

## Distribution and numbers of wintering waterbirds in Sweden in 2015 and changes during the last fifty years

*Utbredning och antal av övervintrande sjöfåglar i Sverige 2015 och förändringar under de senaste femtio åren*

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### Abstract

The International Waterfowl Census started in Europe in 1967, in Sweden already in 1966. In Sweden, country-wide surveys of the inshore coastal areas were undertaken in 1971–1973, 2004 and 2015 in addition to the annual sample counts. In 2015, the entire coast between the Norwegian border and the northern part of the Stockholm archipelago was covered. The total estimate was 616000 (excluding seaducks such as Long-tailed duck and scoters), a slight increase since 2004 and a large increase since 1971–1973. Long-term significant increase or little change was recorded for all species but the Long-tailed Duck which decreased significantly. The distribution showed marked changes for several species, with

larger proportions being found in the Baltic archipelagos in later years. In all EU the seaducks declined whereas most other species were stable or increased. In four diving ducks an increase in Sweden and other northern areas was balanced by decreasing numbers for countries to the south and southwest. Thus population changes in Sweden could be related to milder winters in the northern part of the wintering area.

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### Introduction

Coordinated midwinter counts of waterbirds have been undertaken on a European scale since January 1967, when the midwinter counts of the International Waterfowl Census (IWC) were started in a number of countries including Sweden (Atkinson-Willes 1969, Nilsson 1975, Gillisen et al. 2002; see Nilsson 2008 for more references). Before that, Sweden and some other countries had been running specific national programs for a number of years (Atkinson-Willes 1963, Owen et al. 1986, Nilsson 1968, 1976). It was, however, soon realized that international cooperation was needed and accordingly the IWC was initiated by Wetlands International. Some of the major aims of this project are to get population estimates and trends both on a regional and global scale and to map the distribution of the different species. The IWC also aims to provide background information for international agreements relating to management of wetland birds such as the Ramsar convention and AEWA (African Eurasian Waterfowl Agreement). For general information about IWC and the international results of the Midwinter Counts, see [www.wetlands.org](http://www.wetlands.org).

In Sweden, midwinter counts started one year before the IWC, in January 1966, when a pilot study was carried out (Nilsson 1967). The results of the first forty years of the IWC in Sweden (1967–2006) have been reported by Nilsson (2008), where details of the early counts are to be found.

In short, the aim during the first years of the counts was to get as complete coverage of as many potential wintering areas of waterfowl as possible (Nilsson 1975). To reach this goal, aerial surveys were organized after a Danish model (Joensen 1968, 1974) during 1971–1973 eventually covering all inshore areas of south Sweden (more northern areas being ice-covered in winter in those years). However, it was realized that country-wide surveys could not be undertaken every year and the counts were therefore concentrated at covering a careful selection of important sites counted every year for the calculation of annual indices. A full-scale survey of the inshore areas was again organized in 2004, and in 1987–1989 some regions were fully covered (Nilsson 2008). The first country-wide survey of offshore waters was undertaken in 2007–2011 (Nilsson 2012) but extensive boat

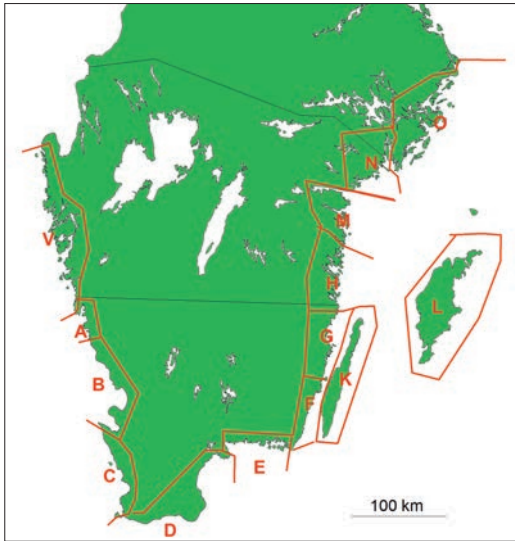


Figure 1. The division of the Swedish coast into regions. For description of the regions, see Table 1 and Nilsson (2008). In the analysis of distribution changes the regions are grouped into four larger units as follows: West = V and A–C, South = D–G, Large Islands = K and L, and Archipelago = H and M–O.

*Indelning av den svenska kusten i regioner. För beskrivning av regionerna se Tabell 1 och Nilsson (2008). I analyserna av förändringar i utbredningen har regionerna slagits samman i fyra storregioner enligt följande: Väst = V och A–C, Syd = D–G, Stora öarna = K och L, and Skärgård = H och M–O.*

surveys were made with the coast guard in some districts during the seventies (Nilsson 1980, 2012).

In 2015, a third country-wide survey of all in-shore coastal waters between the Norwegian border and the northern part of the Stockholm archipelago (Figure 1 and Figure 2) was carried out. In this paper we analyse the results of this survey in comparison with the two former country-wide surveys to elucidate any changes in numbers and distribution of different species, especially in relation to climate change (Lehikoinen et al. 2013, Pavon-Jordan et al. 2015). Moreover, we present population trends for a set of species both on a national and regional scale. New analytical tools allow us to include more species than has previously been done (Nilsson 2008). We will also set the Swedish results in a larger perspective as the results from the IWC in the other Baltic countries are available for comparison (cf. Skov et al. 2011).

In the running text throughout this paper we use only English names of bird species. Scientific names will be found in the species accounts and in figures and tables. In Table 2 the species are

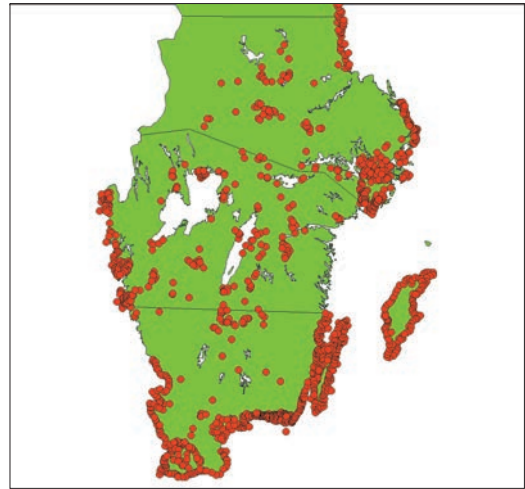


Figure 2. The geographical positions of sites included in the annual midwinter counts at least once during 2006–2015.

*Det geografiska läget för lokaler inventerade åtminstone vid ett tillfälle i samband med midvinterinventeringarna 2006–2015*

listed with their English, scientific and Swedish names. All photos by L. Nilsson.

## Material and Methods

### Organization

The International Midwinter Counts of Waterbirds in Sweden as in the other countries rely on voluntary counters, which cover one or more counting sectors at the specified dates. The counts are organized on the weekend with the Sunday closest to 15 January. Although the observers are encouraged to do the fieldwork during that weekend, it is allowed to do counts the week before and after to avoid bad counting conditions and to get a better coverage.

After the first few exploratory years, the entire Swedish coast was divided into counting sectors with established borders that have been kept the same since then. The strategy has been to have sectors with borders that can easily be recognized in the field. The size of the sectors was chosen to make it possible to cover the entire sector during

Table 1. Habitat characteristics of the different regions of south Sweden shown in Figure 1. *Habitatdata för de olika regionerna i södra Sverige enligt Figur 1.*

Code	Name	Main habitats
V	Bohuslän	Archipelago
A	N Kattegat	Open coast with some islands and skerries
B	S Kattegat	Open coast with shallow water and bays, some islands
C	Öresund	Open coast
D	S & E Scania	Open moraine coast with some beeches
E	Blekinge archipelago	Shallow archipelago with many rich bays and inlets
F	S Kalmarsund (mainland part)	Moraine coast with some smaller islands
G	N Kalmarsund (mainland part)	Open archipelago with relatively few islands
H	North Kalmar archipelago	Typical east coast archipelago
K	Öland	Open coast with cliffs and large areas of shallow water
L	Gotland	Open coast with cliffs and large areas of shallow water
M	Östergötland archipelago	Typical east coast archipelago
N	Södermanland archipelago	Typical east coast archipelago
O	Stockholm archipelago (north to Vaddö)	Typical east coast archipelago

one day. In practice it was normally possible for the counters to cover a number of sectors in a day. For inland Sweden, smaller lakes form one counting sector, whereas the larger lakes were split into several sectors in the same way as the coastal areas. Rivers were in many cases also split into smaller sectors.

During the first years of midwinter counts, the observers freely selected the sites to be covered but from the 1980s the counts for index calculations were standardized and a selection of larger coastal and inland areas (hereafter reference areas) was covered each year to form the basis for trend calculations (Nilsson 2008). These areas were subdivided into the same counting sectors as described above. In addition to the reference areas, counts from smaller sites spread over the country were also collected for the trend-calculations.

For the analysis of the country-wide surveys the coasts of southern Sweden were divided into fourteen regions with similar habitat features (Figure 1, Table 1). These regions were described in detail in Nilsson (2008). For our analysis of changes in the distribution of more common species between the country-wide surveys we have grouped these regions into four larger units (Figure 1). One large unit is called West and includes the regions V, A, B and C, i.e. the coast between the Norwegian border and Falsterbo peninsula, thus including Öresund. A second large unit is called South and includes the regions D, E, F and G, i.e. the coast from Fal-

sterbo to northern Kalmarsund (mainland coast). A third large unit is called Archipelago and includes the regions H, M, N and O, i.e. the rest of the eastern coast of southern Sweden through Stockholm archipelago. The fourth large unit, called Large Islands, includes the regions K and L, i.e. the islands of Öland and Gotland.

The Whooper Swan is included in the annual midwinter counts but in recent years it was realized that the species changed habits and was feeding to a higher extent in terrestrial habitats and could therefore not be accurately covered by the midwinter counts (Nilsson 2014). Therefore a special Whooper Swan survey was organized in 1995, and every fifth year since then, simultaneously with the midwinter count. The Whooper Swan survey in 2015, undertaken at the same time as the country-wide survey discussed here is reported separately in this same publication (Nilsson 2016).

#### *Ground counts*

During the ground counts the observer covered the counting sector(s) either by walking the shore line or from vantage points using telescope to cover the water areas, moving between counting points as fast as possible to minimize the effects of movements of the birds. Normally, one observer managed to survey one to several sectors within the same day.

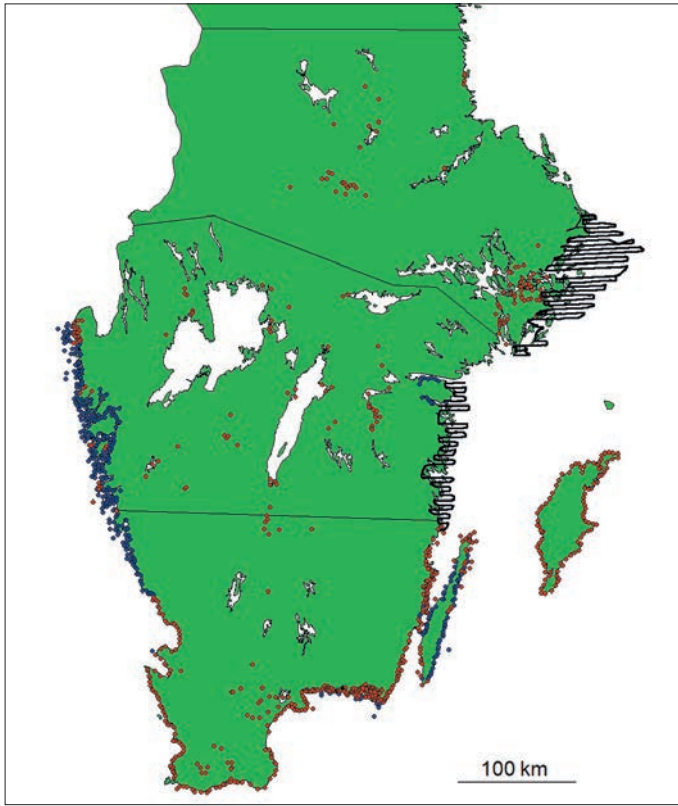


Figure 3. Sites covered at the country-wide survey in January 2015. Red = ground counts, blue = area-based aerial surveys, lines = aerial line transects (for details see Figure 4).

*Inventerade lokaler vid den landsomfattande kustinventeringen i januari 2015. Rött = landbaserade inventeringar; blått = flyginventeringar av hela områden och linjer = linjetaxeringar i skärgårdsområden (för detaljer se Figur 4).*

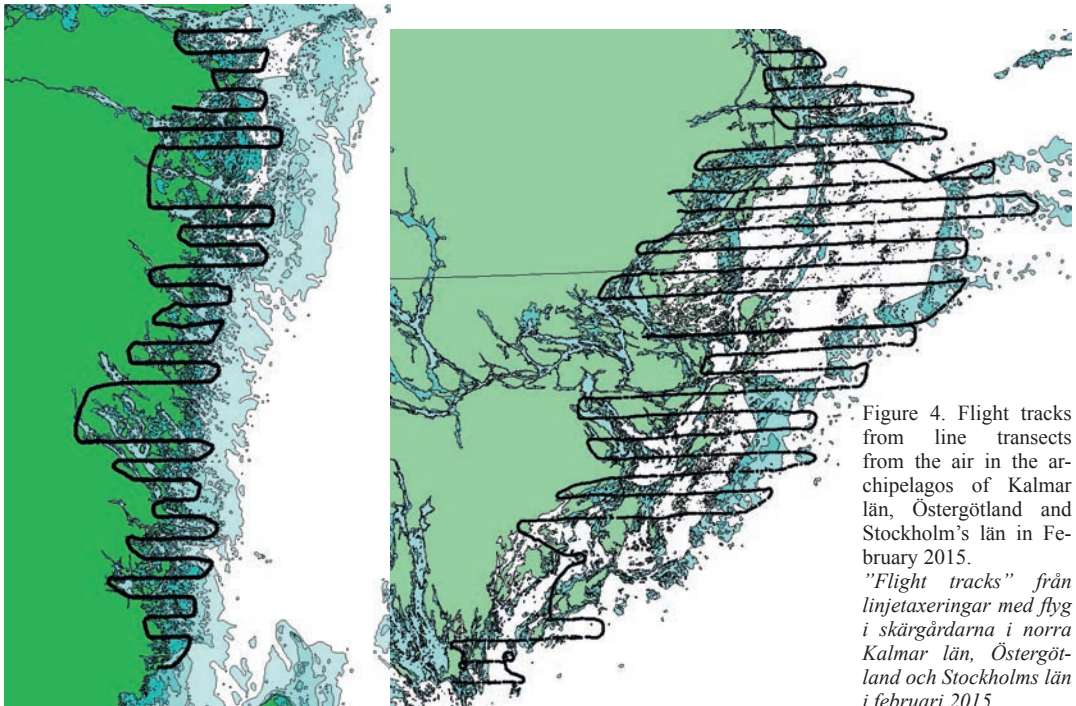


Figure 4. Flight tracks from line transects from the air in the archipelagos of Kalmar län, Östergötland and Stockholm's län in February 2015.

*"Flight tracks" från linjetaxeringar med flyg i skärgårdarna i norra Kalmar län, Östergötland och Stockholms län i februari 2015.*



## *Aerial surveys*

For the aerial surveys in 2015 we used a Cessna 337 Skymaster, a twin-engined high-winged aircraft with good visibility. The flying altitude was about 70 m and the speed 150–180 km/h, i.e. the slowest possible. Aerial surveys were only carried out in good weather conditions. The flight path was recorded by a GPS taking positions every ten seconds. One to two observers covered each side of the aircraft. All observations and the time of each of the observations were recorded. By using the time the observations were later synchronized with the GPS positions and transferred to a database.

During previous aerial surveys of inshore areas, and during surveys of some areas in this study, the aerial surveys covered the same counting sectors as used in the ground counts. Along open shores the flight path was laid out about 200 m from the shore, whereas in the archipelagos the different islands were circled so that the entire shallow water area within the sectors could be overlooked from the air. In the 2015 flight survey this method was used on the west coast, in Kalmarsund and along the open coasts of Öland. In contrast to previous aerial surveys there was no ice in the east coast archipelagos, which made the areas to cover too large for this method, so the remaining areas were covered by line transects (Figure 3).

The aerial line-transect method was developed for the offshore surveys (Nilsson 2012). In 2015 census lines were laid out so that all important water areas in the archipelagos could be covered. The distance between the survey lines here was 4 km. Fixed waypoints at the ends of each transect were established and navigation was undertaken with the aid of the GPS of the aircraft. We counted all waterbirds within a main belt extending 200 m on both sides of the aircraft. This means that we covered a zone 320 m wide as there was a dead angle below the aircraft. All observations of flocks outside the main belt were recorded as additional observation.

To estimate regional totals for the different species we used the counts within the main belts of the surveys and multiplied the number of observed birds with a factor of 12.5. Each flight transect represent a 320 m wide sample band through an area which was 2 km on each side of the aircraft, thus we extrapolated the number of birds by multiplying the number of observed birds with the quota between the width of the study area (4000 m) and the width of the sample band (320 m).

The efficiency of aerial surveys of different spe-

cies was much studied during the seventies by air/ground comparisons for different species in different habitats (Nilsson 1975, cf. also Joensen 1974). In these studies marked differences in the survey efficiency were found between species but also between different observers. During inshore surveys in the seventies, in 2004 and in some areas in 2015 the surveys were based on the counting sectors (see above), whereas the aerial surveys of the Swedish offshore waters in 2007–2011 (Nilsson 2012, Skov et al. 2011) as well as the east coast archipelago surveys in 2015 were performed as line transects. However, we do not believe that the use of two different survey methods severely influences the results. Thus, the results from 2015 are fully comparable with previous surveys.

## *Coverage of counts*

The annual Midwinter Counts cover a sample of counting sectors in the southern part of Sweden (Figure 2). During the last ten years between 644 and 944 counting sectors have been surveyed annually. For further details on the number of sectors covered at the counts see Appendix 1. For analytical reasons the majority of the counting sectors were grouped into 28 reference areas in the late 1980s. Within these reference areas a fixed selection of counting sectors were covered each year, whereas the counting frequency of other counting sectors has varied between years. In some of the reference areas all sectors could not be counted from the ground being hidden behind islands etc.

In the country-wide survey in January 2015, we used a combination of ground counts and aerial surveys to cover the inshore parts of the Swedish coast from the Norwegian border on the west coast to Norrtälje in the northern part of the Stockholm archipelago on the Baltic coast (Figure 3). The areas with open coast, i.e. mainly southern Halland to southern Kalmarsund and Gotland and parts of Öland were covered by ground counts, whereas the rest was covered from the air. Details of the line transects in the east coast archipelagos can be seen from Figure 4. We could not fly the entire Stockholm archipelago, because of military activities in some areas. Moreover it was not possible to cover the archipelagos of the Södermanland county due to lack of flying time in the region. Thus, there are some gaps in the geographical coverage. In all we spent 28.5 flying hours on active counting of waterfowl during the survey.

The coverage of the country-wide survey in 2015 was similar to the country-wide surveys in

1971 and 2004 (Nilsson 2008). In 1972, 1973, 1987–1989, complete coverage was obtained in some regions (see Tables 3–5, for details see Nilsson 2008). For details on the coverage of the counts in different years, see the annual reports that can be downloaded from the project webpage: <http://www.zoo.ekol.lu.se/waterfowl/index.htm>.

### Index calculations

We used the results from the land based counts to calculate population trends for a set of species both on national and regional scale. We based the regional analyses of the coastal regions on the four large areas presented in Figure 1. We did a separate analyses of inland waters. The inland waters were divided into two categories, Inland south and Inland north. We used freeze-up dates for small lakes, <10km<sup>2</sup> (SMHI 2015a) for the grouping. Inland south included lakes from the area where the freeze-up dates normally were after 1 January (Skåne and parts of Bohuslän, Halland and Blekinge) and the other, Inland north, from areas where freeze-up dates were before 1 January (the rest of Sweden). Only a subset of the species analysed at a national level was included in the regional analysis due to limited sample size. At both national and regional level we calculated species population trends based on the maximal available time span for which data were available. This resulted in that the starting year of the time series differed between species, because some species were not surveyed during the first years or they were not abundant enough resulting in too much missing data. On national scale we also calculated species trends for the last ten years (2006–2015). The use of a time span of 10 years is arbitrary, what is important is that it allows us to contrast the long term trends with the population dynamics during recent years.

We used the freely available software package TRIM (<http://www.ebcc.info/trim.html>) to perform the analysis. TRIM is developed to analyse times series of count data and has the ability to handle missing data using a log-linear Poisson regression method (Pannekoek & van Strien 2001). The outcome of this procedure is yearly indices.

For each species we present an overall trend estimate, which is the slope of a linear regression where the dependent variable is the logarithm of the indices, and the independent is year (Pannekoek & van Strien 2001). We run the TRIM model under the assumption that data were serially correlated.

Moreover, for 1971–2015 and 2006–2015, re-

spectively, we produced multiple species indices based on the yearly indices that resulted from the TRIM-analysis of all but two of the species (n=27) included in the national TRIM runs. Two species (Gadwall and Black Guillemot) were excluded because of missing data in the early years of the first mentioned time series.

The multiple species index for a given year was calculated by taking the geometric mean of all species' TRIM-indices that year (Gregory et al. 2005). This was then repeated for all years.

### Weather and ice conditions

The wintering waterbird populations around the inshore parts of the Swedish coast are dependent on the availability of open water. In order to characterize the weather conditions of the winters during the study period we have used two different proxies obtained from the Swedish Meteorological and Hydrological Institute (SMHI), the means of monthly mean temperatures for January for ten stations spread over the southern part of Sweden (the areas covered by duck counts) and the annual maximum for the ice-distribution of the Baltic sea and Kattegat (total area: 420 000 km<sup>2</sup>; SMHI 2015b).

Both these indicators clearly show that the winters in general have been milder in south Sweden during the years of midwinter counts. For the temperature there were several January months with low mean temperatures between 1966 and 1987, the latter the coldest January during the whole study period (Figure 5). After 1987, on the other hand, there was only one really cold January, in 2010.

