ORNIS SVECICA 2:67-76, 1992 https://doi.org/10.34080/os.v2.23059

The importance of mires as breeding habitat for wetland birds in Sweden

BJÖRN L. ARVIDSSON, ULF BOSTRÖM, BÖRJE DAHLÉN, ADJAN DE JONG, ULF KOLMODIN & SVEN G. NILSSON

Abstract

During the last 15 years the bird fauna was censused on 2250 km² of mires, which is 10-15% of the estimated total area of larger, treeless mires (>0.5 km²) in Sweden. The total number of bird species breeding on mires increases from 25 in the most southern region (Götaland) to 43 in the most northern region (N. Norrland), but more of the northern species breed at very low densities. Among taxonomic groups, species richness of wildfowl and shorebirds increases with latitude while that of passerines shows no clear trend. One possible explanation for the increased species diversity towards the north may be that northern mires generally have a more complex habitat structure, making more niches available. There was no general geographic pattern in the population density of different species. Wildfowl, birds of prey (including owls) and shorebirds (including the Crane) breed at higher densities in the north while passerines have lower densities. One reason for the higher breeding densities of wildfowl and shorebirds in the north is that mires there to a larger extent consist of fens than do mires in the south. Also, a lower nest predation in the north is a probable reason. Combining all species there was no trend in breeding density. Calculations of population sizes show that 25% of the 44 species recorded have breeding populations of more than 10 000 pairs while 25% have less than 1 000 pairs on mires. Estimates of population sizes in Sweden as a whole for all species breeding on mires show that 11 species have more than 50%, and four have more than 75% of their total Swedish population on mires. These species are especially interesting from a conservation point of view since they may be used as indicators of valuable mires.

Björn L. Arvidsson, Dept. of Zoology, Medicinargatan 18, S-413 90 Göteborg, Sweden
Ulf Boström, Lars Samuelsgatan, S-941 39 Piteå, Sweden
Börje Dahlén, Strandvägen 6, S-782 00 Malung, Sweden
Adjan de Jong, PL 20465, S-905 90 Umeå, Sweden
Ulf Kolmodin, Eriksgatan 5, S-774 31 Avesta, Sweden
Sven G. Nilsson, Dept. of Ecology, Ecology Building, S-223 62 Lund, Sweden

Introduction

The number of species generally decreases with higher latitude (e.g. Fisher 1960). Several hypotheses for this decrease in species richness have been suggested (Stevens 1989). Contrary to this, species richness, as well as the density of birds, increased towards the north on mires in Finland (Järvinen &Sammalisto 1976) and the same pattern was found for most taxonomic groups on raised bogs in Sweden (Boström & Nilsson 1983).

Peatlands are a typical element of the natural environment in Sweden and cover about 12% of the total land area (SCB 1987). With increasing oil prices in the mid-seventies the interest in using peat as an energy source was renewed and large scale exploitation plans were put forward (Boström 1978). As a consequence, an extensive mire bird census program was started in Sweden (Boström et al. 1984). The bird community of most larger mires in the south and middle parts of Sweden has now been censused while many of the mires in the north still remain to be surveyed.

The main purpose of the census program was to find the most valuable mires from a conservation point of view. Since it was obvious already from the start that a survey of the bird fauna of all larger mires in Sweden was an unrealistic goal, the work was directed at finding indicator species revealing valuable mires. Good candidates for this purpose would be relatively rare species with a large proportion of their total national breeding population on mires.

During the last fifty years the number and area of grazed shore meadows have been heavily reduced in Sweden (Gerell 1988) while during the same time peatlands have been less affected by human activities. Since many of the breeding bird species on mires also breed on wet meadows the relative importance of mires as a breeding habitat for wetland birds has increased during this time.

In this paper we describe regional trends in species richness and population densities, and estimate population sizes of different bird species breeding on mires. In order to assess the relative importance of mires as a breeding habitat for wetland birds we also estimated the total Swedish population sizes for all species breeding on mires.

The scientific names of the bird species are given in Table 1.

Material and methods

Study area

This paper is based on census results from 1522 mires, with a total area of 2250 km^2, distributed throughout Sweden (Fig. 1). All censuses were carried out between 1974 and 1987. Mires were selected on topographic maps and only those with symbols indicating openess were included. Primarily only larger mires (≥0.5 km^2) were selected for censuses but some smaller mires were also surveyed. In order to evaluate regional trends, Sweden was divided into four regions (Fig. 1)

Several types of mire can be distinguished in Sweden (Du Rietz 1949, Mörnsjö 1971). In the regions of Götaland, Svealand and along the east coast of Norrland mires are mainly of the open raised type. The vegetation of these bogs is characterized by a uniformly repeated mosaic of hollow and hummock communities. Water supply comes solely form precipitation. Most mires have been influenced by human activities in the past and some have scattered pines *Pinus silvestris.* Some mires have small pools and most are surrounded by a narrow band of fens (called laggs), but in Götaland this is often drained.

