club300.de/gallery/photo.php?id=7474 http://www.club300.de/gallery/photo.php?id=7471 http://www.club300.de/gallery/photo.php?id=7472	Snow Goose	Uitkerke, Belgium	December 2008
11	http://waarneming.nl/foto/view/1182628 http://waarneming.nl/foto/view/1182629	Snow Goose Hybrid	Grave-Stuw e.o., Netherlands	25 April 2010
12	http://waarneming.nl/foto/view/294135	Snow Goose Hybrid	De Bult , Netherlands	9 March 2008
13	http://waarneming.nl/foto/view/636060	Snow Goose Hybrid	Standort Kraaijenbergse Plassen - De Geest , Netherlands	24 February 2009
14	http://waarneming.nl/foto/view/650126 http://waarneming.nl/foto/view/650125	Snow Goose Hybrid	Ammerzoden, Netherlands	15 March 2009

15-16	http://nwv-schwaben.de/files/Naturfotografie/Berichte/2010-10-Hasler_Hybride-Streifengans.pdf http://nwv-schwaben.de/files/Naturfotografie/Berichte/2011-10-Hasler-Hybride-Streifengans-Schneegans.pdf Probably one of 15-16 also described at http://nwv-schwaben.de/files/Ornithologie/Bilder_aktuelle_Beobachtungen/DSC02663.jpg	Bar-headed Goose Hybrid Bar-headed Goose	Augsburg-Haunstetten, Germany Augsburg, Germany	October 2010 6 October 2011 4 December 2010
17	http://waarneming.nl/foto/view/2574360	Canada x Bar-headed Goose Hybrid	Brabantse Biesbosch - Boven Spieringpolder, Netherlands	4 September 2011
18	http://www.netfugl.dk/pictures.php?id=showpicture&picture_id=13399 http://www.netfugl.dk/pictures.php?id=showpicture&picture_id=13416	Snow Goose x Bar-headed Goose?	Solbjerg Ensö, Denmark	20 September 2006
19	http://www.flickr.com/photos/12639178@N07/4907226218	Greylag Goose x Bar-headed Goose	München, Germany	18 August 2010
20	http://www.fotonatur.de/show.php?id=SM11/SMSTREIF6583 http://www.fotonatur.de/show.php?id=SM20/SMSTREIF8698 http://www.fotonatur.de/show.php?id=SM11/SMSTREIF6589 http://www.fotonatur.de/show.php?id=SM11/SMSTREIF6592	Bar-headed Goose	Schleswig, Germany	June 2005
21-29	http://www.flickr.com/groups/hybridbirds/discuss/72157627808996791/ Eight different hybrids and one probable backcross to Bar-Headed Goose *Åtta olika hybrider samt en trolig återkorsning med stripgås*	Bar-headed x Snow Goose	Schrevenpark, Kiel, Germany	16 August 2011, same birds still there 18 November 2012
30-35	http://www.birdforum.net/showthread.php?t=225418 http://avonbirding.blogspot.de/2012/03/sightings-16312.html http://avonbirding.blogspot.de/2011_12_01_archive.html Five different hybrids, in 2012 only two *Fem olika hybrider, 2012 bara två*	Bar-headed Goose hybrids	Weston Moor, Gordano Valley and Portbury Wharf, England	18 February 2011 16 March 2011 3 April 2011 18 March 2012 27 March 2011 4 April 2011

* Two "Bar-headed Geese" were reported at this location 4–5 June 2011. *Två "stripgäss" rapporterades på denna lokal 4–5 juni 2011.*

Korta rapporter – *Short communications*

Attempted predation of Northern Hawk-owl *Surnia ullula* by Common Kestrel *Falco tinnunculus*?

Predationsförsök på hökuggla Surnia ullula *av tornfalk* Falco tinnunculus*?*

KEITH W. LARSON & SIEGLINDE KUNDISCH

On 21 September 2014 while driving west on the highway E10 in northern Sweden near Björkliden (68.42° N, 18.69° E) we stopped to watch a Northern Hawk-owl *Surnia ulula* perched on the top of a mountain birch snag. It then flew west along the road at tree-top level immediately over our position. As it passed us at approximately 50 meters, we were startled when the hawk-owl was attacked by a Common Kestrel *Falco tinnunculus*. The Kestrel was clearly a large female (based on size and orange colouration with dark primaries) approximately the same length and wing-span as the Hawk-owl but with a smaller body size. They locked talons and the Kestrel awkwardly flew/fell away with the Hawk-owl into the birch forest.

Wanting to know the outcome of the attack, we immediately ran into the forest where we flushed the Kestrel talons still locked with the Hawk-owl. From a distance of ten meters we could see the colouration of the female Kestrel who further revealed her identity by calling. Again, we took chase through the forest when we briefly lost them. We stopped and were alerted to their location by the calling of the Kestrel. As we approached, the calling Kestrel flushed from the ground leaving the dazed Hawk-owl behind. We stood five meters away and watched the Hawk-owl seemingly alert and looking around. After a few minutes it took flight landing in a birch nearby and then flew away apparently uninjured.