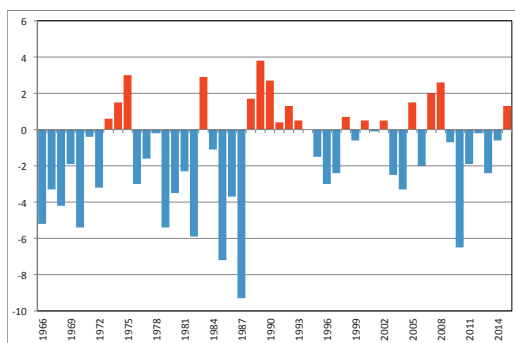


Figure 5. Annual means of monthly mean temperatures for January for ten meteorological stations spread over south Sweden over the area covered by Midwinter Counts. (From the monthly reports of SMHI, the Metrological and Hydrological Institute of Sweden).

*Årsmedeltal av de månatliga medeltemperaturerna för januari på tio väderstationer spridda över södra Sverige (Från SMIs månatliga rapporter).*

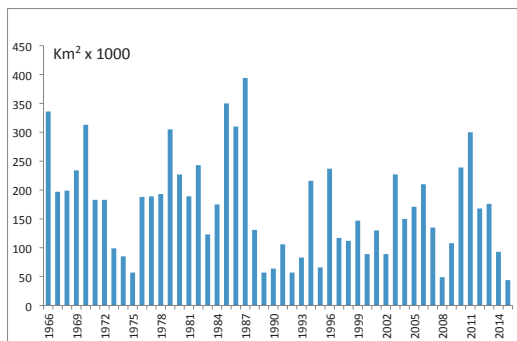


Figure 6. Maximal extent of ice-coverage in the Baltic Sea during the winters 1966–2015. From SMHI.

*Maximal isutbredning i Östersjön under vintrarna 1966–2015. Från SMHI.*

The maximum ice coverage of the Baltic shows a similar picture. Up to 1987 there were six winters with more than 250 000 km<sup>2</sup> in maximum ice-coverage, whereas there was only one such winter in the 28 years after 1987, namely 2011 (Figure 6). The mean temperature for January 2011 was not especially low, but the cold period with much ice came after the midwinter count. Comparing the two periods 1966–1987 and 1988–2015, the mean maximum ice-coverage for the winters were 216 000 km<sup>2</sup> and 134 000 km<sup>2</sup>, respectively.

To evaluate the influence of ice coverage on bird abundance we correlated the multiple species index with the area of open water (420 000 km<sup>2</sup> minus area of ice coverage). We did this for three separate time periods; 1971–1987 (low numbers of wintering waterbirds), 1988–2000 (increasing numbers of wintering waterbirds), and 2001–2015 (high numbers of wintering waterbirds).

### Abundance and distribution of wintering waterbird populations in 2015

In January 2015, the total wintering population of different waterbird species in inshore coastal waters of Sweden was estimated to be 616 000, excluding a number of seaduck species (Long-tailed Duck, Velvet Scoter and Common Scoter), which have their main over-wintering areas further out at sea. Their numbers are excluded in Table 2, which shows the estimated numbers of wintering waterfowls in Swedish coastal waters at the three country-wide surveys of Swedish inshore waters, but are included (when fully covered) for some regions in Table 3–5, which show totals for larger areas from the country-wide surveys and from regional surveys with full coverage. Regional totals from

the 2015 are found in Appendix 2 and Appendix 3. The total number presented above for 2015 is likely to an underestimate. The area covered in 2015 was the same as in former country-wide coastal surveys but this winter was very mild. Thus, unlike the other years there were significant areas of open coastal water north of the surveyed area.

Full cover counts of Swedish inshore waters were also obtained in 1971 and 2004 (Table 2, Nilsson 2008). Total numbers of birds counted in 2004 was not very different from the totals counted in 2015; about 50 000 fewer were found in 2004. There are some differences for the different species, e.g. the Scaup was close to ten times more common in 2015 than in 2004. Other species that were markedly more common in 2015 were Goldeneye, Goosander and Mute Swan, whereas the total count for Tufted Duck was 43 000 higher in 2004 than in 2015.

Numbers counted at the coasts during the first country-wide survey in 1971 were appreciably lower for all species and the total was only 174 000.

In addition to the three country-wide coastal surveys discussed above, some regions were also covered fully in other years (see Table 3–5). The number of waterfowl in region V, the archipelago of Bohuslän (Table 3) shows the same general increase as was found in the national totals (Table 2). For the total waterbird fauna, numbers have increased dramatically between 1971 and 2015. The number of wintering waterfowls in this area is more than five times higher today compared to the beginning of the 1970s. The repeated surveys indicate that this increase has been a more or less continuous process, although a slight decline in numbers have occurred between 2004 and 2015, mainly so for Goldeneye, Eider, Mute Swan and Cormorant.

In the southern regions there were no marked changes in the overall numbers of wintering waterfowl between the early seventies and the late eighties, even if there was much variation between years for different species but also in the annual totals (Table 4). On the other hand overall totals more than doubled between the late eighties and the surveys in 2004 and 2015. The overall totals for the last two surveys were similar even if there were quite marked differences for some species.

Very marked changes in the number of wintering waterbirds were found for the archipelagos of the east coast when comparing the three surveys in 1971–1973 with the surveys in 2004 and 2015 (Table 5). Excluding the Long-tailed Duck, that was not covered fully in 2004 and 2015 (with the exception of Stockholm archipelago (region O, Fig-





Mallard, Goosander and Tufted Duck



Tufted Duck, Goosander and Mallard



Table 2. Total estimated wintering populations of different waterbirds species in Swedish coastal waters in 1971, 2004 and 2015. A dash indicates no estimate; some species were not counted in 1971 and for the seaducks offshore data are lacking in all three years.

*Uppskattat antal övervintrande individer efter de svenska kusterna för olika sjöfågelarter 1971, 2004 och 2015. Ett streck anger att skattning saknas; några arter inventerades inte 1971 och för de havslevande dykänderna saknas data från de yttre havsområdena.*

Species Art	1971	2004	2015
Mallard <i>Anas platyrhynchos</i> Gräsand	29400	77800	87000
Eurasian Teal <i>Anas crecca</i> Kricka	7	315	496
Eurasian Wigeon <i>Anas penelope</i> Bläsand	3	5562	8771
Gadwall <i>Anas strepera</i> Snatterand	4	14	114
Northern Pintail <i>Anas acuta</i> Stjärtand	4	14	25
Northern Shoveler <i>Anas clypeata</i> Skedand	0	1	1
Greater Scaup <i>Aythya marila</i> Bergand	1100	3153	26850
Tufted Duck <i>Aythya fuligula</i> Vigg	52197	225000	182000
Common Pochard <i>Aythya ferina</i> Brunand	92	2660	1208
Goldeneye <i>Bucephala clangula</i> Knipa	17606	71872	87000
Long-tailed Duck <i>Clangula hyemalis</i> Alfågel	–	–	–
Velvet Scoter <i>Melanitta fusca</i> Svärta	–	–	–
Common Scoter <i>Melanitta nigra</i> Sjöorre	–	–	–
Common Eider <i>Somateria mollissima</i> Ejder	4537	48995	51731
Red-breasted Merganser <i>Mergus serrator</i> Småskrake	2439	5334	5196
Goosander <i>Mergus merganser</i> Storskrake	7839	18004	35000
Smew <i>Mergellus albellus</i> Salskrake	348	3716	8007
Shelduck <i>Tadorna tadorna</i> Gravand	2	29	112
Mute Swan <i>Cygnus olor</i> Knölsvan	7281	31138	50500
Whooper Swan <i>Cygnus cygnus</i> Sångsvan	1434	1485	1196
Bewick's Swan <i>Cygnus bewickii</i> Mindre sångsvan	0	0	8
Coot <i>Fulica atra</i> Sothöna	3860	15597	11198
Cormorant <i>Phalacrocorax carbo</i> Storskarv	1008	11709	14258
Shag <i>Phalacrocorax aristotelis</i> Toppskarv	0	0	23
Grey Heron <i>Ardea cinerea</i> Gråhäger	–	495	606
Black-throated Diver <i>Gavia arctica</i> Storlom	–	114	36
Red-throated Diver <i>Gavia stellata</i> Smålom	–	30	124
Great Crested Grebe <i>Podiceps cristatus</i> Skäggdopping	–	4294	2726
Red-necked Grebe <i>Podiceps griseigena</i> Gråhakedopping	–	35	20
Slavonian Grebe <i>Podiceps auritus</i> Svarthakedopping	–	75	86
Little Grebe <i>Tachybaptus ruficollis</i> Smådopping	–	95	35
Total except seaducks			
<i>Summa exkl.. havsdykänder</i>	173999	569776	616112



Eider



Eider

Table 3. Total numbers of wintering waterbirds counted in region V, the archipelago of Bohuslän on the west coast (Figure 1) at surveys covering the entire province. Species marked with dash for 1971 were not counted during that year.

*Antal övervintrande sjöfåglar i region V, Bohusläns skärgård (Figur 1), vid inventeringar som täckte hela landskapet. Arter markerade med streck 1971 inventerades inte det året.*

Species Art	1971	1987	1988	1989	2004	2015
<i>Anas platyrhynchos</i>	1083	3023	4315	2333	7055	2463
<i>Anas crecca</i>	0	0	0	0	11	0
<i>Anas penelope</i>	0	0	2	0	1	0
<i>Anas strepera</i>	0	1	0	0	1	0
<i>Anas acuta</i>	0	0	0	0	0	0
<i>Aythya marila</i>	0	0	25	0	10	0
<i>Aythya fuligula</i>	1020	4	82	0	328	361
<i>Aythya ferina</i>	40	1	3	0	3	0
<i>Bucephala clangula</i>	996	1242	2967	1803	13161	6822
<i>Clangula hyemalis</i>	87	0	0	81	11	7
<i>Polysticta stelleri</i>	0	0	0	0	0	0
<i>Somateria mollissima</i>	2881	1918	4702	5549	36582	29706
<i>Melanitta fusca</i>	10	0	131	136	13	4
<i>Melanitta nigra</i>	14	11	56	128	76	80
<i>Mergus serrator</i>	214	427	1006	1076	1313	766
<i>Mergus merganser</i>	114	790	356	66	1020	539
<i>Mergellus albellus</i>	0	10	9	0	52	2
<i>Tadorna tadorna</i>	0	0	5	1	10	13
<i>Cygnus olor</i>	1007	1393	1680	913	3287	2330
<i>Cygnus cygnus</i>	167	709	374	230	316	100
<i>Fulica atra</i>	40	3	1	0	235	5
<i>Phalacrocorax carbo</i>	172	1503	1601	652	3438	1766
<i>Phalacrocorax aristotelis</i>	–	0	0	0	0	21
<i>Ardea cinerea</i>	–	0	18	121	99	50
<i>Gavia arctica</i>	–	0	28	5	2	0
<i>Gavia stellata</i>	–	0	4	1	0	1
<i>Podiceps cristatus</i>	–	0	2	0	2	3
<i>Podiceps griseigena</i>	–	0	0	0	2	0
<i>Podiceps auritus</i>	–	0	0	0	5	0
<i>Tachybaptus ruficollis</i>	–	0	0	2	17	1
Total Summa	7845	11035	17367	13097	67050	45040





Long-tailed Duck



Cormorant



Table 4. Total numbers of wintering waterbirds in regions A–L (from northern Kattegat through northern Kalmarsund, Öland and Gotland; Figure 1) at surveys covering the inshore areas of this entire area. Species marked with a dash for 1971 were not counted during that year. For *Clangula hyemalis*, *Melanitta fusca* and *Melanitta nigra* (marked with grey in the table) only a small proportion of the total populations are found close to the shore, so the figures presented do not represent total population estimates for the regions but are the numbers actually counted in surveys of the inshore areas.

*Antalet övervintrande sjöfåglar räknade i regionerna A–L (från N Kattegatt till och med Kalmarsund, Öland och Gotland; Figur 1) vid räkningar som täckte de inre farvattnen i hela detta område. Arter markerade med streck 1971 räknades inte det året. För alfågel, svärta och sjöorre (markerade med grått i tabellen) återfinns endast en mindre andel av det totala beståndet nära stranden, varför de angivna siffrorna inte representerar några beståndsskatningar utan endast anges vad som räknats vid inventeringarna av de inre farvattnen.*

Species Art	1971	1972	1973	1987	1988	1989	2004	2015
<i>Anas platyrhynchos</i>	22310	33630	33290	18852	32997	44137	60476	72220
<i>Anas crecca</i>	7	2	68	11	38	36	297	496
<i>Anas penelope</i>	3	13	74	0	247	450	5560	8765
<i>Anas strepera</i>	0	0	0	0	0	2	6	114
<i>Anas acuta</i>	4	3	3	2	3	9	14	25
<i>Aythya marila</i>	1100	121	364	216	3398	2481	2854	26850
<i>Aythya fuligula</i>	35780	40950	66510	51085	48422	61715	145714	97706
<i>Aythya ferina</i>	52	202	351	186	837	1188	2500	1208
<i>Bucephala clangula</i>	14970	17360	24150	23552	21427	19468	30644	35282
<i>Clangula hyemalis</i>	11312	29509	35192	10753	8144	7974	30934	12328
<i>Polysticta stelleri</i>	5	6	4	46	6	57	2	0
<i>Somateria mollissima</i>	1307	2347	2663	1388	2122	1994	10725	21980
<i>Melanitta fusca</i>	662	2157	2570	31	843	700	1155	8162
<i>Melanitta nigra</i>	626	431	221	14	193	537	4316	5462
<i>Mergus serrator</i>	1865	2272	3664	3833	3599	2791	3913	4415
<i>Mergus merganser</i>	4070	2826	4490	8218	2453	3481	8539	6539
<i>Mergellus albellus</i>	348	177	377	384	214	347	3295	5733
<i>Tadorna tadorna</i>	2	1	19	0	11	173	10	99
<i>Cygnus olor</i>	4407	4610	5770	7817	7165	8424	20800	18990
<i>Cygnus cygnus</i>	1247	902	859	975	414	467	1084	1067
<i>Cygnus bewickii</i>	0	0	0	0	0	0	0	8
<i>Fulica atra</i>	3700	6264	9330	1710	1890	1560	14472	11193
<i>Phalacrocorax carbo</i>	518	812	563	1356	2343	1729	5648	10212
<i>Phalacrocorax aristotelis</i>	–	0	0	0	0	0	0	2
<i>Aredea cinerea</i>	–	15	34	21	75	72	392	556
<i>Gavia arctica</i>	–	1	1	2	52	10	112	36
<i>Gavia stellata</i>	–	2	2	1	212	91	14	123
<i>Podiceps cristatus</i>	–	9	6	57	83	53	4285	2723
<i>Podiceps griseigena</i>	–	0	0	4	11	9	33	20
<i>Podiceps auritus</i>	–	2	3	0	2	1	70	86
<i>Tachybaptus ruficollis</i>	–	0	0	1	1	4	76	34
Total Summa	104295	144624	190578	130515	137202	159960	357940	352431



Coot and Mallard



Goldeneye

Table 5. Total numbers of wintering waterbirds counted in the regions H, M, N and O on the east coast, from northern Kalmar county through Stockholm archipelago (Figure 1) at surveys covering the inshore areas of the entire area. Species marked with dash for 1971 were not counted during that year. The outer parts used by *Clangula hyemalis* were not covered completely and no counts are shown for this species. \* = incomplete coverage 2015 (region N was not covered) and total estimates based on line transects.

*Antalet räknade övervintrande sjöfåglar i ostkustskärgårdarna, regionerna H, M, N och O, från norra Kalmar län till Vaddö i Stockholms skärgård; Figur 1) vid inventeringar som täckte hela området. Arter markerade streck 1971 inventerades ej detta år. De yttre alfågeldområdena inventerades inte fullständigt, varför alfågeldata inte redovisas här. \* = ofullständig täckning 2015 (region N ej inventerad) summorna är beräknade från linje-taxeringar.*

Species Art	1971	1972	1973	2004	2015*
<i>Anas platyrhynchos</i>	4960	7260	6620	9090	11400
<i>Anas crecca</i>	0	0	0	3	0
<i>Anas penelope</i>	0	0	0	1	6
<i>Anas strepera</i>	0	0	0	1	0
<i>Anas acuta</i>	0	0	0	0	0
<i>Aythya marila</i>	0	3	0	289	0
<i>Aythya fuligula</i>	15395	16662	17285	78622	70100
<i>Aythya ferina</i>	0	52	41	157	0
<i>Bucephala clangula</i>	1010	2140	2380	26325	41950
<i>Clangula hyemalis</i>	–	–	–	–	–
<i>Polysticta stelleri</i>	3	0	1	1	0
<i>Somateria mollissima</i>	229	481	336	160	45
<i>Melanitta fusca</i>	4	2	71	7	0
<i>Melanitta nigra</i>	2	12	41	65	0
<i>Mergus serrator</i>	110	100	50	57	15
<i>Mergus merganser</i>	3590	4370	4570	8425	25671
<i>Mergellus albellus</i>	0	0	16	345	2272
<i>Tadorna tadorna</i>	0	0	0	0	0
<i>Cygnus olor</i>	1477	1224	1732	6584	27830
<i>Cygnus cygnus</i>	20	19	19	51	29
<i>Fulica atra</i>	120	1020	4950	652	0
<i>Phalacrocorax carbo</i>	205	736	476	1817	2280
<i>Aredea cinerea</i>	–	1	1	4	0
<i>Gavia arctica</i>	–	1	0	1	0
<i>Gavia stellata</i>	–	2	1	2	0
<i>Podiceps cristatus</i>	–	0	4	12	0
<i>Podiceps griseigena</i>	–	0	2	0	0
<i>Podiceps auritus</i>	–	0	0	0	0
<i>Tachybaptus ruficollis</i>	–	1	0	2	0
Total Summa	27125	36086	38596	138696	197348



ure 1) during 2015), the totals for the other species in the inshore areas were four to six times higher in the two later surveys compared with the seventies. Very marked changes were found for most common species.

### Species accounts

In this section the distribution and numbers of the more common wintering species in 2015 are discussed separately. For each species a map showing the national distribution according to the counts in 2015 is presented. Similar maps for the two previous country-wide surveys are found in Nilsson (2008), where details for the previous surveys can also be found. For some of the more common species their detailed distribution in three archipelago areas (the central part of the archipelago of Bohuslän (region V), Småland – Östergötland (regions H and M) and the Stockholm archipelago (region O)) is shown in maps. Changes in the distribution of the more common species between the three country-wide surveys over four larger regions (see division in Figure 1) are also presented in a series of graphs. Long-term and short-term trends for the different species will be discussed later (p 31).

### Mallard *Anas platyrhynchos*

The most wide-spread species in winter is the Mallard which was found in good numbers over most of south Sweden, i.e. in the parts of the country where ice-free water was available. Along the coasts the species was found to be common in all areas except the east coast archipelagos north of

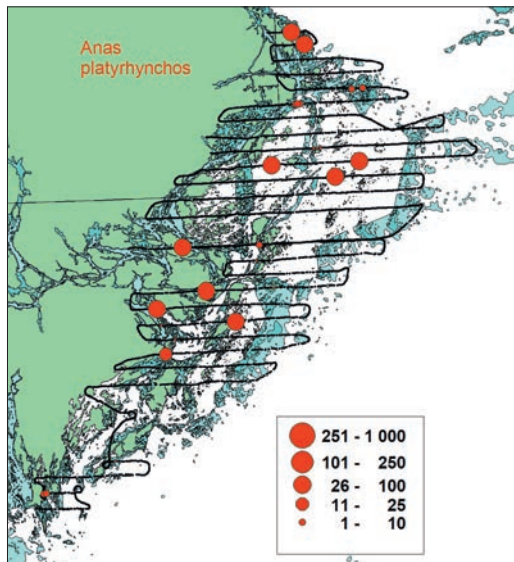
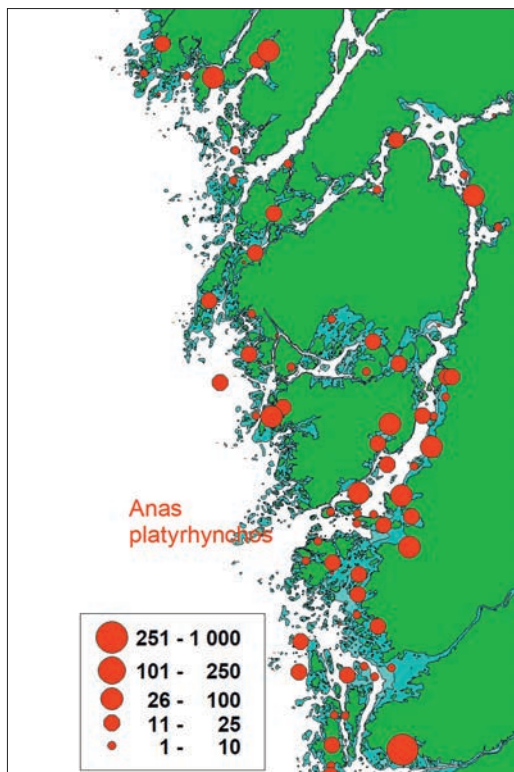
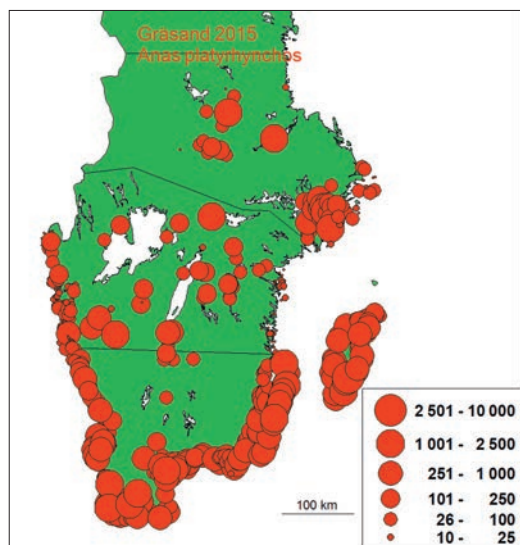


Figure 7. National and regional midwinter distribution of Mallard *Anas platyrhynchos* in 2015. Gräsandens midvinterutbredning på nationell och regional nivå 2015.