Mires in the western part of Norrland (both southern and northern parts), below the alpine zone, are very different and normally consist of a mixture of bogs and fens (aapa and palsa mires). The vegetation structure is similar to that of bogs (including the laggs) in south Sweden, but the proportion of fens is larger and therefore these mires are generally wetter and thus more suitable for breeding waterbirds (Kolmodin & Nilsson 1982).

Species richness, as well as density, on small mires (<0.5 km^2) are low (Boström & Nilsson 1983, Nilsson 1986). Of the total peatland area a large proportion consists of such small mires (Table 1, Boström et al. 1984). Among the larger mires some are unimportant

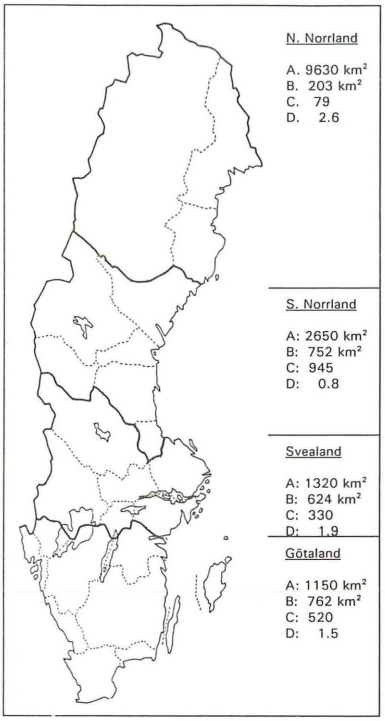

Fig. 1. The different Swedish regions used in this paper with information on A: total area of large (>0.5 km^2), open mire, B: total area of censused mire, C: number of mires, D: mean size of censused mires. Dashed lines delimit different provinces.

Olika regioner använda i den här uppsatsen med uppgifter om A: arealen större, öppen myr, B: totalareal inventerad myr, C: antal inventerade myrar, D: medelstorlek av inventerade myrar. Streckade linjer avgränsar landskap.

for wetland birds simply because they have been destroyed by human activities and now have a dense tree layer (> 10 trees per 0.01 km^2), usually pines. Unfortunately there is no exact measure of the area of forested large mires but some estimates can be made. In the region of Götaland about two thirds of the total area of large open mire have been censused. From this we can estimate that about 40% of the larger mires are forested. In the region of North Norrland about 10% of the mires are forested (Stenpil 1982). In the regions of Svealand and South Norrland it is more difficult to make an estimate but mires in these regions are probably less affected by drainage than mires in the region of Götaland (a more densely populated area) but more than in the region of North Norrland. Assuming that the

Table 1. Estimated population density (pairs/100 km²) and census efficiency of different bird species breeding on mires in Sweden. C.E. = Census efficiency.

Populationstäthet (par/100 km²) och uppskattad inventeringseffektivitet för olika fågelarter på myrar i Sverige. C.E. = Inventeringseffektivitet.

	Götaland	Svealand	S. Norrland	N. Norrland	C. E.
Peatland area *Myrareal* (km²)	3500	7400	11900	27400	%
Area > 50 ha (km²)	1880	1680	3100	10770	
Red-throated Diver *Gavia stellata*	< 1	11	6	2	70
Slavonian Grebe *Podiceps auritus*	-	< 1	2	1	70
Whooper Swan *Cygnus cygnus*	< 1	< 1	2	1	75
Bean Goose *Anser fabalis*	-	< 1	1	2	30
Wigeon *Anas penelope*	-	2	7	13	30
Teal *A. crecca*	13	25	30	27	30
Mallard *A. platyrhynchos*	23	32	24	21	30
Pintail *A. acuta*	-	-	< 1	1	30
Tufted Duck *Aythya fuligula*	< 1	4	9	11	30
Scaup *A. marila*	-	< 1	2	3	30
Long-tailed Duck *Clangula hyemalis*	-	< 1	1	2	30
Common Scoter *Melanitta nigra*	-	< 1	1	2	30
Velvet Scoter *M. fusca*	-	1	4	6	30
Goldeneye *Bucephala clangula*	9	32	17	22	30
Hen Harrier *Circus cyaneus*	-	-	< 1	4	50
Osprey *Pandion haliaetus*	3	4	4	1	75
Crane *Grus grus*	10	30	21	18	65
Golden Plover *Pluvialis apricaria*	154	86	61	51	70
Lapwing *Vanellus vanellus*	46	80	57	50	85
Temminck's Stint *Calidris temminckii*	-	-	< 1	1	45
Dunlin *C. alpina*	-	-	3	9	45
Broad-billed Sandpiper *Limicola falcinellus*	-	< 1	4	16	45
Ruff *Philomachus pugnax*	< 1	< 1	31	135	65
Jack Snipe *Lymnocryptes minimus*	-	< 1	1	11	45
Snipe *Gallinago gallinago*	52	49	84	106	45
Whimbrel *Numenius phaeopus*	< 1	13	37	42	85
Curlew *N. arquata*	43	40	20	42	75
Spotted Redshank *Tringa erythropus*	-	-	-	24	65
Redshank *T. totanus*	4	< 1	7	4	65
Greenshank *T. nebularia*	-	48	58	83	75
Green Sandpiper *T. ochropus*	24	20	15	< 1	45
Wood Sandpiper *T. glareola*	32	139	158	230	65
Red-necked Phalarope *Phalaropus lobatus*	-	< 1	14	13	45
Black-headed Gull *Larus ridibundus*	23	53	26	29	60
Common Gull *L. canus*	25	45	27	5	60
Arctic Tern *Sterna paradisaea*	-	< 1	7	8	60
Short-eared Owl *Asio flammeus*	-	< 1	3	6	30
Skylark *Alauda arvensis*	50	59	22	-	50
Meadow Pipit *Anthus pratensis*	744	226	224	137	50
Yellow Wagtail *Motacilla flava*	50	267	317	300	50
Whinchat *Saxicola rubetra*	246	87	111	13	50
Sedge Warbler *Acrocephalus schoenobaenus*	-	< 1	< 1	3	50
Great Grey Shrike *Lanius excubitor*	< 1	3	4	4	50
Reed Bunting *Emberiza schoeniclus*	17	42	60	117	50