Retracing our steps back to the car we recovered a hat placed in a birch to mark the location where we initially flushed the Kestrel and Hawk-owl in the forest. On the ground there was a small pile of Hawk-owl body feathers. Close inspection of the feathers revealed no blood or tissue attached to the tip of the feather shafts suggesting an attempt at predation by the Kestrel. These feathers appeared to be fright-moulted. Fright moult is a well-documented behaviour where a prey species sheds, typically body feathers, as an escape mechanism when attacked (Lindström & Nilsson 1988).

Although Kestrels are known predators of small passerines, rodents, lizards and insects, there is no mention in the literature of a kestrel predating on any species of owl (Cramp 1980). It is possible that the Kestrel upon seeing this predator flew in to mob the Hawk-owl and then shifted to predatory behaviour. Alternatively, Kestrels are documented to pirate food from other avian predators and scavengers (Balfour 1973, Reese 1973, Slade 1977, Korpimäki 1984). It is possible that this Kestrel perceived the hawk-owl to be carrying food and attempted to steal it. However, we did not see the Hawk-owl carrying food. Kleptoparastism, i.e. food piracy, is suggested to evolve in some groups of birds as by-product of mobbing behaviour (Brockmann & Barnard 1979) but this paper shows that intraspecific food-stealing is effectively the same behaviour. A comprehensive review of the literature shows that certain orders of birds contain a disproportionate number of kleptoparasitic species. Birds in these orders occupy a limited range of ecological niches and are most commonly either predatory or dietary opportunists. Kleptoparasitism is particularly associated with certain ecological conditions, such as the availability of hosts feeding on large, visible food items and periods of food shortage. Birds show a wide range of socially parasitic feeding interactions of which kleptoparasitism is one extreme. The parasitic pattern of food-stealing is likely to involve frequency-dependent selection and may be an example of an evolutionarily stable strategy.”,”URL”:”http://www.sciencedirect.com/science/article/pii/0003347279901854”,”DOI”:”10.1016/0003-3472(79. In this case, an individual mobs a potential predator carrying food. If the predator is driven away, their food may remain behind to reward the attacker, in this case the kestrel.

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Sammanfattning

När vi den 21 september 2014 körde på väg E10 nära Björkliden fick vi syn på en hökuggla i en björktopp. När ugglan sedan flög bort längs vägen attackerades den av en tornfalkhona. Fåglarna hakade i varandras klor och föll otympligt ner i björkskogen. För att se vad som skulle hända följde vi fåglarna in i skogen och där fann vi tornfalken och hökugglan på marken fortfarande i varandras klor. När vi närmade oss flög tornfalken iväg och lämnade den något förvirrade hökugglan. Hökugglan satt kvar och tittade sig omkring men efter några minuter flög den iväg och satte sig i en björktopp, så vitt vi kunde se oskadad. Vi följde våra fotspår tillbaka till platsen där vi först påträffade fåglarna. Där fanns en del hökugglefjädrar som vi inspekterade noga. Vi kunde dock inte finna blod eller vävnadsrester som kunde tyda på ett verkligt predationsförsök utan tolkade fjäderförlusten som resultat av skräckruggning, vilket är en känd flyktreaktion vid en attack. Tornfalkar tar allehanda byten men det omnämns inte i litteraturen att någon art av uggla skulle utgöra byte. I vårt fall kanske tornfalken såg högugglan och skulle mobba den men hastigt växlade om till jakt. Alternativt kan tornfalken ha trott sig se att hökugglan hade ett byte. Det är känt att tornfalkar kan stjäla byten från andra fåglar, ett beteende som föreslagits kunna utvecklas som biprodukt av mobbning. Enligt vad vi såg hade ugglan dock inget byte

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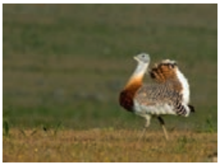

Invitation to Badajoz, Spain!

10th Conference of the European Ornithologists' Union

University of Extremadura, Spain: 24 – 28 August 2015

We are excited to invite the EOU delegates to Badajoz, site of the University of Extremadura (UEx). Badajoz is the biggest city in Extremadura. It is situated close to the Portuguese border, on the left bank of the river Guadiana. Badajoz is well positioned with good bus and car links to Madrid, Seville and Lisbon. Extremadura is recognized nowadays in Europe as an ecological region with unique nature spaces in Europe, and a real treasure for birdwatchers. Extremadura offers the possibility of birdwatching in natural habitats of great beauty and also of enjoying its interesting cultural and historical heritage.