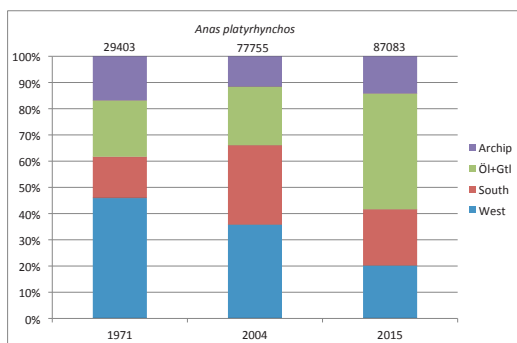
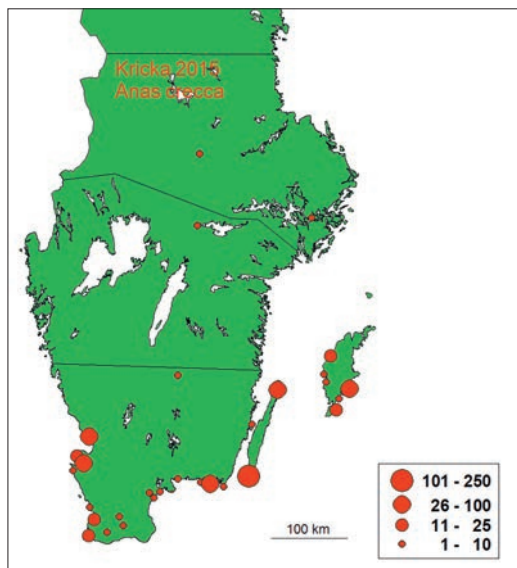


Figure 8. The percentage distribution of Mallard *Anas platyrhynchos* in four larger regions along the coasts of south Sweden during the country-wide surveys in 1971, 2004 and 2015. Total numbers counted or estimated shown above the bars.

*Utbredning i procent för gräsand inom fyra större regioner längs kusterna av södra Sverige vid de landsomfattande inventeringarna 1971, 2004 och 2015. Antalet räknade eller beräknade individ av de olika arterna visas över staplarna.*

Kalmarsund. The species occurs in most inland areas with open water (Figure 7). The detailed map over the west coast archipelagos shows that it is mostly concentrated to the inner waters even if some smaller groups were also found further out on the more exposed skerries. The relatively few flocks that were seen in the Stockholm archipelago occurred both in the inner and middle parts of the archipelago.



In the Mallard about 45% were found on the west coast including Öresund during the 1971 survey, this proportion decreased to about 20% in 2015 (Figure 8). During this survey the islands Öland and Gotland hosted almost 45% of all Mallards counted. The proportion of Mallards found in the archipelagos showed only small changes between the three surveys even if the total number of individuals was much larger in 2004 and 2015 than in 1971.

In all, 87 000 Mallards were estimated to overwinter along the coasts in 2015, implying that the Mallard was the second commonest species in inshore coastal waters together with the Goldeneye. For the inland areas we do not have any estimate of the total wintering Mallard population for 2015 as it was a mild winter with much open water and the Mallard is wide-spread also in inland areas. During the survey in 2004 the total population of Mallards in Sweden was estimated to be about 150 000 compared to 68 000 in 1971. In 2004, the coastal total for the Mallard was 78 000 (Table 2), i.e. almost half of the national estimate. With this in mind it is most probable that the total population for Sweden in the winter of 2015 was more than 200 000.

#### Teal *Anas crecca* & Wigeon *Anas penelope*

These two dabbling ducks have a restricted winter distribution in Sweden. When the counts started they were only seen in small numbers in the country during the winter but both species have estab-

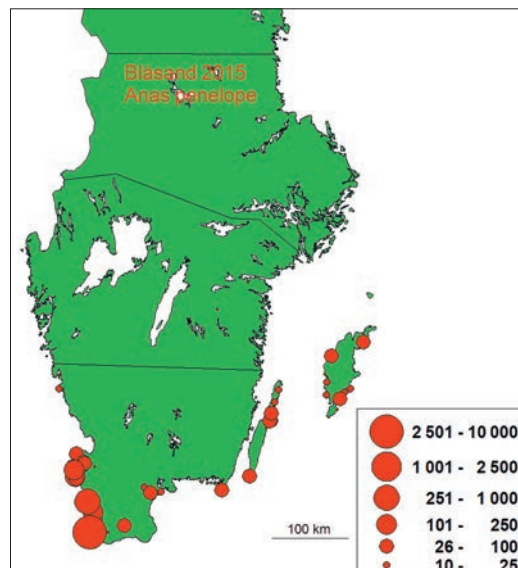


Figure 9. Midwinter distribution of Teal *Anas crecca* and Wigeon *Anas penelope* in Sweden 2015. *Midvinter utbredning för Kricka och Blåsand i Sverige 2015*

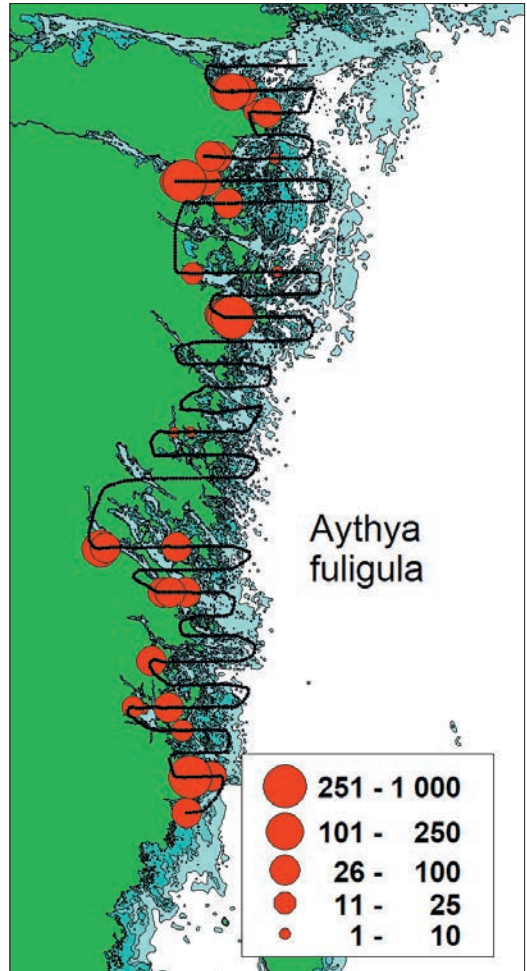
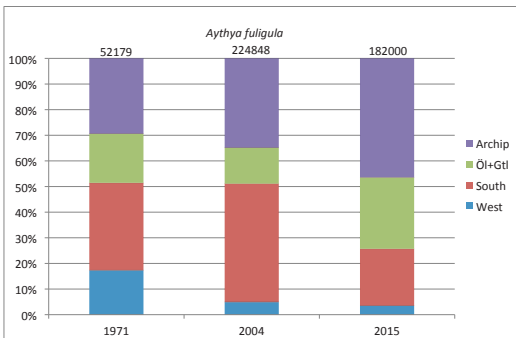
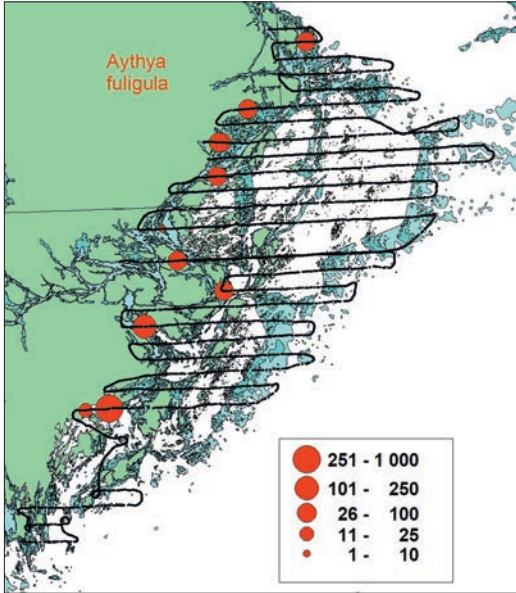
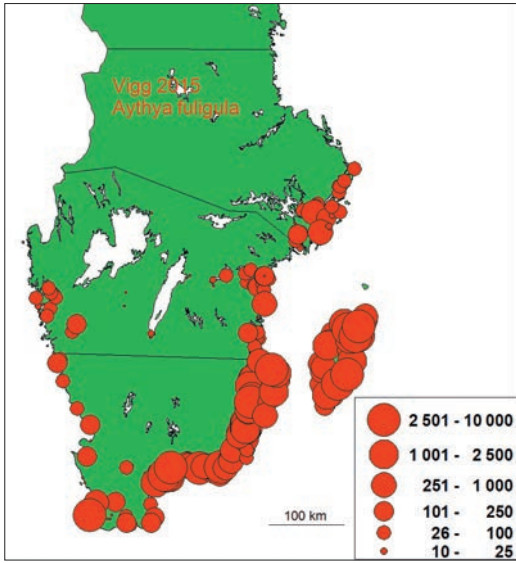


Figure 10. National and regional midwinter distribution of Tufted Duck *Aythya fuligula*.

*Viggens* midvinterutbredning på nationell och regional nivå 2015.

Figure 11. The percentage distribution of Tufted Duck *Aythya fuligula* in four larger regions along the coasts of south Sweden during the country-wide surveys in 1971, 2004 and 2015. Total numbers counted or estimated shown above the bars.

*Utbredning i procent för vigg inom fyra större regioner längs kusterna av södra Sverige vid de landsomfattande inventeringarna 1971, 2004 och 2015. Antalet räknade eller beräknade individ av de olika arterna visas över staplarna.*

lished a wintering habit in south Sweden in more recent years. They are mostly concentrated to Scania with some occurrences on Öland and Gotland (Figure 9).

#### Tufted Duck *Aythya fuligula*

Among the diving ducks in inshore waters, the Tufted Duck was the commonest species followed by the Goldeneye and Mallard. In 2015 the total number of Tufted Ducks in the Swedish coastal waters was estimated to be 182 000 compared to 225 000 in 2004 and only 52 200 in 1971 (Table 2). The Tufted Duck was distributed along the entire Baltic coast surveyed, with some larger concentrations also in the Öresund (Figure 10), whereas only smaller numbers were found on relatively few sites on the west coast north of Öresund. In the east coast archipelagos, the Tufted Ducks were markedly concentrated to the inner parts, where often large flocks were found. These sites are mainly used as daytime roosts from which the Tufted Ducks disperse over the feeding areas further out at sea (Nilsson 1972). Only low numbers were found on a small number of inland sites.

Between the surveys in 1971 and especially 2015 there was a marked shift in the distribution from about 50% in the Öresund and the South region to about 25% here in 2015, the majority of the Tufted Ducks in Swedish coastal waters being found in the archipelagos and along the big islands in the Baltic, especially Gotland (Figure 11).

#### Scaup *Aythya marila*

The Scaup was counted in unusually high numbers in 2015, 26 850 individuals were observed. Most of them (88%) were concentrated to the east coast of the island of Gotland (Figure 12). Smaller numbers were found in the flocks of the numerous Tufted Duck in some other regions, but on Gotland several pure flocks with Scaup were found.

In all three surveys the majority of Scaups has been observed in the waters surrounding the Baltic islands and especially Gotland, but some flocks regularly occur also in the southern region and a few in Öresund (Figure 13). The total number in 2015 was much higher than in the other two surveys and the dominance for Gotland was much more marked.

#### Pochard *Aythya ferina*

Most Pochards occurred in a few areas along the coasts of south Sweden with a marked concentration in the province of Blekinge (Figure 12). Totally 1208 individuals were observed in 2015,

which can be compared with the 2660 Pochards that were counted in 2004. The total was much lower in 1971, with only 92 registered individuals. The Pochard will easily be underestimated during aerial surveys as they occur in the larger flocks of Tufted Ducks. In 2015 smaller numbers were also found inland.

#### Goldeneye *Bucephala clangula*

The Goldeneye is well spread along the entire coast covered in the present survey (Figure 14), being equally common on the west and east coast. In all, 87 000 Goldeneyes were estimated to be present in the areas surveyed in 2015, but this does not fully represent the national total for the species. The Goldeneye is well spread in small numbers on several inland sites and there was only little ice in the inland of south Sweden in 2015. The same applies to the coasts north of the surveyed areas in the Baltic. During the earlier surveys these inshore areas were ice-covered but in 2015 many ice-free areas potentially used by the Goldeneye was not covered by counts. It is therefore highly probable that the wintering population of Goldeneyes in Sweden was between 90 000 and 95 000 or even higher. The coastal total for the inshore areas in 2004 was 72 000, whereas the total for 1971 was appreciably lower, 17 600 (Table 2).

On the west coast, the Goldeneyes were mainly found in the inner parts of the archipelagos, even if some flocks were found on more exposed sites (Figure 14). In the narrow archipelago of Östergötland and Småland (regions H and M in Figure 1), they were also found in the innermost areas, whereas they occurred some distance from the mainland coast in the much wider Stockholm archipelago, but there were no Goldeneyes in the outer parts of this archipelago.

The Goldeneye is the species showing the most marked change in the distribution between the surveys (Figure 15). In 1971, only about 5% of the total coastal number was from the archipelagos compared to about 50% in the survey in 2015. In the same time there were marked changes in the total counts of the species. 2004 were somewhat in between when it comes to the distribution over the areas and the counts were not markedly lower than in 2015.

#### Velvet Scoter *Melanitta fusca* & Common Scoter *Melanitta nigra*

In the inshore coastal areas covered by the present survey, the Velvet Scoter and the Common Scoter were only found in larger numbers in Skålderviken

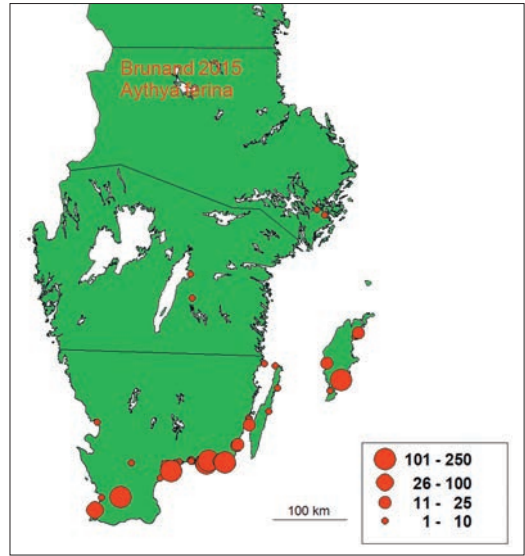
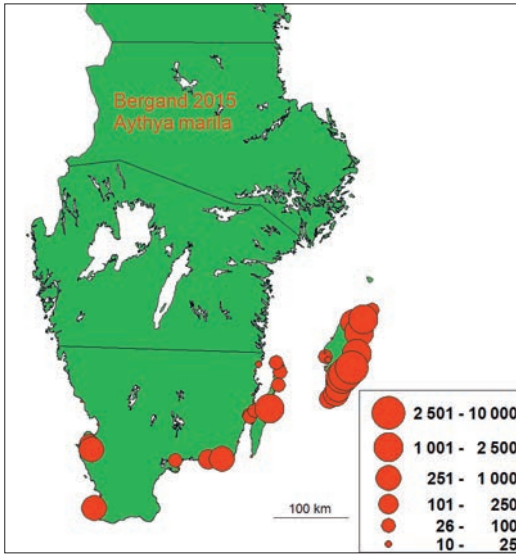


Figure 12. Midwinter distribution of Scaup *Aythya marila* and Pochard *Aythya ferina* in Sweden 2015. *Midvinter utbredning för Bergand och Brunand i Sverige 2015.*

and Laholmsbukten in southern Kattegat (Figure 16). In the other areas only small numbers of these two species were recorded from the shoreline. Both species do however in most areas stay far out at sea, not being seen from the shore, they are regular in relatively large flocks in offshore waters south of Falsterbo and in Hanöbukten (Nilsson 2012, Green & Nilsson 2015).

In Skålderviken and Laholmsbukten in southern Kattegat large proportion of the scoters can be counted from the shoreline in good weather condi-

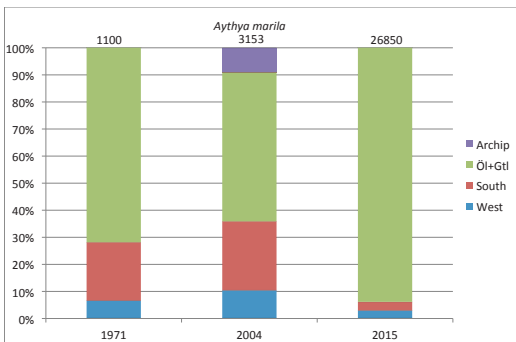


Figure 13. The percentage distribution of Scaup *Aythya marila* in four larger regions along the coasts of south Sweden during the country-wide surveys in 1971, 2004 and 2015. Total numbers counted or estimated are shown above the bars. *Utbredning i procent för bergand inom fyra större regioner längs kusterna av södra Sverige vid de landsomfattande inventeringarna 1971, 2004 och 2015. Antalet räknade eller beräknade individer av de olika arterna visas över staplarna.*

tions. In 2015, the total number of Common Scoters counted from the shore in south Swedish waters (Table 4) was 8162 and the number of Velvet Scoters was 5462.

#### Eider *Somateria mollissima*

The Eider was concentrated to the west coast and was not found in any of the other archipelagos covered by the 2015 survey (Figure 17). The only area not covered by the present survey where

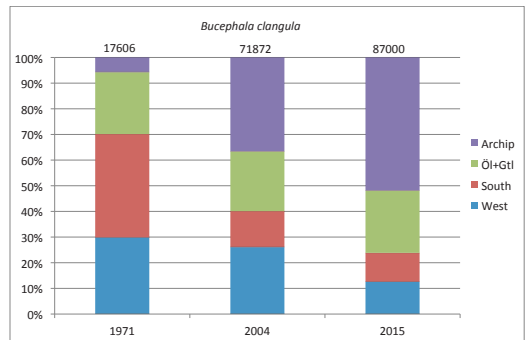


Figure 15. The percentage distribution of Goldeneye *Bucephala clangula* in four larger regions along the coasts of south Sweden during the country-wide surveys in 1971, 2004 and 2015. Total numbers counted or estimated shown above the bars.

*Utbredning i procent för knipa inom fyra större regioner längs kusterna av södra Sverige vid de landsomfattande inventeringarna 1971, 2004 och 2015. Antalet räknade /beräknade individer av de olika arterna visas över staplarna.*



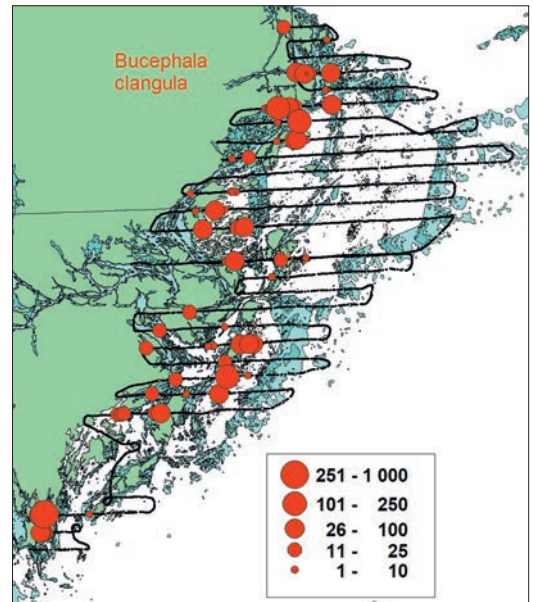
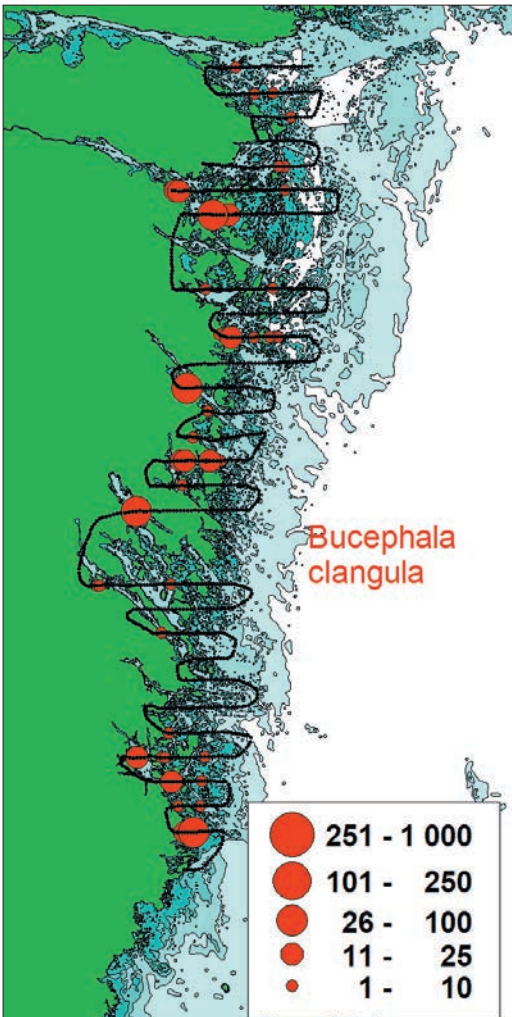
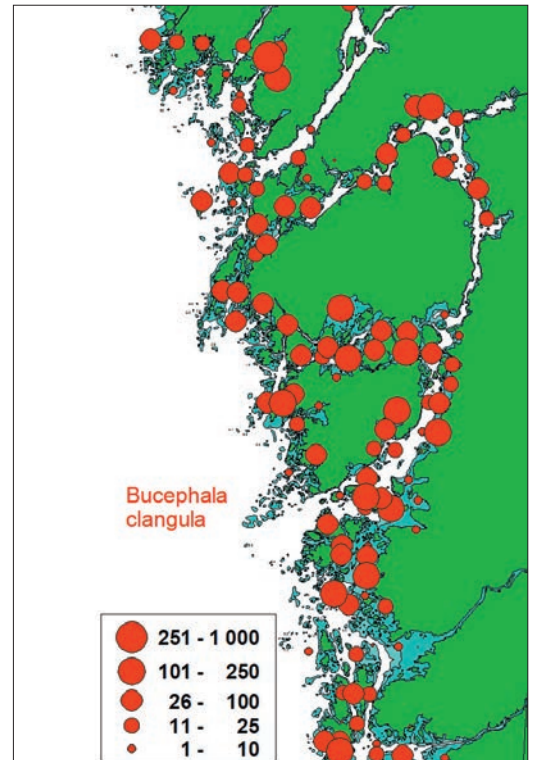
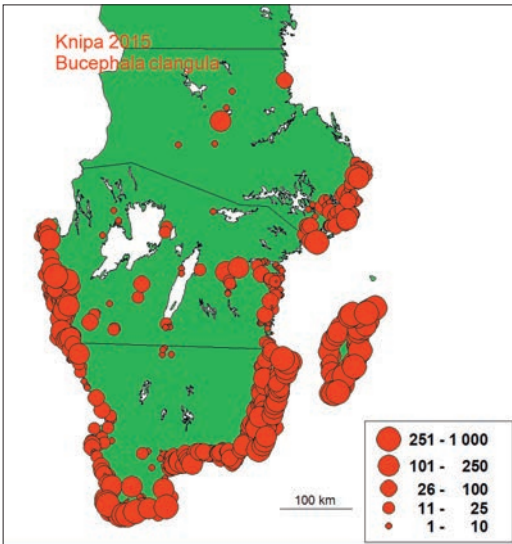


Figure 14. National and regional midwinter distribution of Goldeneye *Bucephala clangula*.  
Knipans midvinterutbredning på nationell och regional nivå 2015

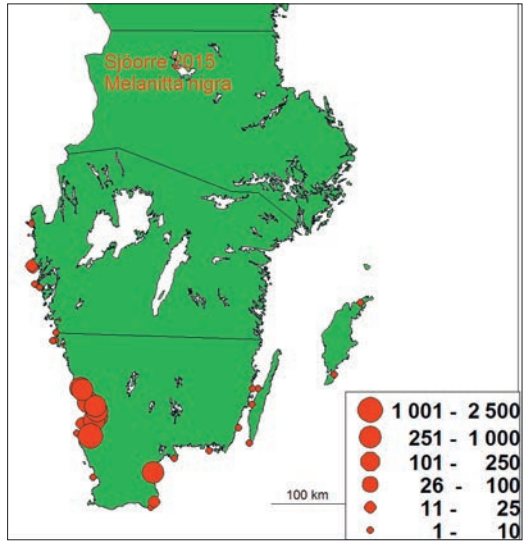
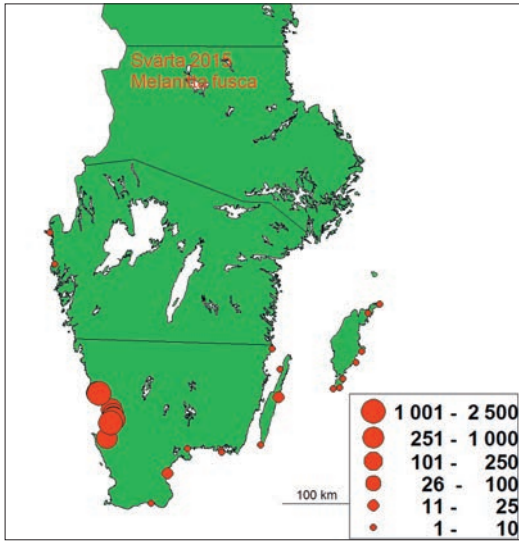


Figure 16. Midwinter distribution of Velvet Scoter *Melanitta fusca* and Common Scoter *Melanitta nigra* in Sweden 2015. *Midvinter utbredning för svärta och sjöorre i Sverige 2015.*

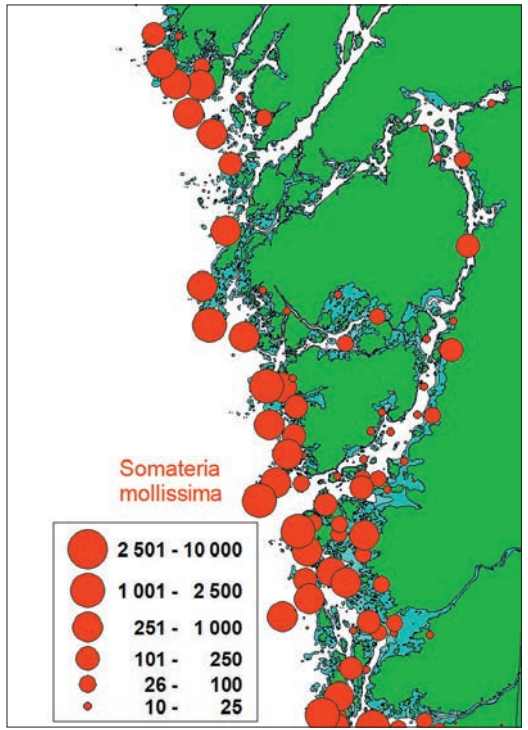
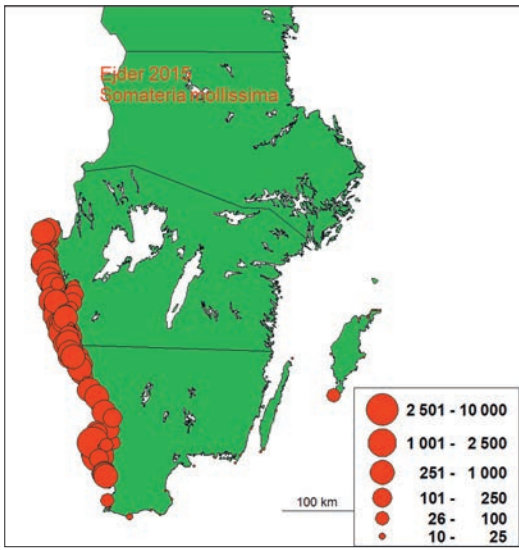


Figure 17. Midwinter distribution of Eider *Somateria mollissima* in Sweden 2015 with details for a part of the Swedish west coast. *Midvinterutbredning för ejder i Sverige 2015 med detaljer för en del av den svenska västkusten.*

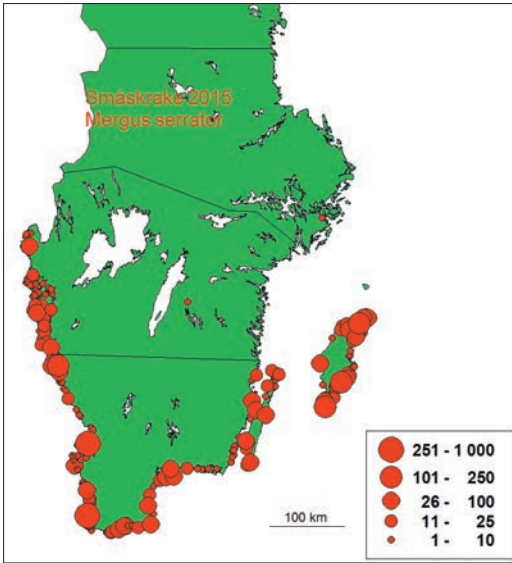


Figure 18. Midwinter distribution of Red-breasted merganser *Mergus serrator* in Sweden 2015 with details for a part of the Swedish west coast.

*Midvinterutbredning för småskrake i Sverige 2015 med detaljer för en del av den svenska västkusten.*

large flocks are known to occur is the offshore waters south of Falsterbo (Green & Nilsson 2015). In other parts of the Baltic only small numbers were found, for example at the southern tip of Gotland. In the archipelagos of Bohuslän (Figure 17) the majority of Eiders were found in the outer zone with small skerries and sea shallows and only few individuals were found in the more sheltered inner water areas.

In the areas covered in 2015, 51 700 Eiders were counted, which is slightly more than in 2004, when 49 000 were present in the same areas. These two estimates were markedly higher than the total for 1971, when only 4500 were observed. Based on the offshore surveys south of Falsterbo (Green & Nilsson 2015, Nilsson 2012), there could be a further 10 000–13 000 Eiders in these waters, bringing the national total to little more than 60 000.

#### Red-breasted merganser *Mergus serrator*

The Red-breasted Merganser was distributed all around the coasts of south Sweden from the Norwegian Border to the northern part of Kalmarsund and around Öland and Gotland (Figure 18) but almost absent elsewhere. In the west coast archipelagos they occurred mostly in small groups spread over both the more sheltered and more exposed parts, but some flocks were found further to the

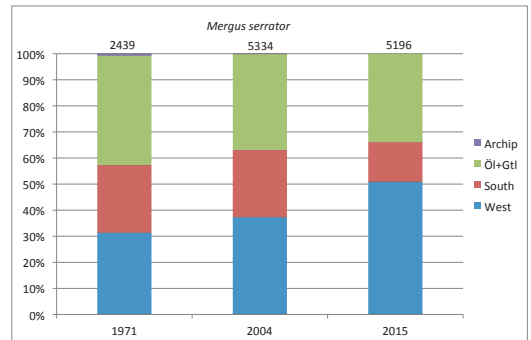
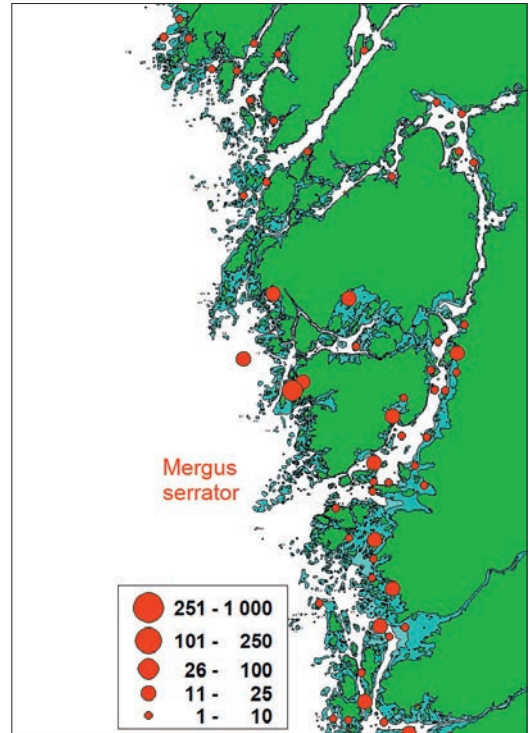


Figure 19. The percentage distribution of Red-breasted merganser *Mergus serrator* in four larger regions along the coasts of south Sweden during the country-wide surveys in 1971, 2004 and 2015. Total numbers counted or estimated shown above the bars.

*Utbredning i procent för småskrake inom fyra större regioner längs kusterna av södra Sverige vid de landsomfattande inventeringarna 1971, 2004 och 2015. Antalet räknade eller beräknade individ av de olika arterna visas över staplarna.*

sea. In 2015, the national total for inshore areas was 5200 compared to 5300 in 2004. As for most other species the wintering total was much lower in 1971, 2400. The totals do not represent the total wintering population of the species for Sweden as much larger numbers are sometimes found offshore



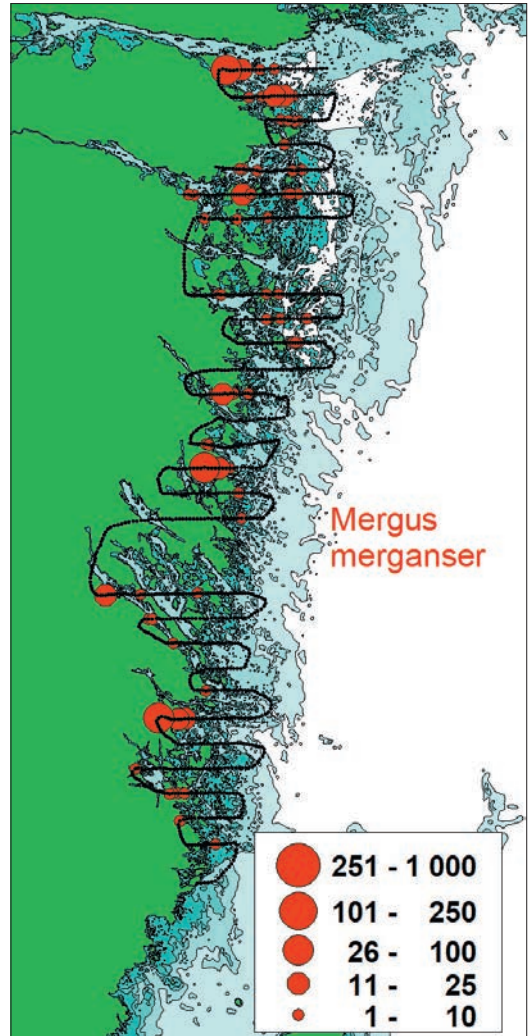
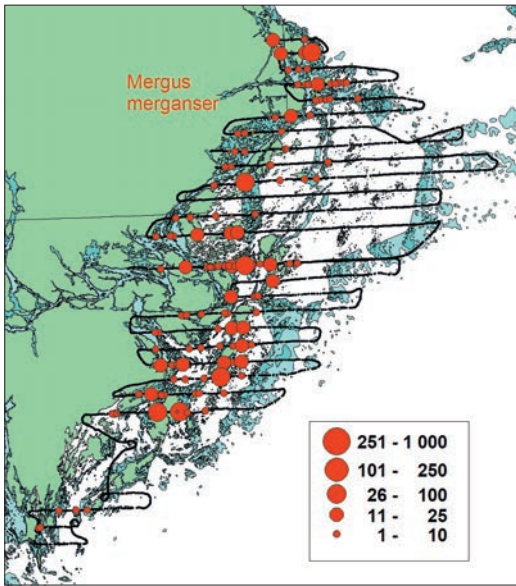
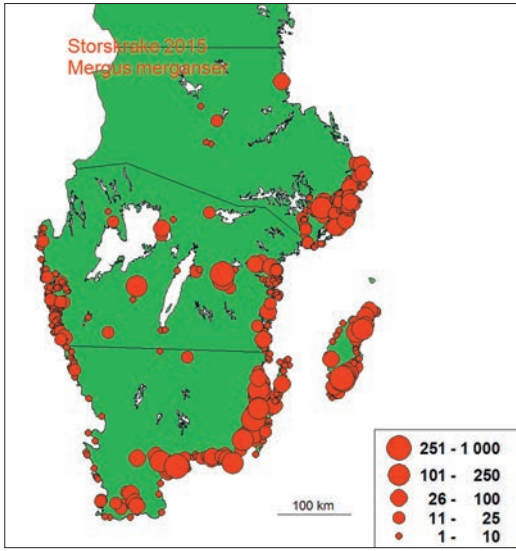


Figure 20. National and regional midwinter distribution of Goosander *Mergus merganser* in Sweden 2015. *Storskrakens midvinterutbredning på nationell och regional nivå i Sverige 2015*

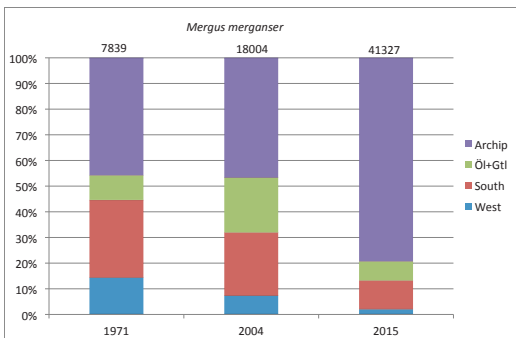


Figure 21. The percentage distribution of Goosander *Mergus merganser* in four larger regions along the coasts of south Sweden during the country-wide surveys in 1971, 2004 and 2015. Total numbers counted or estimated shown above the bars. *Utbredning i procent för storskrake inom fyra större regioner längs kusterna av södra Sverige vid de landsomfattande inventeringarna 1971, 2004 och 2015. Antalet räknade eller beräknade individer av de olika arterna visas över staplarna.*



especially in SW Sweden (Nilsson 2012, Green & Nilsson 2015).

The Red-breasted Merganser showed relatively small changes between the surveys compared to the other species, although the share for the Öresund and the west coast increased from about 30% to 50% (Figure 19). As in 2015, the species was absent from the Baltic archipelagos in the two previous surveys.

#### Goosander *Mergus merganser*

The map for the Goosander in 2015 shows a typical picture for a mild winter, with Goosanders spread over the inland part of southern Sweden and in the archipelagos both on the west coast and in the Baltic (Figure 20). Goosanders were sparsely distributed along the open coasts of Kattegat and Scania, whereas several flocks occurred on open coasts around Gotland.

In the east coast archipelagos the Goosanders were mostly found in the innermost parts of the narrow archipelagos of Kalmar and Östergötland (H+M, Figure 1), whereas they were more concentrated to areas a little further from the shore in the Stockholm archipelago.

The number of Goosanders in the coastal areas covered was about 35 000 in 2015, which is almost twice as many as was reported in 2004, when 18 000 were counted and much higher than the 7800 estimated for 1971 (Table 2). Especially

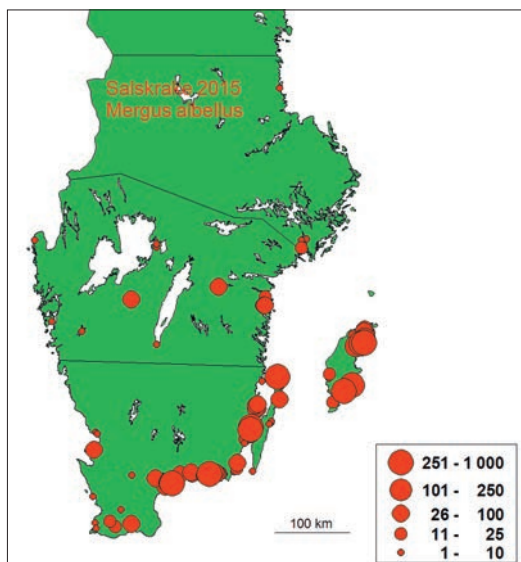


Figure 22. Midwinter distribution of Smew *Mergellus albellus* in Sweden 2015.

Midvinterutbredning för salskrake i Sverige 2015

during mild winters these figures do not represent national totals for the species. Like the Goldeneye, the Goosander is also found on a number of inland sites, and moreover, some Goosanders may have stayed in the ice-free areas north of the coastal areas covered by the present survey. The national total was probably a few thousand individuals higher than 35 000.

The Goosander has a totally different distribution in south Swedish waters compared to the Red-breasted merganser. The numbers occurring in the Öresund and on the west coast are normally small and the vast majority of coastal Goosanders are found in the Baltic. Even in 1971, when the total numbers counted was much lower than in 2015, a large proportion was found in the archipelagos, this share increasing to about 80% in the mild winter of 2015 (Figure 21).

#### Smew *Mergellus albellus*

In 2015, the total number of Smews wintering in Sweden was estimated to about 8000 individuals compared to 3700 in 2004 and 350 in 1971. Most Smews were noted along the south-eastern coast of Sweden with large flocks seen in the archipelago of Blekinge, in the Kalmarsund and on some sites on Gotland (Figure 22). Smaller numbers were also found inland.

At the first survey, the species was quite rare in Sweden and it was highly concentrated to the archipelago of Blekinge and to Öresund with some flocks and smaller groups on inland waters, especially in the southernmost province of Sweden,

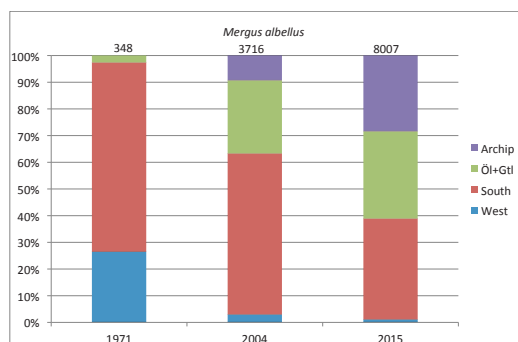


Figure 23. The percentage distribution of Smew *Mergellus albellus* in four larger regions along the coasts of south Sweden during the country-wide surveys in 1971, 2004 and 2015. Total numbers counted or estimated shown above the bars.

Utbredning i procent för salskrake inom fyra större regioner längs kusterna av södra Sverige vid de landsomfattande inventeringarna 1971, 2004 och 2015. Antalet räknade eller beräknade individer av de olika arterna visas över staplarna.