The UEx is a Spanish public university with particular interest in Science, where many research groups are focusing on ornithological investigations. UEx campus in Badajoz is big and comfortable. The UEx will provide all our conference facilities within a compact area including a lecture theatre seating up to 450 delegates, smaller lecture theatres for parallel sessions, break-out areas, display areas and meeting rooms.

Current bottom line cost is not more than € 230 per delegate. This budget covers all site bookings, administration, delegate packs, coffee & refreshments, lunch, welcome reception, social evening dinner and mid-conference excursion. Costs for accommodation in Badajoz usually range between 20 and 50 euros per night in August. The local organizing committee will negotiate good rates with the student residences, hostels and hotels in Badajoz.

We are planning three full conference days plus one day of mid-conference excursions, which will include a range of natural landscapes and valuable monumental sites.

We are looking forward to seeing you in 2015!

UEx Local Organizing Committee

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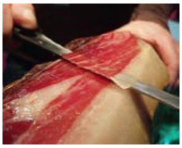


Innehåll i årgång 24, 2014 *Contents of volume 24, 2014*

BERG, C. & LERNER, H. **Second brood in Canada Geese *Branta Canadensis?*** *Andrahäckning hos kanadagås* Branta canadensis? 51

ENEMAR, A. & WIKLANDER, K. **Density and fluctuations of a nest-pocket breeding population of the Treecreeper *Certhia familiaris* over a 28-year period.** *Tätheten och fluktuationerna hos en holkhäckande population trädkrypare* Certhia familiaris *under 28 år.* 27

ERICSSON, P, NILSSON, L.O., HAGLUND, K. & ERICSSON, D. **Breeding biology of a Tawny Owl *Strix aluco* population in south-western Sweden – a 15 year survey.** *Häckningsbiologin hos en population av kattuggla* Strix aluco *i sydvästra Sverige – en femtonårig studie.* 41

HAAS, F., BARBET-MASSIN, M., GREEN, M., JIGUET, F. & LINDSTRÖM, Å. **Species turnover in the Swedish bird fauna 1850–2009, and a forecast for 2050.** *Artomsättningen i den svenska fågelfaunan 1850–2009 samt en prognos för 2050.* 106

KAMPE-PERSSON, H. **Staging and wintering Taiga Bean Geese *Anser fabalis fabalis* in north-east Scania, south Sweden.** *Rastande och övervintrande taigasädgäss* Anser fabalis fabalis *i Nordostskåne.* 56

LARSON, K.W. & KUNDISCH, S. **Attempted predation of Northern Hawk-owl *Surnia ullula* by Common Kestrel *Falco tinnunculus?*** *Predationsförsök på hökuggla* Surnia ullula *av tornfalk* Falco tinnunculus? 165

LEHMHUS, J. & GUSTAVSSON, C.G. **Hybrids between Bar-headed Goose *Anser indicus* and Snow Goose *Anser caerulescens.*** *Hybrider mellan stripgås* Anser indicus *och snögås* Anser caerulescens. 147

MARLING, S. **Tätheten av gransångare *Phylloscopus c. collybita* och lövsångare *Phylloscopus trochilus* i ett sydsvenskt villaområde.** *Density of Chiffchaffs* Phylloscopus c. collybita *and Willow Warblers* Phylloscopus trochilus *in a south Swedish villa suburb.* 99

NILSSON, L. **Fluctuations and trends in the numbers of staging waterbirds in south Sweden in September 1973–2013.** *Fluktuationer och trender hos rastande sjöfåglar i södra Sverige i september 1973–2013.* 129

NOREVIK, G. **Horned Grebe *Podiceps auritus* and Red-necked Grebe *Podiceps grisegena* in Sweden 2011 – results from a national survey.** *Svarthakedopping* Podiceps auritus *och gråhakedopping* Podiceps grisegena *i Sverige 2011 – resultat från en nationell inventering.* 81

PETERSSON, A., BERGNER, A. & THORIN, M. **A hybrid Common Redstart x Black Redstart *(Phoenicurus phoenicurus x P. ochruros)* breeding in southeastern Sweden.** *En hybrid rödstjärt x svart rödstjärt* (Phoenicurus phoenicurus x P. ochruros) *häckande i sydöstra Sverige.* 35

SOLHEIM, R. **Age of Great Grey Owls *Stirix nebulosa* observed in Scandinavia in 2012 as revealed by digital photos in the national species report archives.** *Ålderssammansättning hos lappugglor* Strix nebulosa *observerade i Skandinavien 2012 bestämd med hjälp av digitala fotografier inskickade till Artdatabankens artportal.* 3

STRÖM, K. & NIKLASSON, A. **European Storm Petrels *Hydrobates pelagicus* visiting the Swedish west coast; results from a ringing study 1988–2012.** *Stormsvalor* Hydrobates pelagicus *som besöker den svenska Västkusten; resultat från en ringmärkningsstudie 1988–2012.* 12

Nya böcker ***New books*** 79