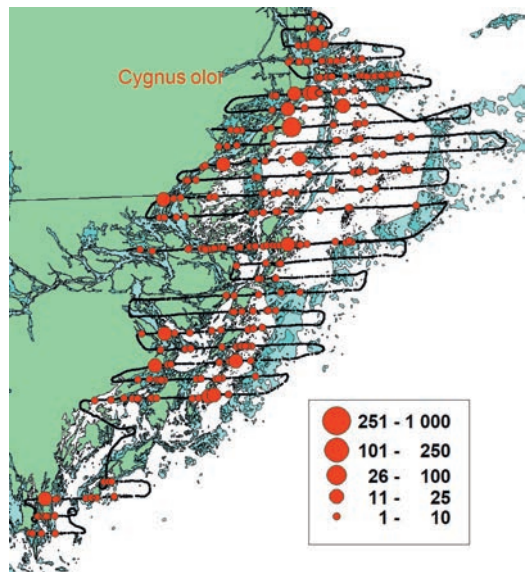
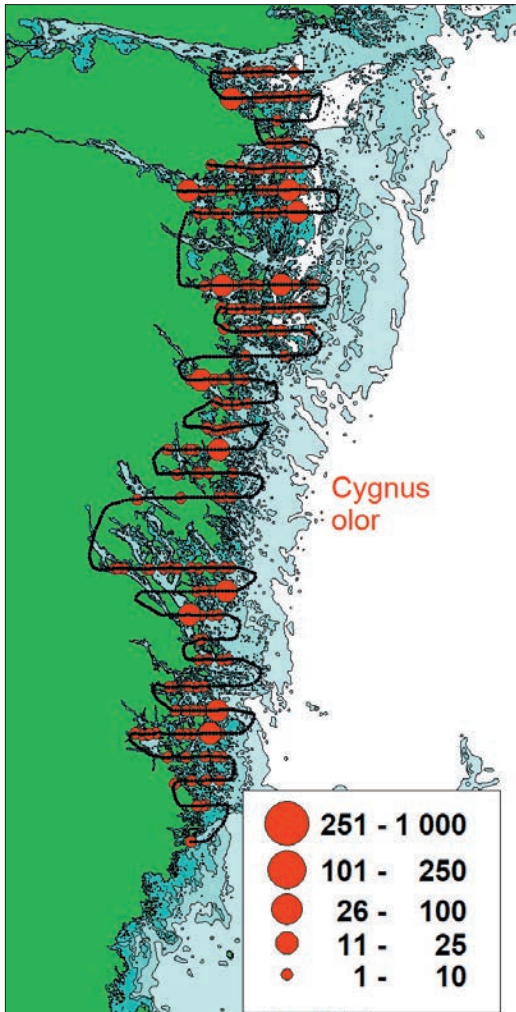
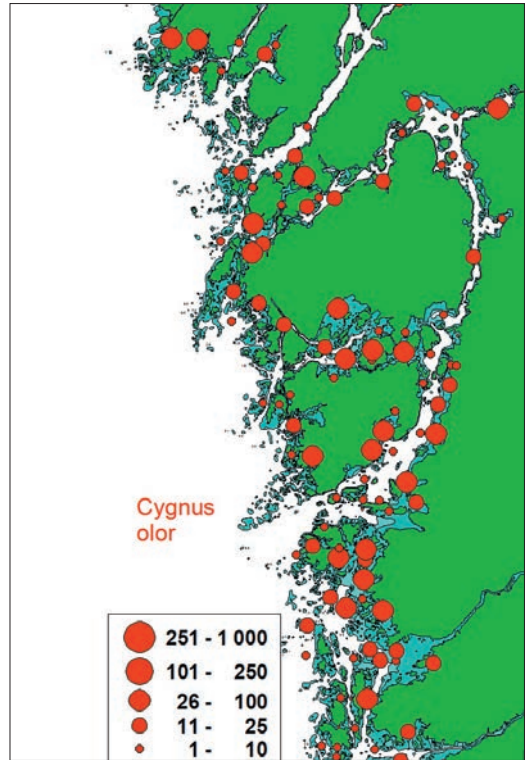
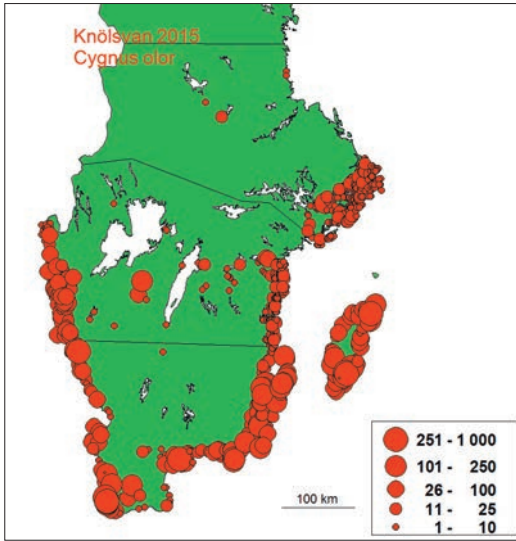


Figure 24. National and regional midwinter distribution of Mute Swan *Cygnus olor* in Sweden 2015.  
*Knölsvanens midvinterutbredning på nationell och regional nivå i Sverige 2015.*

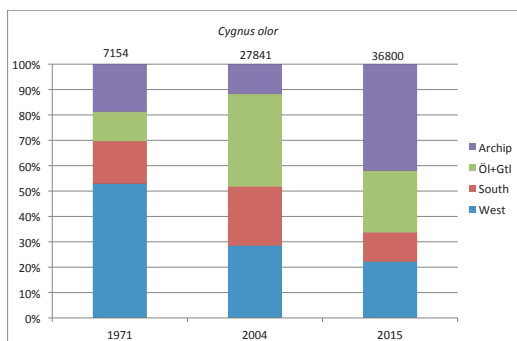


Figure 25. The percentage distribution of Mute Swan *Cygnus olor* in four larger regions along the coasts of south Sweden during the country-wide surveys in 1971, 2004 and 2015. Total numbers counted or estimated shown above the bars. *Utbredning i procent för knölsvan inom fyra större regioner längs kusterna av södra Sverige vid de landsomfattande inventeringarna 1971, 2004 och 2015. Antalet räknade eller beräknade individer av de olika arterna visas över staplarna.*

Scania. At the next survey, in 2004, the situation had changed but the majority (60%) were still found in the south. However, some flocks had begun to appear in the Archipelago and the Large Islands (Figure 23). This trend was accentuated in 2015. This winter the numbers were roughly equal in the three larger Baltic areas (3000 in South, 2600 in Large Islands and 2200 in Archipelago) but the proportional increase was larger towards northeast, 36%, 160% and 540%, respectively. The change in South was moderate and in one of the regions E, Blekinge, there was no change at all. Numbers were thus similar in the south, especially in Blekinge, most of the increase was found on Öland and Gotland and in the east coast archipelagos, especially in Kalmarsund and Östergötland.

#### Mute Swan *Cygnus olor*

The Mute Swan was distributed all over the Swedish coast, both in the archipelagos and on the open coasts. As the winter was mild, there were also large flocks on some inland lakes, especially in Scania, but also further north (Figure 24). In the west coast archipelagos the Mute Swan was well spread in smaller groups over the inner parts and sheltered areas further to the sea. In the Baltic archipelagos the swans were mostly found in small groups and in many areas in pairs spread over the entire archipelago. In the Stockholm archipelago several smaller groups and pairs were found far out at the sea close to the outermost small skerries and island.

The number of wintering Mute Swans in Sweden

show the same increase as most other species discussed here. In January 2015 somewhat more than 50 000 were estimated for the coast compared to 31 000 2004 and 7300 1971.

The Mute Swan was found in relatively high numbers in all four regions. Simultaneous with the large increase in numbers between 1971 and 2004 there was a change in the proportion of the birds wintering in the different regions (Figure 25). More than 50% of all Mute Swans were found on the west coast and Öresund in the 1971 survey, and this proportion continued to decline between 2004 and 2015. On the other hand, less than 20% of the total was found in the Archipelago area in 1971 and 2004 compared to more than 40% in 2015. Thus, the relative importance of the archipelago as wintering sites for Mute Swans has increased during past decades.

#### Whooper Swan *Cygnus cygnus*

Since the start of the IWC it was noted that the Whooper Swans gradually changed their habits to feed more and more on land, behaving like geese. This made it impossible to follow the population development of the species in the normal midwinter counts, so a series of special Whooper Swan surveys were started in Europe in 1995 (Laubek et al. 1999, Nilsson 1997), which has since then been repeated every five years. Thus the country-wide coastal survey in 2015 coincided with the special Whooper Swan survey in January. This survey will be discussed in a separate paper in this volume (Nilsson 2016).

#### Great crested Grebe *Podiceps cristatus*

The only common species among the grebes was the Great Crested Grebe with a total of 2700 in 2015 compared to 4300 in 2004; data are missing for 1971. Along the coasts it was distributed in flocks in the Öresund, the Hanöbukten and at the coasts of Gotland (Figure 26). In other regions the species was less abundant occurring only in smaller numbers. A large proportion of the wintering Great Crested Grebes in Sweden are known to stay in one large flock in Lundåkrabukten in Öresund. The flock often stays far out at sea and can be difficult to count from land especially in bad weather, which will cause quite marked variation in the counts between years.

#### Heron *Ardea cinerea*

The Heron was counted in relatively small numbers. It was widespread in south Sweden both at the coasts and inland (Figure 26). Herons were includ-



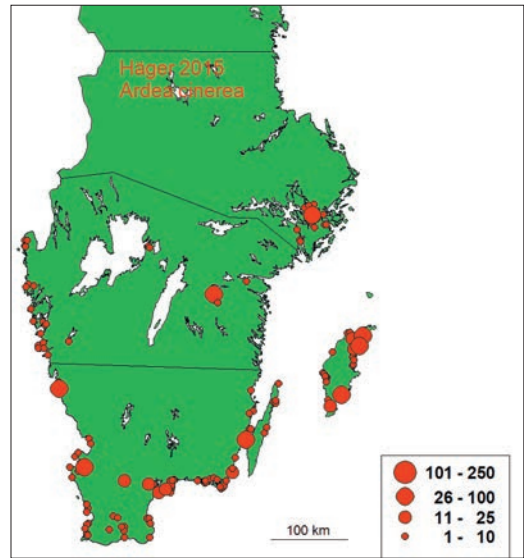
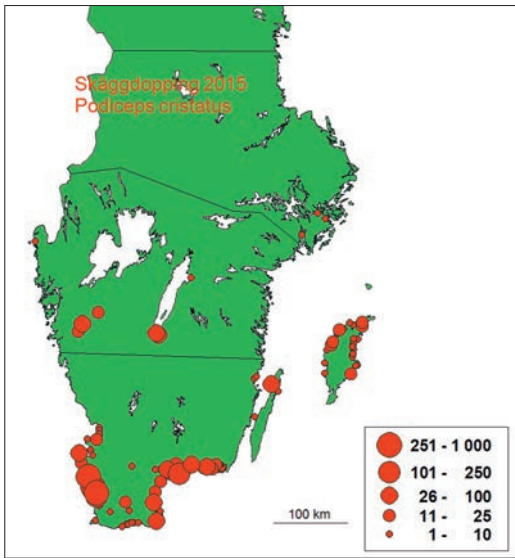


Figure 26. Midwinter distribution of Great-crested Grebe *Podiceps cristatus* and Heron *Ardea cinerea* in Sweden 2015. Midvinterutbredning för skäggdopping och häger i Sverige 2015.

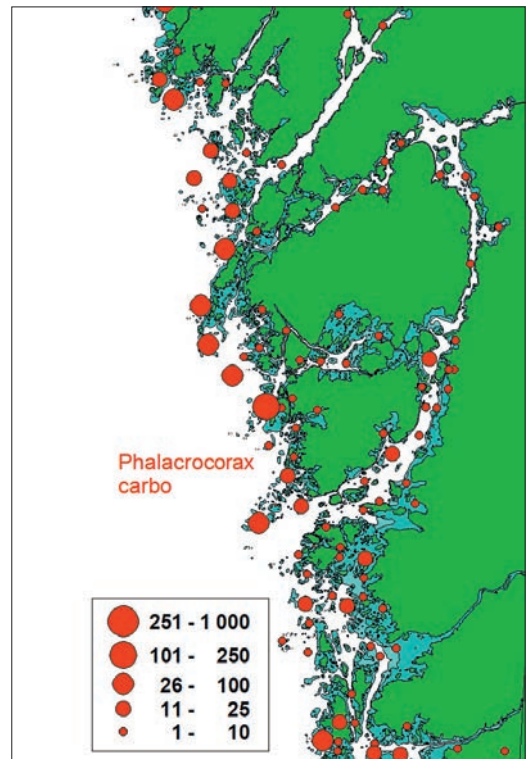
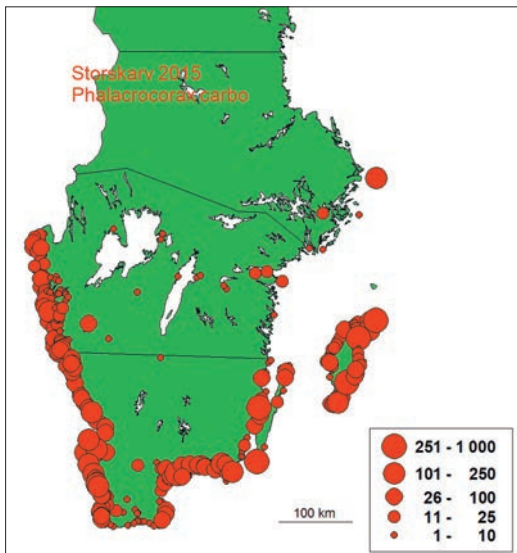


Figure 27. Midwinter distribution of Cormorant *Phalacrocorax carbo* in Sweden 2015 with details for a part of the Swedish west coast. Midvinterutbredning för storskarv i Sverige 2015 med detaljer för en del av den svenska västkusten.



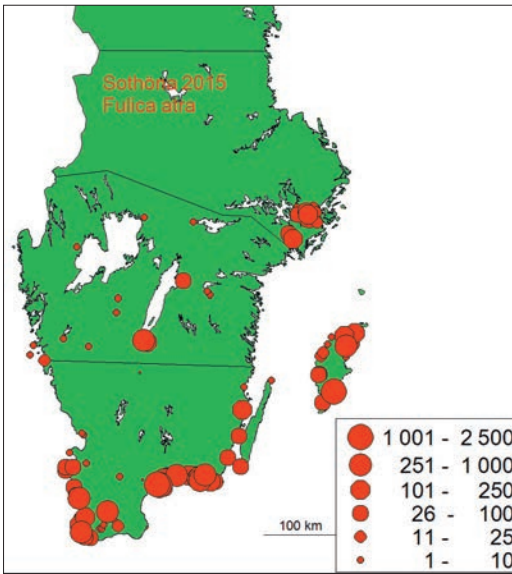


Figure 28. Midwinter distribution of Coot *Fulica atra* in Sweden 2015.  
*Midvinterutbredning för sothöna i Sverige 2015.*

ed in the country-wide surveys in 2004 and 2015, when about 500 and 600, respectively, were estimated for the coasts with smaller numbers inland.

#### Cormorant *Phalacrocorax carbo*

Cormorants were common along the west coast and the southern Baltic coasts of Sweden, whereas there were few occurrences of the species in the main Baltic archipelagos north of Kalmar Sund (Figure 27). The detailed map for central Bohuslän shows that this species occurs in all coastal waters, but most of the larger groups were seen on the outermost skerries and islands. The number of wintering Cormorants in Swedish coastal waters was estimated to be 14 300 in 2015 compared to 11 700 in 2004 and 1000 in 1971.

#### Coot *Fulica atra*

The Coot was more or less concentrated to the southernmost coastal areas (76%) with some occurrences along the coast of Gotland (19%) (Figure 28). There were also some inland flocks, but no Coots were observed in the Baltic archipelagos. In 2015, 11 200 Coots were estimated for the inshore coastal areas compared to 16 000 in 2004 and 3900 in 1971.

#### Other species

In addition to the species discussed above a number of other waterbird species have been counted in smaller numbers at the surveys in all three years but also during the annual ground based midwinter counts. For details of these species at the country-wide surveys see Tables 2–5 with a regional breakdown for 2015 in Tables A2 and A3 (see also Nilsson 2008 and the annual reports from the project, <http://www.zoo.ekol.lu.se/waterfowl/index.htm>, for older data).

#### Trends in the wintering waterbird populations 1966–2015

There is a remarkable difference between the long- and short-term population trends (Table 6). In the former category 25 out of 29 species show significantly positive trends, whereas only six species show significantly positive 10-year trends. The difference gets even more pronounced when focusing on species showing negative trends. Only one species, the Long-tailed Duck, demonstrates a long-term decline, which can be compared with the 15 species that have declined between 2006 and 2015. However, it should be emphasized that the slope of the short term trend is much more sensible for occasional years of either high or low number of birds. In this context it should be mentioned that there were two cold winters in 2010 and 2011 after

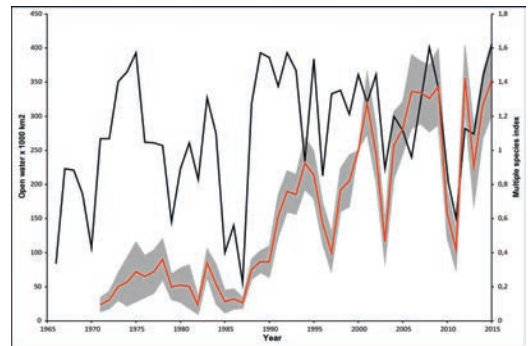


Figure 29. Multispecies index over time (red solid line) with 95% confidence interval (grey area) based on 27 waterbird species observed during the Midwinter counts. Black solid line shows the minimum area of open water during winter in Kattegat and the Baltic Sea (calculated as 420 000 km<sup>2</sup> minus maximum ice cover, cf. method).

*Sammansatt index (röd linje) med 95% konfidensintervall (grått område) baserat på 27 sjöfågelarter räknade under midvinterinventeringarna. Svart linje anger minimum arealen öppet vatten under vintern i Kattegatt och Östersjön (beräknat som 420 000 km<sup>2</sup> minus maximal isutbredning (se metod!).*

Table 6. Population trends, based on the national data set, until year 2015 according to the TRIM analyses for 29 seabird species in January for the entire (E) time series for each of the species and for last ten (10) years. Green: significant ( $p < 0.05$ ) increase; red: significant ( $p < 0.05$ ) decrease; white: no significant trend. Starting year of the long-term time series is shown in column E. Also shown are the slope of each species trend line and the corresponding standard error.

*Beståndsutvecklingen för hela Sverige fram till år 2015 enligt TRIM-analyserna för 29 sjöfågelarter i januari för respektive arts hela (E) tidsserie samt för de tio (10) senaste åren. Grönt: signifikant ökning; rött signifikant minskning; vitt: ingen signifikant trend. Tidsseriernas startår visas i kolumn E. Dessutom visas lutningskoefficienten för respektive art trendlinje och korresponderande standardfel.*

	Slope (E)	S.E. (E)	Slope (10)	S.E. (10)	E 10
<i>Cygnus olor</i>	1.030	0.001	0.982	0.005	1966
<i>Cygnus cygnus</i>	1.009	0.001	0.984	0.009	1966
<i>Tadorna tadorna</i>	1.049	0.025	0.937	0.045	1966
<i>Anas penelope</i>	1.179	0.027	0.971	0.010	1966
<i>Anas strepera</i>	1.174	0.031	1.020	0.032	1987
<i>Anas crecca</i>	1.078	0.008	0.952	0.021	1966
<i>Anas platyrhynchos</i>	1.020	0.001	1.005	0.004	1966
<i>Anas acuta</i>	1.105	0.034	0.866	0.032	1966
<i>Aythya ferina</i>	1.053	0.005	0.933	0.015	1966
<i>Aythya fuligula</i>	1.019	0.001	0.985	0.007	1966
<i>Aythya marila</i>	1.070	0.005	1.063	0.012	1966
<i>Somateria mollissima</i>	1.038	0.002	1.067	0.008	1966
<i>Clangula hyemalis</i>	0.980	0.001	0.973	0.009	1966
<i>Melanitta nigra</i>	1.064	0.005	1.125	0.020	1966
<i>Melanitta fusca</i>	0.996	0.004	1.355	0.047	1966
<i>Bucephala clangula</i>	1.022	0.001	1.010	0.004	1966
<i>Mergellus albellus</i>	1.072	0.004	1.023	0.011	1966
<i>Merganser serrator</i>	1.028	0.001	0.970	0.007	1966
<i>Merganser merganser</i>	1.011	0.001	0.981	0.006	1966
<i>Gavia stellata</i>	1.104	0.057	1.032	0.032	1971
<i>Gavia arctica</i>	1.081	0.011	0.950	0.027	1971
<i>Tachybaptus ruficollis</i>	1.061	0.005	0.876	0.018	1971
<i>Podiceps cristatus</i>	1.104	0.006	0.968	0.011	1971
<i>Podiceps grisegena</i>	1.052	0.020	0.926	0.031	1971
<i>Podiceps auritus</i>	1.071	0.011	1.080	0.045	1971
<i>Phalacrocorax carbo</i>	1.054	0.002	0.996	0.006	1971
<i>Ardea cinerea</i>	1.065	0.003	0.920	0.008	1971
<i>Fulica atra</i>	1.019	0.002	0.877	0.008	1966
<i>Cephus grylle</i>	1.098	0.024	0.952	0.023	1998

a long series of mild winters, which may have influenced the short-term trends. Trend-diagrams for the different species are found in Appendix 5.

The multispecies index for 1971–2015 (Figure 29) shows a highly significant increase over time ( $r^2=0.69$ ,  $F_{1,43}=97.7$ ,  $p < 0.001$ ), which is not the case for the period 2006–2015 ( $r^2=0.01$ ,  $F_{1,8}=0.08$ ,

$p > 0.05$ ). From late 1980s until the millennium shift the multispecies index shows a more or less continuous increase, thereafter the increase has flattened out. Thus, the time series indicates a period with low numbers of wintering birds (roughly between 1971 and 1987), a period with increasing numbers (1988–2000), and a period with high numbers

Table 7. Significance of regional trends for 1971–2015 based on the midwinter counts for seven species, all widespread in coastal areas, five of them widespread also inland. Regions consist of the following areas presented in Figure 1: V (Bohuslän), AB (Kattegat), C (Öresund), D (S and E Scania), E (Blekinge), FG (Kalmarsund), HMNO (northern Kalmar county, Östergötland and Stockholm arcipelagos), K (Öland), L (Gotland). For definition of inland waters (Inland, north and south, respectively, see method). Green cells denote significant increase, red significant decline, white no significant trend and grey missing data. Significant levels are indicated as: \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ . Slopes and s.e. are presented in appendix.

*Regionala trender, baserat på data från midvinterräkningarna 1971–2015, för sju arter; alla vanliga vid kusten och fem även i inlandet. I regionerna ingår följande ytor presenterade i Figur 1: V (Bohuslän), AB (Kattegat), C (Öresund), D (Skånes syd- och ostkust), E (Blekinge), FG (Kalmarsund), HMNO (N Kalmar län, Östergötland och Stockholm), K (Öland), L (Gotland). För förklaring till uppdelningen av inlandsvatten (Inland, south och north, se metod). Grönt indikerar signifikant ökning, rött signifikant minskning, vitt ingen signifikant trend, grått data saknas. Signifikansnivåerna visas enligt följande: \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ . Trendlinjernas lutning och standardfel presenteras i appendix.*

Region	V	AB	C	D	E	FG	HMNO	K	L	Inland, N	Inland, S
<i>Anas platyrhynchos</i>		***	***	***	***	***	***	***	***	***	
<i>Aythya fuligula</i>		***	**	*	***	***	***	***	***		
<i>Bucephala clangula</i>	***	*	***	***	***	***	***	***	***	***	
<i>Mergus serrator</i>		***	***	***	***	***		***			
<i>Mergus merganser</i>	**	***	**			***	***	***	***		
<i>Cygnus olor</i>	***		***	***	***	***	***	***	***		
<i>Fulica atra</i>		***	**	***	***				***		

(2001–2015). The multispecies index for each of the relatively stable periods, 1971–1987 and 2001–2015, were both positively correlated with area of open water (Pearson's  $r = 0.56$ ,  $p < 0.05$  and  $r = 0.73$ ,  $p < 0.01$ , respectively. No such correlation was present for the transition period between low and high abundance of waterbirds ( $r = -0.13$ ,  $p > 0.05$ ). The average minimum area open water for each of the three periods was as follows; 1971–1987: 245 000 km<sup>2</sup> (s.d. = 92 500), 1988–2000: 336 000 km<sup>2</sup> (s.d. = 57 600), and 2001–2015: 297 000 km<sup>2</sup> (s.d. = 71 800). The difference in minimum area of open water is significant between periods (one-way ANOVA,  $F_{2,42} = 5.35$ ,  $p < 0.01$ ).

The subdivision of the national data set allowed us to do regional trends of seven species in coastal areas and five in inland areas (Table 7, Appendix 4). Not surprisingly, the regional trends show the same general picture as the national ones. But opposed to the national trends a few regions show declining numbers of some species. In Kattegat and Öresund, Tufted Ducks as well as Red-breasted Mergansers have declined significantly in numbers between 1971 and 2015. The same is true for Mute Swans in Bohuslän and European Coots in Kattegat. The declining species are restricted to the Swedish west-coast; in the Baltic Sea all species analysed here are either increasing or stable. The

latter is the case also for northerly as well as southerly inland waters.

## Discussion

### *Sweden as a wintering area for waterbirds*

To evaluate the importance of Sweden as a winter area for waterbirds in the European perspective, the estimates based on the 2015 survey are compared with the population estimates published for the north-western European flyway (Table 8, Delany & Scott 2006, Wetlands International 2015). In some cases there have been changes in the populations that have not yet been accommodated in the published population estimates but anyhow these give a background for evaluating the Swedish winter areas from an international perspective.

The country-wide survey in 2015 provides estimates of the wintering populations for most species occurring in inshore waters. To make the picture complete we have included estimates of the wintering populations of three seaducks from the offshore surveys in Swedish waters in 2009–2011 (Nilsson 2012).

For the Long-tailed Duck, two estimates are presented in Table 8, one from the mild winter of 2009 when all waters could be covered and the Swedish

Table 8. The wintering populations of different waterfowl species in Sweden in 2015 in relation to the estimated populations for NW Europe (according to Wetlands International 2015). \* = Based on offshore surveys in 2009–2011, no offshore data in 2015 (see Nilsson 2012).

*Vinterbestånden av olika sjöfågelarter i Sverige 2015 jämfört med de uppskattade bestånden för NW Europa (enligt Wetlands International 2015). \* = baserat på offshore inventeringar 2009–2011, ingen offshoreinventering 2015 (se Nilsson 2012).*

Species	NW Europe	2015 survey	Estimate Sweden	Sweden %
<i>Anas platyrhynchos</i>	4500000	87000	150000–200000	4.4
<i>Anas crecca</i>	500000	500	500	0.1
<i>Anas penelope</i>	1500000	8700	9000	0.6
<i>Aythya marila</i>	310000	26850	27000	8.7
<i>Aythya fuligula</i>	1200000	182000	190000	15.8
<i>Aythya ferina</i>	300000	1208	1250	0.4
<i>Bucephala clangula</i>	1300000	87000	90000	6.9
<i>Clangula hyemalis</i> *	1600000	–	440000–700000	27.5–43.8
<i>Melanitta fusca</i> *	450000	–	4500	1.0
<i>Melanitta nigra</i> *	1600000	–	19000	1.1
<i>Somateria mollissima</i>	976000	51730	60000	6.1
<i>Mergus serrator</i>	170000	5196	9000	5.3
<i>Mergus merganser</i>	266000	35000	40000	15.0
<i>Mergus albellus</i>	40000	8007	8000	20.0
<i>Cygnus olor</i>	250000	50500	52000	20.1
<i>Cygnus cygnus</i>	60000	12000	12000	20.0
<i>Fulica atra</i>	1750000	11200	13000	0.7
<i>Phalacrocorax carbo</i>	390000	14200	15000	3.8
<i>Podiceps cristatus</i>	360000	2700	3000	0.8

population was estimated to be 440 000 and one estimates from the cold winters of 2010 and 2011, when many areas of the Baltic were covered by ice and the wintering population of the Swedish areas covered was in the order of 700 000. The high counts in the two ice winters are most probably due to the freezing of the important wintering areas for the species in the outer parts of the Riga Bay and a subsequent move of some of these birds into Swedish waters.

For the Velvet Scoter and the Common Scoter data from 2009 have been used, but much higher numbers of Common Scoter were found during a partial survey of the southernmost offshore areas in 2007 (cf. Nilsson 2012), the total number of Velvet Scoters and Common Scoters in the offshore waters of regions D, F and K (Figure 1) were then estimated to be 6150 and 39 900, respectively. It is however probable that these were temporary aggregations as such concentrations have never been seen here before. Numbers estimated from the surveys in 2009–2011 are likely to be more represent-

ative for the wintering populations.

The Eider is also a typical seaduck, but the coverage of the main areas of the west coast was complete and the only area of importance for the species not covered in 2015 was the offshore waters around Falsterbo and southern Öresund with an estimated wintering population of about 10 000, a value included in the estimates in Table 8. The Red-breasted Merganser is also found in larger numbers in some offshore areas, especially around Falsterbo and in the southern Öresund (Green & Nilsson 2015, Nilsson 2012), the estimates having been adjusted accordingly.

As presented above, some Goldeneyes and Goosanders are also staying on inland waters and smaller numbers winter along the coasts north of the areas covered in 2015 (being ice-covered during earlier surveys). The estimates from the 2015 survey (Table 8) have been adjusted to include also these birds.

Considering the Swedish coastal waters as a unit, the Long-tailed Duck is clearly the most common



species with up to 700 000 present during the cold winters of 2010 and 2011 (Nilsson 2012). For the inshore coastal waters the Tufted Duck is the most common species with a total estimated winter population of 190 000 in 2015, but more than 225 000 were counted in the previous country-wide survey in 2004.

When comparing the Swedish estimates with the estimates of the winter populations for the entire north-western Europe (Table 8) it is clear that Swedish waters are of great international importance for some wintering species. The offshore banks in the Swedish Economic Zone are especially important for the Long-tailed Duck, where between 27% and 44% of the estimated total population for the Baltic and for north-western Europe (cf. Skov et al. 2011) were found in Swedish waters in 2009–2011. Other species for which Sweden has a high proportion of the total north-west European winter population are Tufted Duck, Goosander, Smew, Mute Swan and Whooper Swan. For these species between 15% and 20% of the estimated wintering population in north-west Europe was found wintering in Sweden.

Sites that regularly are used by more than 1% of the estimated population for the flyway are considered to be internationally important resting/wintering sites for the species according to the Ramsar convention (Wetlands International 2015). In the same way sites that regularly hold more than 20 000 waterbirds are also considered internationally important. Even if Sweden has important proportions of the wintering populations of some species, relatively few wintering sites qualify as Internationally Important Sites as most wintering waterbirds in Sweden occur quite dispersed when they are not concentrated to a few sites due to the ice conditions in cold winters.

For the most abundant waterbird in Swedish waters, the Long-tailed Duck, some offshore areas are clearly to be considered as internationally important sites. This especially applies to the Hoburg bank and the Midsjöbanks (Nilsson 2012), recent maximum counts being 426 000 and 213 000 Long-tailed Ducks respectively, i.e. 27% and 13% of the entire Baltic wintering population at some occasions.

Among the inshore species, internationally important wintering numbers were found on a few sites for the Tufted Duck, Smew and in some cases Goosander. For the Tufted Duck and Smew, internationally important numbers were regularly found in the Blekinge archipelago between Ronneby and Karlskrona. In mild winters such concentrations

were also found in the inner parts of the archipelagos, e.g. in the Kalmarsund and Östergötland for the Smew and in the Stockholm archipelago for the Goosander and Tufted Duck, but the exact sites for the flocks varied between years due to ice conditions. However, most common inshore diving species are more dispersed. Even if flocks are sometimes surpassing the criteria it is difficult to fulfil it as it should be shown that the sites regularly hold large concentrations. This is normally not the case because the exact localization of the concentrations normally varies between times.

#### *Development of the wintering populations during the last 50 years*

The long-term trends for the wintering populations of waterbirds in Sweden over the past fifty years has been significantly increasing, with the exception of the Long-tailed Duck which was significantly decreasing, and three species that did not show any clear long-term trends: Shelduck *Tadorna tadorna*, Velvet Scoter and Red-throated Diver *Gavia stellata*. Of these three species, the Shelduck and the Red-throated Diver were only counted in small numbers. For the scoters, it is not clear if the indices presented are representative for the entire Sweden as they are based on ground counts from the shore and the majority of the Scoters are found offshore.

Among the seaducks a representative sample of the Swedish wintering population is covered by the annual counts for the Eider and the Red-breasted Merganser. The indices presented for the Long-tailed Duck are based on a relatively large sample of sites where appreciable numbers of the species have been counted annually during the study period. For the Long-tailed Duck extensive data are available for the offshore areas around the mainland coast and Öland from the seventies showing a marked decrease in the wintering population of the species to the present day as was found in the indices from the ground counts (Nilsson 2012). The same pattern is indicated in restricted data available from the coasts of Gotland. For the Long-tailed Duck data from the offshore banks are available from a survey in 1992/1993 (Durinck et al. 1994) and the SOWBAS survey in 2007–2009 (Skov et al. 2011, Nilsson 2012). Taken together these data indicate a major decrease in the wintering population of Long-tailed Duck in Swedish waters.

For the seaducks an analysis of the trends for wintering waterbirds in the waters of the European Union (Nagy et al 2015) indicate a decreasing

long-term trend. In 1992/1993, the Baltic population of Long-tailed Duck was estimated to be 4.2 million, whereas the estimate in 2007–2009 was only 1.48 million individuals, a dramatic decrease (Skov et al. 2011). Similarly, the wintering populations of the Velvet Scoter and the Common Scoter showed a marked decrease between the surveys. The surveys are made with different methods (ship-based and aerial surveys) and over long time and are therefore strictly not fully comparable but the marked decrease for the seaducks in the region is totally clear.

In the Eider the wintering population has also shown a marked decrease between the two all-Baltic surveys (Skov et al. 2011). This is also reflected in the breeding populations in the Baltic (Desholm et al. 2002, Ekroos et al. 2012). The time-series analysis presented here indicates an opposite pattern, both the long and short term trends are positive. However, this result is a bit misleading. A previous study, covering exactly the same time periods, showed that the number of over-wintering Eiders was declining on the Swedish east-coast, whereas the opposite was true for the west-coast (Nilsson & Haas 2015). Because most Eiders winter along the west-coast the national trend presented in this study is much influenced by the situation there. The total counts of Eiders along the west coast show no major changes between the two last surveys.

The Red-breasted Merganser is also considered as a seaduck but the proportion that occurs in in-shore waters during winter makes the trend estimates relevant. The SOWBAS census in 2007–2009 (Skov et al. 2011) indicates a major decrease of the Baltic population also in this species, which was not apparent in the national indices presented here. Moreover, the analysis in the SOWBAS project overlooked major concentrations of the species in SW Swedish waters (Green & Nilsson 2015).

The overall trend for the waterbirds in the European Union, considering all species covered by the IWC, is increasing (Nagy et al. 2015, cf also van Roomen et al. 2012). A breakdown of the counts shows a decreasing trend for most seaducks as discussed above in a Baltic perspective. Species other than seaducks show increasing trends with the exception of the Pochard, where the European trend is decreasing. The Swedish long term trend shows an opposite direction, but during the past ten years numbers have declined

For some species recent multi-country trend data that can be compared with the Swedish data presented here have been published, but there is a

marked time-lag in the analysis and publication of trend data based on the IWC in different countries. For the Mallard, Dalby et al. (2013) analysed data from the Nordic countries. In general, the trends for the breeding populations of Mallard in the different countries were increasing, whereas the mid-winter trends varied between countries.

#### *Distribution of wintering waterbirds in Swedish waters in relation to climate change*

For the three diving duck species Tufted Duck, Goldeneye and Goosander, Lehtikoinen et al. (2013) analysed the IWC data from a number of countries in relation to climate change and found significant increases in the northern parts, whereas decreases were found in the southern areas. Similar results were also obtained in an international analysis of the IWC count data for the Smew (Pavon-Jordan et al. 2015). Van Roomen et al. (2012) found decreasing numbers of wintering waterbirds in the IJsselmeer area in the Netherlands in contrast to some of the international trends.

The northward shift in winter distributions is also indicated in the Swedish data. For several species the proportion of birds wintering in the Baltic archipelagos has increased, especially when comparing the most recent census with the census in 1971. The northward shift was most probably related to the better availability of open water in the archipelagos of the Baltic in recent years.

The regional trends also show a pattern in line with this. Of the seven species included in the regional analyses all were either increasing or stable on the east coast, whereas four species showed negative trends in at least one of the west coast regions.

Over the years there have not only been changes in distribution and numbers of the wintering waterbirds, but new wintering habits have also been established. When counts started, both the Teal and the Wigeon were only seen in very small numbers at the Midwinter counts, but new wintering habits were established during the latter part of the study period. An analysis of the European IWC data for the Wigeon (Fox et al. 2016) show increasing numbers wintering in the north and decreasing winter populations in the SW but the centre of gravity for the winter population is still in the Netherlands and the UK.

It is reasonable to believe that the general increase of waterbirds wintering along the Swedish coast to some extent can be explained by the gradual reduction of areas covered by ice. Until the

mid-1980s the number of wintering waterbirds was on an obviously lower level than during the last 15 years. The transition between these two stages took place during a time period (1988–2000) with mild winters. In contrast to the low (1971–1987) and high abundance period (2001–2015), respectively, the between year variation in multispecies index was not at all explained by the ice coverage during the transition period. This indicates that the abundance of waterbirds was at least partly limited by the availability of open water during the two periods when the wintering waterbird communities were relatively stable, but not when the wintering populations increased. Thus, it seems likely that mild winters promoted the increase of wintering birds. But this alone cannot explain the expansion of waterbirds. The number of birds has increased proportionally more than what can be explained if it was a linear relationship between bird abundance and area of open water (cf. Table 2 and Figure 29). However, the mild winters in the early seventies followed after a series of cold winters during the sixties. Especially the winter of 1962/1963 was extremely cold in most parts of Europe with a high rate of mortality among waterbirds (Dobinson & Richards 1964, Owen et al. 1986). Thus, it is likely that our study took its start when the waterfowl populations were reduced to very low numbers. If that is the case it might be that the increase of wintering waterbirds was not limited by ice coverage until a certain point, i.e. around year 2000, when the number of birds had increased to a level where they saturated most areas with open water with suitable foraging conditions. What is troublesome in this context is that our results indicate that the number of waterbirds was influenced by the ice conditions also before they started to expand. With data currently available we cannot find any reasonable explanation for this.

It is highly probable that the changes seen in the wintering populations of waterbirds in Sweden with the large increase during the 1990s is an effect both of a real increase in the size of breeding populations (cf. similar trends in a number of species in Europe; Holt et al. 2012, van Roomen et al. 2012) and changes in distribution due to the milder winters.

The changes in the distribution of waterbirds in relation to the milder winters in the north can over time cause problems for the management of the waterbird populations as the localization of important concentrations might change making the present network of protected areas less accurate. Pavon-Jordan et al. (2015) analysed the interna-

tional IWC data for the Smew in relation to the EU Natura 2000 network and came to the conclusion that regular national and international assessments of the network was urgent to site-safeguard networks for this and other species of waterbirds.

In this study we use large scale data of ice coverage and we bundle data from the original counting sectors before performing the analyses. One possible way to go to further increase the understanding of the dynamics of wintering waterbirds, might be to make use of small scale data, but also to include factors like water depth and various measures indicating the quality of potential feeding areas.

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## Svensk sammanfattning

Samordnade sjöfågelinventeringar har förekommit i Europa sedan januari 1967, då de internationella midvinterinventeringarna av sjöfågel startade i ett antal länder inkl. Sverige (Atkinson-Willes 1969, Nilsson 1975, Nilsson 2008). Tidigare förekom nationella inventeringar i ett antal länder, även Sverige. I Sverige hade en midvinterinventering av sjöfåglar genomförts redan 1966. Syftet med inventeringarna var främst att få en uppfattning om de olika sjöfågelarternas bestånd regionalt och globalt samt att följa förändringar i bestånden av olika arter. Ett annat viktigt syfte var att studera arternas utbredning och förändringar i densamma samt att ge underlag för bedömning av skyddsbehov för sjöfågeln och deras lokaler kopplat till internationella konventioner såsom Våtmarkskonventionen och AEWA (African-Eurasian Waterfowl Agreement).

De första årens inventeringar avsåg att åstadkomma så stor täckning som möjligt av de olika arternas utbredningsområde (Nilsson 1975). För att nå målet organiserades flyginventeringar efter de svenska kusterna under 1971–1973. Det stod emellertid tidigt klart att det inte var möjligt att nå en landsomfattande täckning och inventeringarna koncentrerades därför till att täcka ett representativt urval av lokaler varje år för att kunna beräkna beståndsindex för de olika arterna. En ny landsomfattande inventering av de inre farvattnen genomfördes 2004, medan heltäckande inventeringar av vissa regioner ägde rum 1987–1989 (Nilsson 2008). De yttre farvattnen täcktes fullständigt första gången under 2007–2011, men regionala inventeringar förekom också på 1970-talet (Nilsson 2012).

2015 organiserades åter en landsomfattande inventering av de inre farvattnen mellan den norska gränsen och norra delen av Stockholms skärgård. I denna uppsats analyserar vi resultaten från denna inventering i jämförelse med de båda tidigare storinventeringarna. Dessutom presenteras en serie beståndsindex på nationell och regional nivå för de viktigaste arterna för perioden 1966–2015.

### *Material och Metodik*

Sjöfågelinventeringarna genomförs i huvudsak med hjälp av frivilliga inventeringarna. Inventeringarna organiseras vid den helg som ligger närmast den 15:e januari varje år med veckan före och efter som reservtid. Landets kuster delades tidigt in i ett stort antal räkningssektorer, vilka var så pass

små att de kan täckas av en observatör under en och samma dag. Från och med 1980-talet organiserades inventeringarna kring ett antal referensområden (Figur 1, Tabell 1) inom vilka samma lokaler inventerades på samma sätt varje år för att ge underlag för indexberäkningar. Därutöver inventerades också ett antal mindre lokaler spridda över landet.

Vid den landsomfattande inventeringen 2015 inventerades skärgårdarna med flyg. Vi använde en tvåmotorig, högvindad CESSNA 337 för inventeringarna. Flyghöjden var normalt ca 70 m och hastigheten vid inventeringarna 150–180 km/tim. Två observatörer täckte var sin sida av flygplanet. Observationerna registrerades med tidsangivelse och positionen för varje observation fastställdes med GPS.

I Bohuslän samt Kalmarsund sökte vi igenom aktuella vattenområden genom att cirkla runt öar och vikar och spana av de grunda områdena. Denna metodik hade tidigare år också använts i ostkustens skärgårdsområden. Eftersom 2015 var en mild isfri vinter var de områden i skärgårdarna som skulle täckas omfattande, varför inventeringarna genomfördes som linjetaxeringar spridda över området. Inventeringslinjer lades ut med 4 km lucka över det aktuella området och navigering skedde med hjälp av GPS. Observatörerna täckte 200 m på vardera sidan av flygplanet. På grund av en död vinkel under planet kom täckningen vid denna typ av inventering ut bli 320 m av totalt 4000 m, varför det räknade antalet fåglar multiplicerades med en faktor 12,5 för att ge en uppskattning av beståndet inom olika större områden.

Inventeringarnas täckningsgrad vid de årliga inventeringarna framgår av Figur 2. Under de senaste tio åren inventerades mellan 644 och 944 lokaler vid de årliga landbaserade inventeringarna. För ytterligare information rörande täckningsgraden hänvisas till Tabell A1. Flyginventeringarnas täckning 2015 visas i Figur 3, medan Figur 4 visar läget för linjetaxeringarna i skärgårdarna.

### Indexberäkningar

Vi beräknade populationstrender för 29 arter på nationell skala och för ett färre antal arter på regional skala. På såväl nationell som regional nivå beräknades en långtidstrend, som längst sträckte sig tillbaka till 1966. Nationellt skattades även en korttidstrend (2006–2015). Med hjälp av programvaran TRIM (TRends & Indices for Monitoring data, [www.ebcc.info](http://www.ebcc.info)) beräknades årliga artindex, som i sin tur utgjorde basen för att räkna ut den årliga genomsnittliga förändringstakten. Den senare



Mallard *Gräsand*



Mallard *Gräsand*



beräkningen antar att förändringen är linjär, vilket är ett antagande som inte stämmer för alla arter. TRIM-analyserna baseras på en loglinjär Poisson regression som är särskilt utvecklad för att beräkna tidsserier från antalsdata. TRIM har den fördelen att klara av att hantera omständigheter som är vanligt förekommande i fågelövervakningssammanhang, exempelvis att alla inventeringsområden inte inventeras varje år (missing data). Utöver de artspecifika trendanalyserna räknade vi ut ett flerartsindex baserat på 27 arter. Detta gjordes genom att för vart och ett av åren mellan 1971 och 2015 beräkna det geometriska medelvärdet av de ingående arternas årliga index.

### Väderlek och isförhållanden

Sjöfågeln i de inre farvattnen är starkt beroende av förekomsten av öppet vatten. För att belysa vinterns olika hårdhet mellan åren har vi använt två olika mått, dels medeltemperaturen för januari beräknat för tio meteorologiska stationer spridda över södra Sverige (Figur 5), dels omfattningen av den maximala isläggningen i Östersjön under olika vintrar (Figur 6).

Båda indikatorerna på vinterns hårdhet visar att vintrarna generellt har varit mildare under den senare delen av de 50 år inventeringarna pågått. Före 1987, som var den kallaste vintern under perioden noterades flera kalla vintrar, medan endast en riktigt kall vinter förekom under den senare delen av inventeringsperioden. Fram till och med 1987 noterades sex vintrar med ett maximalt istäcke i Östersjön på över 250 000 km<sup>2</sup>, medan det endast förekom en sådan vinter senare.

### *Antal och utbredning för övervintrande sjöfåglar 2015*

Vid inventeringen vintern 2015 beräknades antalet övervintrande sjöfåglar i de inre svenska kustvattnen till 616 000. I detta antal ingår inte de tre havslevande arterna alfågel, svärta och sjöorre, vilka har sin huvudsakliga utbredning till havs. Ejdern ingår däremot i detta antal eftersom merparten av ejdrarna finns i de områden som täcks av inventeringen. Det övervintrande beståndet för de olika arterna framgår av Tabell 2, som också redovisar antalet sjöfåglar vid de två tidigare landsomfattande inventeringarna 1971–1973 och 2004. Inventeringen 2015 torde ha underskattat några arter såsom knipa och storskrake eftersom täckningen var densamma som på 1970-talet och 2004, då områdena längs norrlandskusten var isbelagda. 2015

fanns det mycket öppet vatten och förmodligen också en del fågel här.

Skillnaden i totalantal sjöfåglar 2015 och 2014 var inte särskilt stor, ca 50 000 färre 2004. Däremot förekom betydande skillnader för några arter, särskilt markant var detta för berganden, där nästan tio gånger så många bergänder fanns i landet 2015 jämfört med 2004, de allra flesta på Gotland. Både knipen och storskraken var också mer vanligt förekommande 2015 än 2004, medan förhållandet var det motsatta för viggen. Vid inventeringarna 1971–1973 var det övervintrande antalet sjöfåglar efter kusterna (i de inre farvattnen) betydligt lägre än 2004 och 2015, endast 174 000.

Antalet övervintrare inom tre grupperingar av regioner redovisas i Tabellerna 3–5 (jämför också Figur 1 för regionindelning). Inom alla tre grupperingar var antalet övervintrare mycket högre 2004 och 2015 än under 1971–1973. I Bohuslän var antalet ca 5 gånger högre vid den senaste inventeringen, däremot var skillnaderna inte så stora mellan 2004 och 2015. I de inre farvattnen i södra Sverige var förändringarna i antalet övervintrande sjöfåglar mellan 1971–1973 och slutet av 1980-talet ganska måttliga, men sedan skedde en markant ökning. Ökningen av antalet övervintrare var särskilt markant i ostkustens skärgårdar, där det fanns mellan fyra och sex gånger så många övervintrare jämfört med 1970-talet.

Regionala summer från inventeringen 2015 återfinns i Appendix 2 och Appendix 3. Motsvarande summer från tidigare inventeringar har publicerats i Nilsson (2008).

### De olika arterna

För de vanligaste sjöfågelarterna redovisas utbredningen under vintern 2015 i en serie kartor (Figur 7–28). Jämförbara kartor från de landsomfattande inventeringarna 1971–1973 och 2004 återfinns i Nilsson (2008). För vissa skärgårdsarter visas också detaljutbredningen inom tre skärgårdsregioner i speciella kartor (Mellersta Bohuslän, Kalmar–Östgöta läns skärgård samt Stockholms skärgård).

Förändringar i utbredningen för några viktiga arter framgår förutom genom att jämföra de publicerade kartorna i denna uppsats med tidigare publicerade kartor (Nilsson 2015) i en serie diagram som visar det totala sjöfågelbeståndets fördelning på fyra storregioner (Väst, Syd, Skärgård och de Stora öarna; se Figur 1). Diagrammen återfinns i anslutning till respektive arts kartredovisning.





Tufted Duck *Vigg*



Whooper and Mute Swan *Sång- och knölsvan*

## *Trender hos de övervintrande sjöfågelbestånden 1966–2015.*

Långtidstrenderna för 25 av de 29 arterna som analyserats på nationell nivå är signifikant positiva, vilket kontrasterar mot korttidstrenderna där 15 av arterna uppvisar negativ utveckling (Tabell 6). Endast en art, alfågeln, har minskat både i det korta och långa perspektivet. De enskilda arternas trendkurvor visas i Appendix 5.

Flerartsindexet (Figur 29) understryker skillnaden mellan lång- och korttidsutvecklingen. Mellan 1971 och 2015 är flerartstrenden starkt positivt ( $r^2=0,69$ ,  $F_{1,43}=97,7$ ,  $p<0,001$ ), vilket inte är fallet för perioden 2006–2015 ( $r^2=0,01$ ,  $F_{1,8}=0,08$ ,  $p>0,05$ ). I Figur 29 visas även den minsta arealen öppet vatten under respektive vinter i Kattegatt och Östersjön. Från början av 1990-talet och framåt är det uppenbart att flerartsindexet påverkas av issituationen, det mönstret är inte lika tydligt dessförinnan.

Trenderna mellan 1971 och 2015 analyserades för sju arter på regional nivå i kustområdena och för fem i inlandet (Tabell 7, Tabell A4). Dessa trender är i stor grad samstämmiga med de nationella, men med några undantag. Vigg och småskrake har minskat signifikant i Kattegatt och Öresund. Likaså minskar knölsvanen i Bohuslän och sothönan i Kattegatt. I Östersjön och inlandet visar samtliga arter antingen ökande eller stabila trender.

## *Diskussion*

Sverige som ett övervintringsområde för sjöfåglar

För att belysa Sveriges betydelse som övervintringsområde för sjöfåglar ur ett europeiskt perspektiv har vi jämfört skattningarna från 2015 års inventering med publicerade skattningar för den nordvästeuropeiska regionen (Wetlands International 2015). Eftersom inventeringen endast omfattar de inre farvattnen har vi kompletterat dessa data med resultaten från den senaste inventeringen av de yttre farvattnen (2009–2011) i bedömningen (Nilsson 2012). Resultaten från jämförelserna sammanfattas i Tabell 8.

För alfågeln anger vi två skattningar för de svenska farvattnen: 440 000 för den milda vintern 2009 och ca 700 000 för de kalla vintrarna 2010 och 2011. Dessa båda vintrar var Rigabukten och den baltiska kusten i stort sett isbelagda och alfågeln därifrån var tvungna att söka sig till andra områden. När det gäller svärta och särskilt sjöorre var antalet övervintrare i de svenska farvattnen

ovanligt högt (Nilsson 2012) och vi använder därför skattningarna från 2010 och 2011 i jämförelserna. Ejdem är också att anse som en havslevande dykand, men för denna art täckte inventeringarna de viktigaste områdena på västkusten, men kanske 10 000 övervintrare från Falsterbo området saknades.

Sammantaget för både kustnära och yttre farvatten så var alfågeln den vanligaste arten i de svenska farvattnen. För de inre farvattnen var vigg vanligast med 190 000 vintern 2015 och inte mindre än 225 000 2004.

Mellan 27% och 44 % av Östersjöns alfåglar återfanns i de svenska farvattnen vid inventeringarna 2009–2011 (jfr. Skov et al. 2011). Andra arter där Sverige hyste en betydande andel av det nordvästeuropeiska beståndet var vigg, storskrake, salskrake, knölsvan och sångsvan. Enligt våtmarkskonventionen klassas ett område som regelbundet utnyttjas av minst 1% av den regionala populationen som ett internationellt betydelsefullt område. För de flesta övervintrande sjöfåglar är sådana områden sparsamt förekommande efter de svenska kusterna eftersom det sker en hel del rörelser beroende på isförhållandena. Några sådana koncentrationer har dock påträffats för arter som vigg, storskrake och salskrake. För en art som alfågeln är Midsjöbankarna och Hoburgs Bank utanför Gotland helt klart att betrakta som internationellt viktiga med upp till 27% resp. 13% av hela beståndet för Östersjön.

Utvecklingen i sjöfågelbestånden de senaste 50 åren

Långtidstrenderna för de övervintrande sjöfågelbestånden i Sverige har i princip varit signifikant ökande för alla arter utom alfågeln, som visat en signifikant nedåtgående trend samt tre andra arter (gravand, svärta och smålom) som inte visar någon klar trend. Indexvärdena för alfågel baseras på inventeringar från land, men inventeringarna av de yttre havsområdena visar samma mycket negativa utveckling.

En internationell analys av trenderna i de övervintrande sjöfågelbestånden inom EU (Nagy et al 2015) visar generellt en uppåtgående trend för flertalet arter med undantag för de havslevande dykanderna där den totala trenden är starkt nedåtgående. En annan art som visar en nedåtgående trend för hela EU är brunanden.



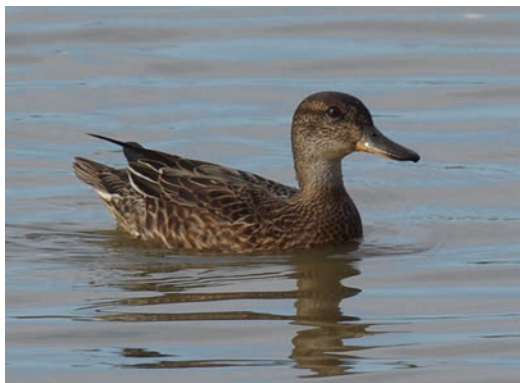
Sjöfåglarnas utbredning i de svenska farvatnen i relation till klimatförändringar

Internationella analyser för vigg, knipa och stor-skrake (Lehikoinen et al. 2013) samt salskrake (Pavon-Jordan et al. 2015) visar klart att det skett stora förändringar i utbredningen av de övervintrande bestånden, markanta minskningar har konstaterats i den södra delen av det gamla vinterområdet samtidigt som ökningarna i bestånden registrerats i norr.

En förskjutning av vinterutbredningen norrut kan också konstateras i det svenska materialet med mycket markanta ökningarna av den andel som övervintrar i skärgårdarna. Antalet övervintrare av de olika arterna i de sydligare delarna av landet har varit konstant eller ökat något, medan flertalet arter ökat mycket markant i Östersjöns skärgårdar, där ökningen varit mycket större än den ökning som noterats för de nationella resultaten.

Förutom de förskjutningar som skett i vinterutbredningen för flera sjöfågelarter har också nya övervintringstraditioner etablerats i landet. När inventeringarna startade sågs endast enstaka krickor och bläsänder, men nu har en övervintringstradition utbildats och båda arterna har övervintrande bestånd i sydligaste Sverige.

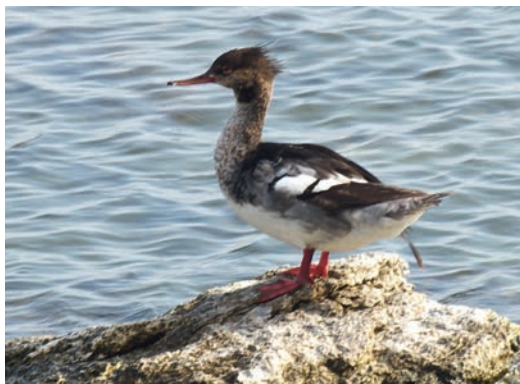
De pågående förändringarna i de övervintrande sjöfåglarnas utbredning som ett svar på de mildare vintrarna kan medföra problem för skötseln av andfågelpopulationerna. Den ändrade utbredningen kan medföra att fåglarnas vinterutbredning inte längre sammanfaller med fördelningen av skyddade områden. Pavon-Jordan et al. (2015) har uppmärksammat detta problem i en analys av salskrakens vinterutbredning och funnit att det är viktigt att snarast se över nätverket av Natura-2000 områden så att det bättre överensstämmer med fåglarnas utbredning.



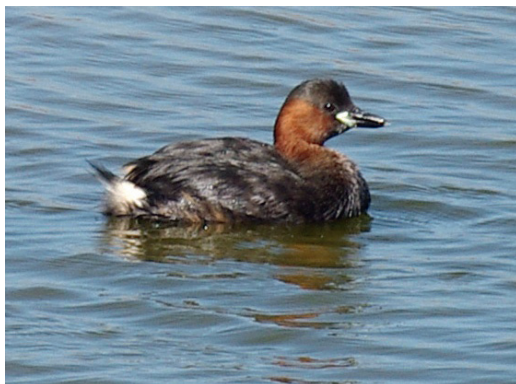
Teal



Mallard



Red-breasted Merganser



Little Grebe

## Appendix 1.

Total number of sites covered at the ground-based midwinter counts in Sweden in different years split on coastal and inland sites.

*Antalet lokaler täckta vid de landbaserade midvinterinventeringarna i Sverige olika år uppdelat på kust och inlandslokaler.*

Year <i>År</i>	Coast <i>Kust</i>	Inland <i>Inland</i>	Total <i>Summa</i>	Year <i>År</i>	Coast <i>Kust</i>	Inland <i>Inland</i>	Total <i>Summa</i>
1966	109	19	128	1991	459	168	627
1967	234	121	355	1992	392	173	565
1968	215	179	394	1993	476	183	659
1969	475	218	693	1994	458	187	645
1970	402	264	666	1995	486	190	676
1971	1318	309	1627	1996	486	157	643
1972	1311	401	1712	1997	491	165	656
1973	1240	447	1687	1998	520	151	671
1974	891	283	1174	1999	466	145	611
1975	818	307	1125	2000	476	161	637
1976	840	293	1133	2001	460	161	621
1977	827	206	1033	2002	477	152	629
1978	773	212	985	2003	486	141	627
1979	439	192	631	2004	687	331	1018
1980	393	175	568	2005	532	153	685
1981	407	131	538	2006	547	170	717
1982	433	120	553	2007	722	222	944
1983	397	109	506	2008	568	217	785
1984	317	92	409	2009	550	193	743
1985	336	79	415	2010	502	197	699
1986	359	76	435	2011	417	211	628
1987	1694	223	1917	2012	538	191	729
1988	787	456	1243	2013	580	187	767
1989	832	405	1237	2014	530	168	698
1990	464	219	683	2015	486	158	644



Long-tailed Duck



## Appendix 2.

Numbers counted and estimated of the different species in different regions at the midwinter counts of the Swedish coasts in January 2015.  
*Antalet inräknade och beräknade individer av de olika arterna inom olika regioner vid midvinterinventeringar av de svenska kusterna januari 2015.*

Region	<i>Anas platyrh.</i>	<i>Anas creca</i>	<i>Anas penelope</i>	<i>Anas strepera</i>	<i>Anas actua</i>	<i>Aythya marila</i>	<i>Aythya fuligula</i>	<i>Aythya ferina</i>	<i>Bucephala clangula</i>	<i>Clangula hyemalis</i>	<i>Melanitta fusca</i>	<i>Melanitta nigrae</i>	<i>Somateria mollissima</i>	<i>Mergus serrator</i>	<i>Mergus merganser</i>	<i>Mergellus albellus</i>
V (Bohuslän)	2463	0	0	0	0	0	361	0	6822	7	4	80	29706	766	539	2
A (N Kattegat)	1965	10	1.5	0	0	0	200	0	488	6	0	29	4810	484	69	0
B (S Kattegatt)	4178	104	253	2	1	503	290	2	366	4	8112	5104	3994	717	21	77
C (Öresund)	8956	50	7965	0	10	289	5437	38	3298	0	0	7	13040	672	61	10
D (S & E Scania)	6279	1.5	36	39	0	4	9971	226	5490	651	13	295	2.5	557	446	488
E (Blekinge)	7177	40	70	17	4	628	2808	694	2078	77	3	1	7	134	622	825
F (S Kalmarsund)	3480	0	1	0	0	132	11168	78	1011	59	0	9	2	32	1275	1451
G (N Kalmarsund)	1783	2	0	5	0	99	16867	2	1336	38	1	4	0	72	1508	264
H (N Kalmar county)	1700	0	0	0	0	0	18000	0	9000	210	0	0	30	15	5000	0
K (Öland)	15957	179	222	10	6	1410	13574	6	8359	7566	16	8	9	451	449	367
L (Gotland)	22445	96	203	41	4	23785	37391	162	12856	3927	17	5	93	1296	2088	2251
M (Östergötland)	2100	0	6	0	0	0	39500	0	4950	1840	0	0	0	0	5071	2272
O (Stockholm)	7600	0	0	0	0	0	12600	0	28000	13700	0	0	15	0	15600	0
Total	86083	496	8771	114	25	26850	168167	1208	84054	28085	8166	5542	51731	5196	32749	8007

### Appendix 3.

Numbers counted and estimated of the different species in different regions at the midwinter counts of the Swedish coasts in January 2015.  
*Antalet inräknade och beräknade individer av de olika arterna inom olika regioner vid midvinterinventeringar av de svenska kusterna, januari 2015.*

Region	<i>Tadorna tadorna</i>	<i>Cygnus olor</i>	<i>Cygnus bewickii</i>	<i>Cygnus cygnus</i>	<i>Gavia arctica</i>	<i>Gavia stellata</i>	<i>Podiceps cristatus</i>	<i>Podiceps griseigena</i>	<i>Podiceps auritus</i>	<i>Tachybaptus ruficollis</i>	<i>Ardea cinerea</i>	<i>Phalacrocorax aristotelis</i>	<i>Phalacrocorax carbo</i>	<i>Fulica atra</i>
V (Bohuslän)	13	2330	0	100	0	1	3	0	0	1	50	21	1766	5
A (N Kattegat)	39	956	0	3	0	0	0	0	0	0	51	0	554	0
B (S Kattegat)	20	499	8	58	2	49	30	2	65	2	56	2	1504	105
C (Öresund)	36	4362	0	4	0	2	1871	0	2	0	38	0	1766	2319
D (S & E Scania)	1	1004	0	60	6	2	222	0	12	2	33	0	837	3250
E (Blekinge)	2	1483	0	294	1	1	380	5	0	10	34	0	1339	3001
F (S Kalmarsund)	0	599	0	82	5	2	0	0	0	2	86	0	218	79
G (N Kalmarsund)	0	1191	0	15	1	0	12	0	1	0	8	0	550	163
H (N Kalmar county)	0	5600	0	29	0	0	0	0	0	0	0	0	30	0
K (Öland)	1	2207	0	264	2	50	28	3	2	0	9	0	982	58
L (Gotland)	0	6689	0	287	19	17	180	10	4	18	241	0	2462	2218
M (Östergötland)	0	6730	0	0	0	0	0	0	0	0	0	0	250	0
O (Stockholm)	0	15500	0	0	0	0	0	0	0	0	0	0	2000	0
Total	112	49150	8	1196	36	124	2726	20	86	35	606	23	14258	11198

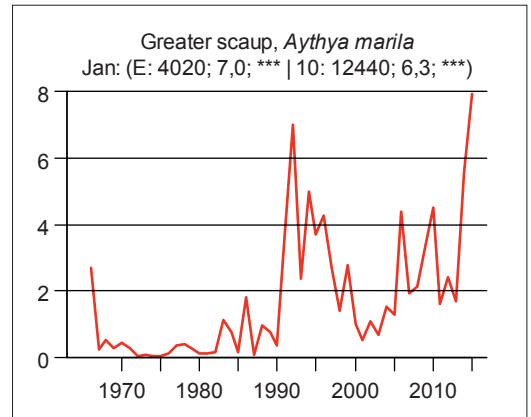
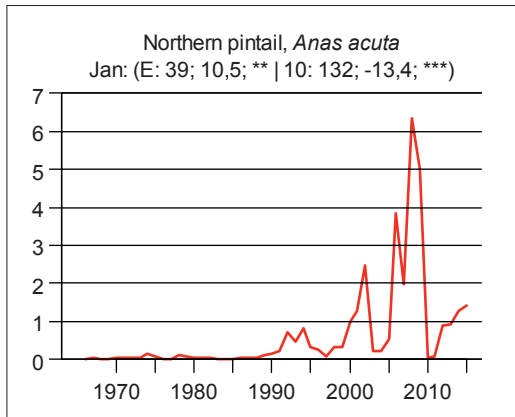
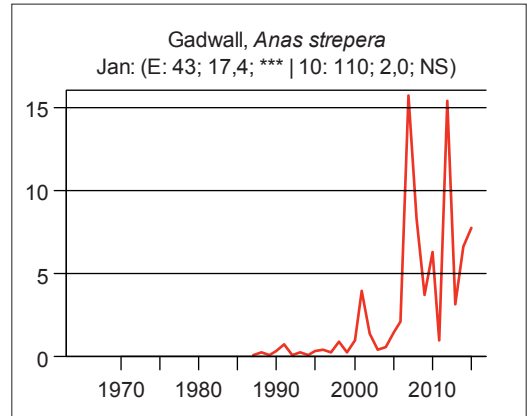
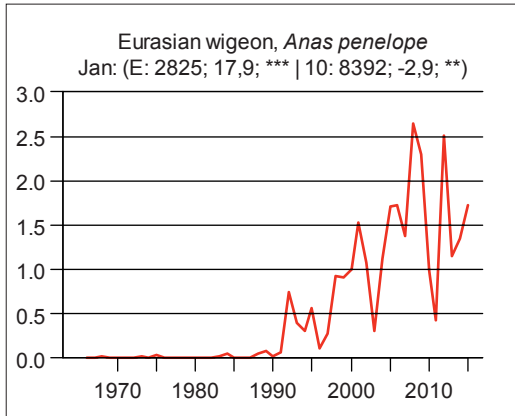
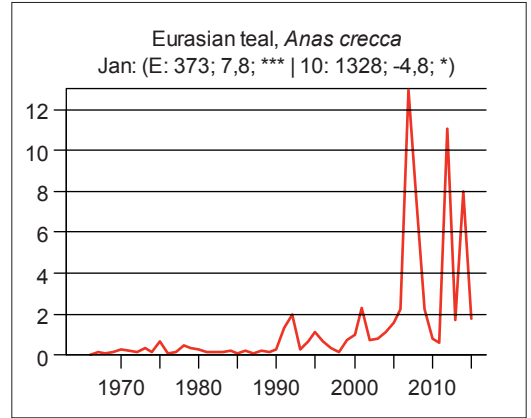
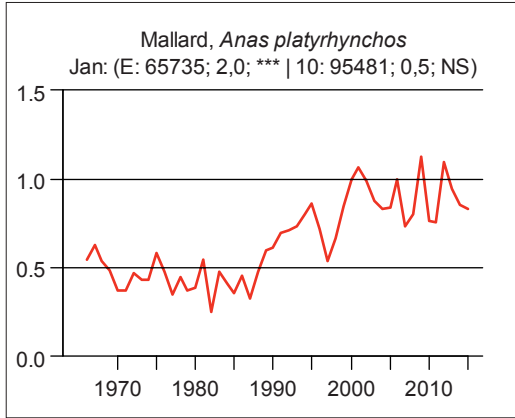
#### Appendix 4.

Regional trends for 1971–2015 based on the midwinter counts for seven species, all widespread in coastal areas and five also inland. See Figure 1 for Region. For definition of inland waters (Inland, north and south, respectively, see method). Population changes are represented with the slope of the trend line, the corresponding standard error (se) and significance level (\* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ , ns = non-significant). Empty cells denote missing data.

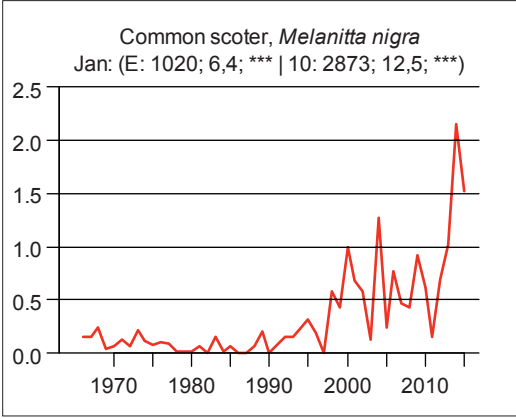
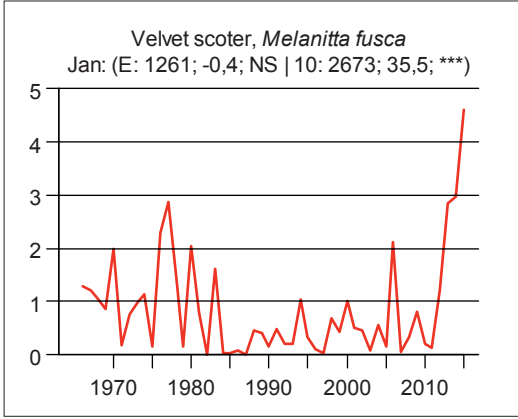
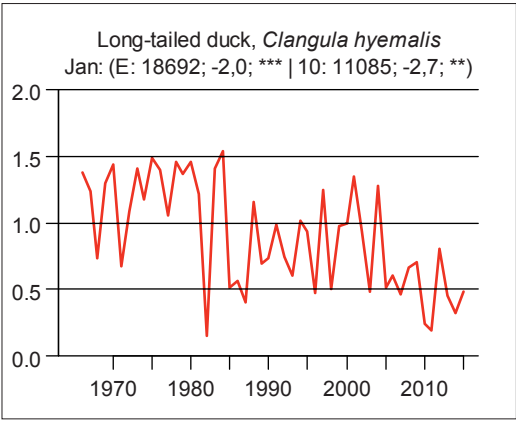
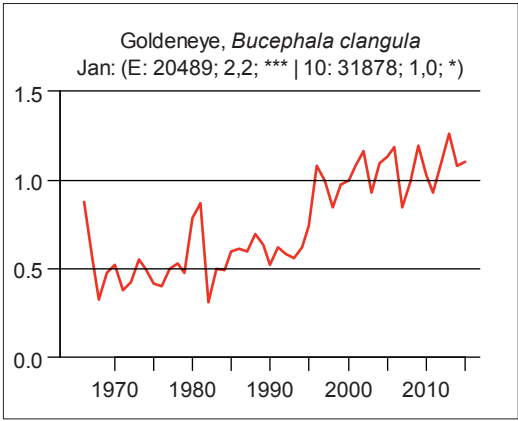
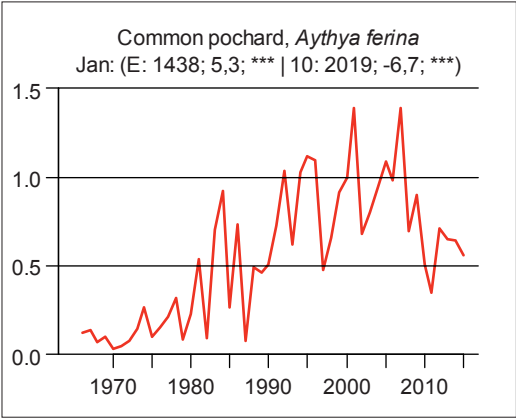
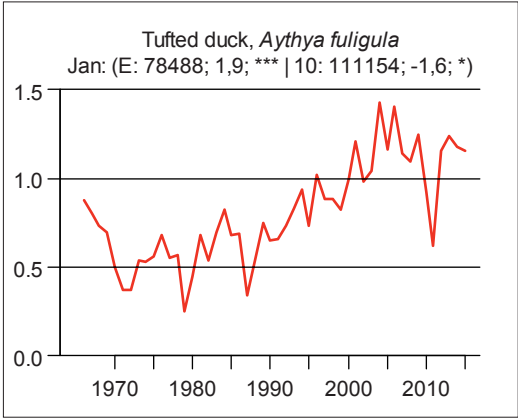
*Regionala trender, baserat på data från midvinterräkningarna 1971–2015, för sju vanliga sjöfågelarter, varav fem är vanliga även i inlandet. Se Figur 1 för Region. För förklaring till uppdelningen av inlandsvatten (Inland, south och north, se metod). Populationstrenderna presenteras enligt följande: slope = trendlinjens lutning, se = standardfel och Sign = statistisk signifikans (\* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ , ns = non-significant). Tomma celler visar att data saknas.*

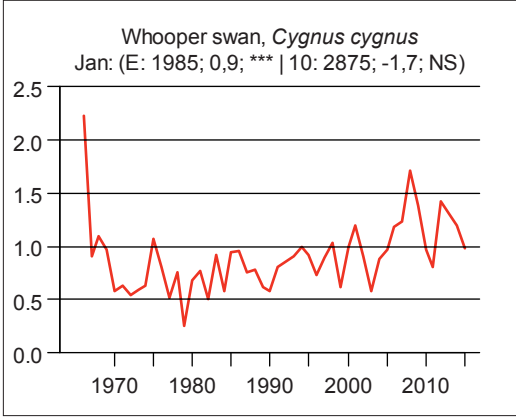
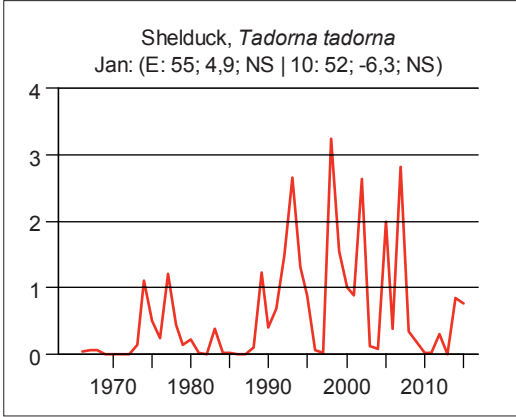
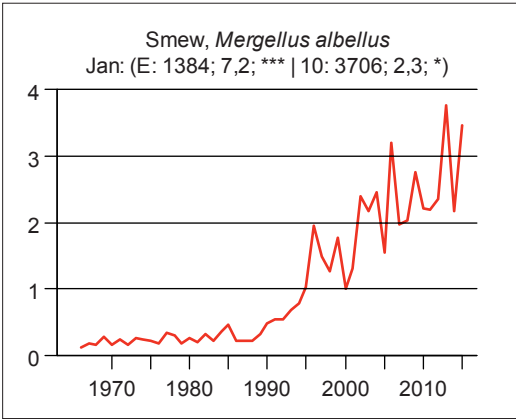
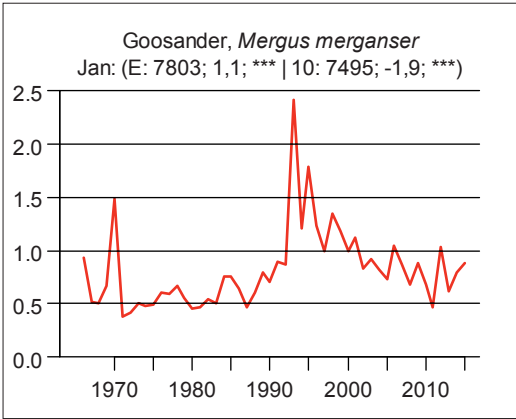
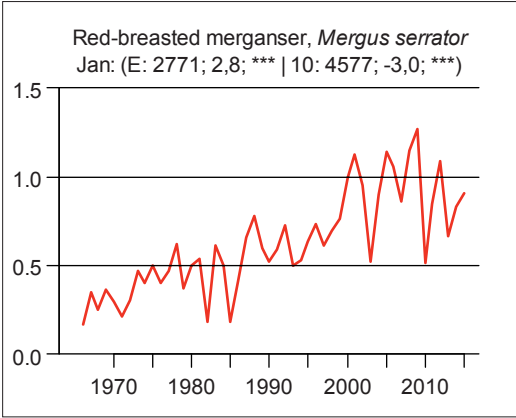
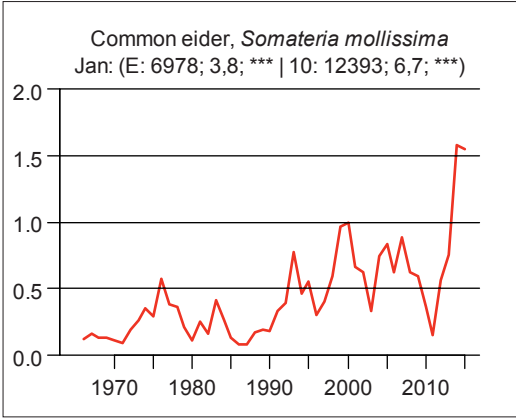
Region		<i>Anas platyrh.</i>	<i>Aythya fuligula</i>	<i>Bucephala clangula.</i>	<i>Mergus serrator</i>	<i>Mergus merganser</i>	<i>Cygnus olor</i>	<i>Fulica atra</i>
V Bohuslän	Slope	0.996	1.106	1.033	1.006	1.022	0.983	1.078
	se	0.008	0.066	0.005	0.005	0.008	0.005	0.061
	Sign	ns	ns	***	ns	**	***	ns
AB Kattegatt	Slope	1.018	0.969	0.993	1.015	0.961	1.006	0.948
	se	0.003	0.007	0.003	0.003	0.011	0.003	0.011
	Sign	***	***	*	***	***	ns	***
C Öresund	Slope	1.019	0.989	1.019	1.064	0.982	1.028	1.010
	se	0.002	0.004	0.003	0.006	0.006	0.003	0.004
	Sign	***	**	***	***	**	***	**
D S & E Scania	Slope	1.044	1.008	1.014	1.031	1.002	1.025	1.031
	se	0.003	0.004	0.002	0.003	0.004	0.003	0.006
	Sign	***	*	***	***	ns	***	***
E Blekinge	Slope	1.045	1.028	1.026	1.061	1.006	1.024	1.035
	se	0.004	0.004	0.003	0.008	0.003	0.003	0.005
	Sign	***	***	***	***	ns	***	***
FG Kalmar- sund	Slope	1.026	1.040	1.020	1.026	1.027	1.035	1.021
	se	0.003	0.007	0.004	0.007	0.004	0.003	0.014
	Sign	***	***	***	***	***	***	ns
HMNO Part of east coast	Slope	1.013	1.023	1.067	0.986	1.021	1.014	1.005
	se	0.002	0.004	0.004	0.014	0.002	0.002	0.005
	Sign	***	***	***	ns	***	***	ns
K Öland	Slope	1.048	1.033	1.043	1.038	1.038	1.041	1.036
	se	0.005	0.010	0.005	0.005	0.005	0.004	0.035
	Sign	***	***	***	***	***	***	ns
L Gotland	Slope	1.037	1.033	1.037	1.002	1.030	1.055	1.021
	se	0.004	0.004	0.003	0.004	0.005	0.003	0.004
	Sign	***	***	***	ns	***	***	***
I n l a n d , north	Slope	1.011		1.012		1.005	1.005	0.998
	se	0.001		0.002		0.003	0.005	0.006
	Sign	***		***		ns	ns	ns
I n l a n d , south	Slope	1.004		1.008		0.984	1.010	1.014
	se	0.003		0.010		0.010	0.009	0.016
	Sign	ns		ns		ns	ns	ns

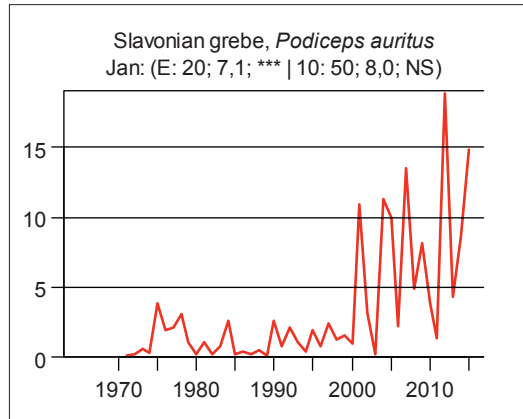
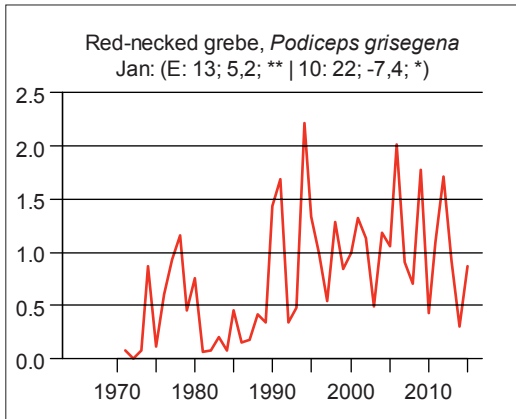
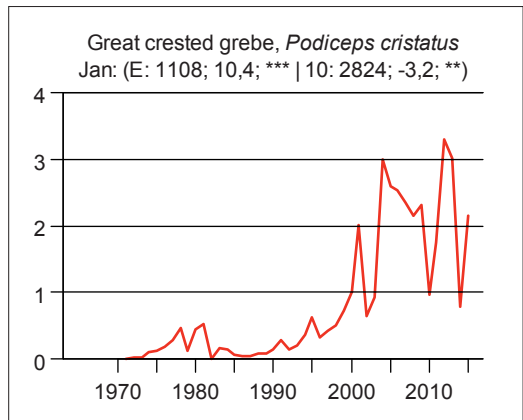
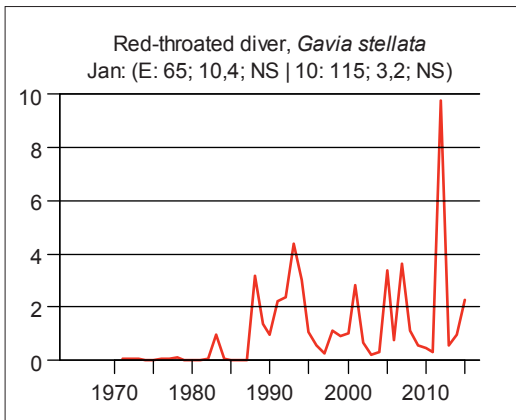
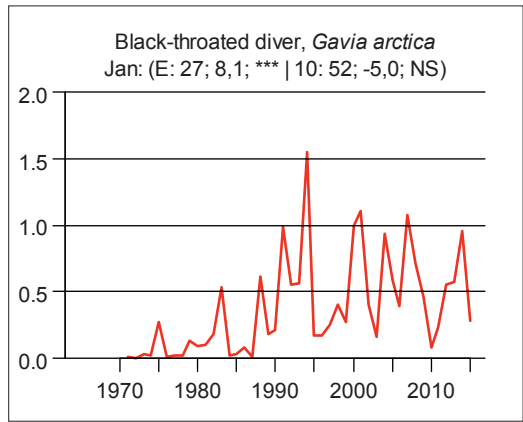
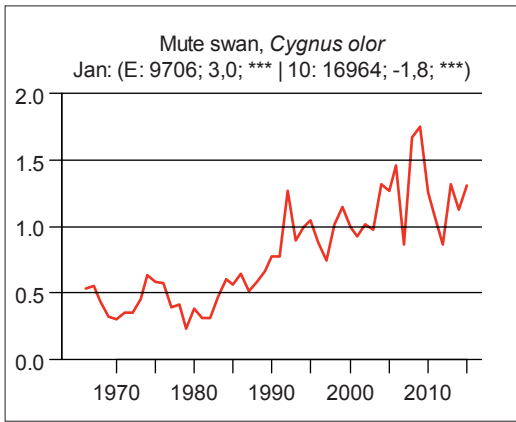
Appendix 5.



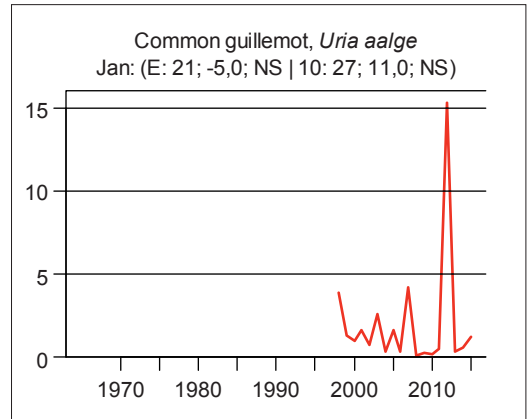
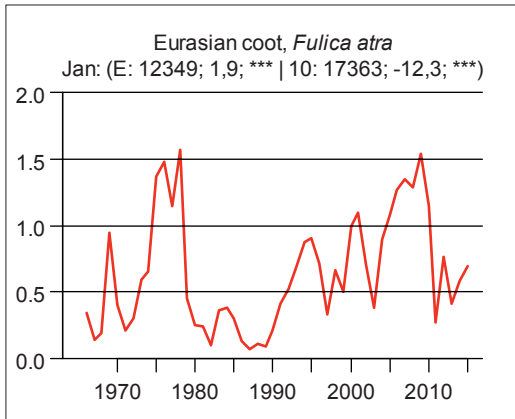
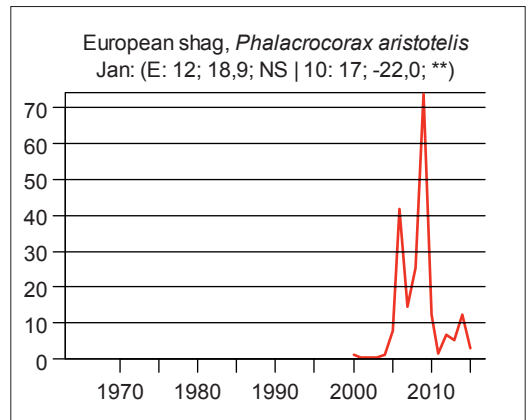
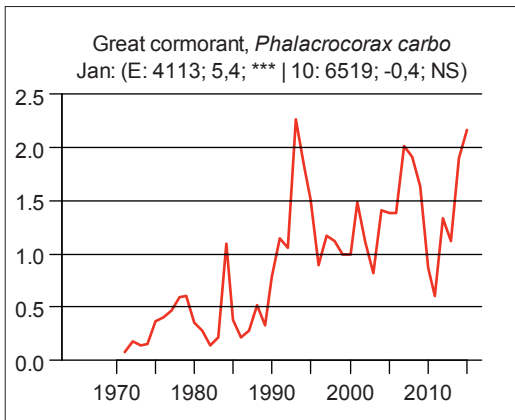
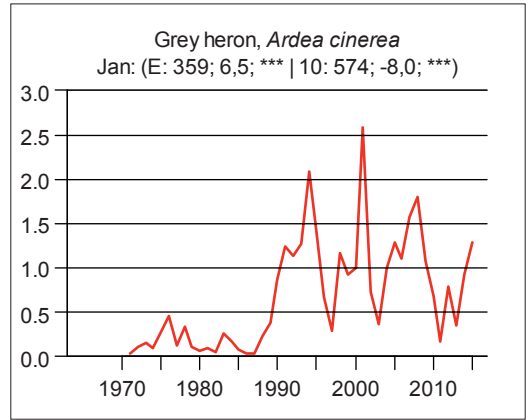
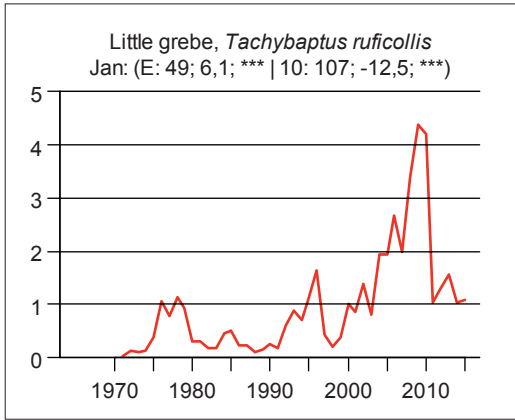


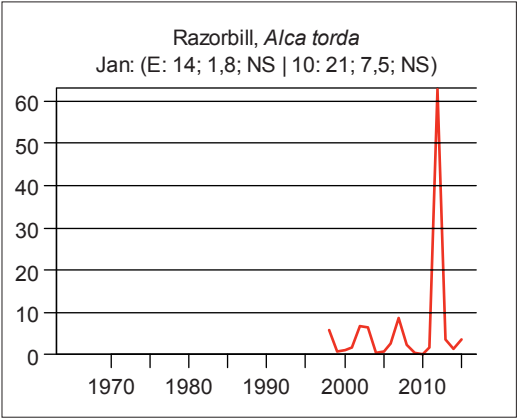
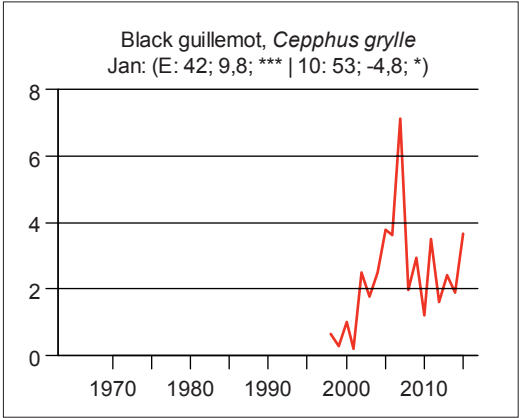












Goosander