proportion of larger forested mires is somewhere between these proportions, and is related to the degree of urbanization, a crude estimate is that about 20% of mires in Svealand and 15% in South Norrland are forested.

From the assumptions made above and the fact that some smaller mires also have been surveyed, about 10-15% of the total area of larger open mires in Sweden have been censused, but the variation is large between the regions. In Götaland about 66% have been censused

whereas in North Norrland the same figure is only 2%, something that may affect our estimates of population densities.

There is also a difference in the mean size of censused mires between regions, from 0.9 km^2 in Svealand to 2.6 km^2 in North Norrland (Fig. 1).

Census method

The mires were visited once (in a few cases twice) during the first two weeks in June (southern regions) or from mid June to the first week of July (northern regions). Censuses were only conducted in the morning and under good weather conditions. Mires were normally censused along parallel lines, 100-150 m apart, and walking speed was low: 0.1 km^2 being censused per about 15 min. A more thorough description of the method used can be found in Boström & Nilsson (1983). Observations of birds were recorded according to the mapping method (Svensson 1975).

Census efficiency

The total density of ducks on mires in south Sweden has been estimated at 0.5-1.0 pairs per km^2 (Nilsson 1977) but only 0.2 pairs per km^2 were found during censuses in the same area (Boström & Nilsson 1983) indicating a census efficiency of 20-40%. In this paper we have used 30% for all ducks and for Bean Goose (very secretive on the breeding grounds, see Eriksson & Henricsson 1990). Census efficiency for Crane has been estimated at 65% (Bylin 1980) and for Red-throated Diver at 70% (Boström & Nilsson 1983). The latter estimate was also used for Slavonian Grebe. Whooper Swan and Ospery are also quite easily discovered; we have used a census efficiency of 75% in this paper. For Hen Harrier and Short-eared Owl no figures on census efficiency are available; we have used 50% for Hen Harrier and 30% for the somewhat more difficult Short-eared Owl.

For seven specis of shorebirds we have used census efficiencies reported earlier (Kolmodin et al. 1987); for other shorebirds, where no census efficiencies are available, we have assumed that census efficiency for Temminck's Stint, Dunlin, Broad-billed Sandpiper, Jack Snipe, Green Sandpiper and Red-necked Phalarope are equal to that of the Snipe (45%), that census efficiency for Ruff, Spotted Redshank and Redshank equals that of the Wood Sandpiper (65%).

Census efficiency for gulls and terns was estimated at 60% (Svensson 1978) and for passerines at 50% (Kolmodin et al. 1987). All census efficiencies used in this paper are reported in Table 1.

Calculations

Calculations were primarily made on a provincial level (see Fig. 1). Population densities (P) in different regions are weighted mean values from these calculations and were made in the following way:

$$P=N_c/E*A_c;$$

where N_c is the censused number of pairs, E is the census efficiency as a proportion of one and A_c is the area of censused mires. The population sizes (N) in the different regions are the sum from the provinces in each region:

$$N=P*A;$$

where A is the total area of large open mires in the province.

Our estimates of population sizes on a national level are mainly based on provincial surveys and estimates (SOF 1990, unpubl.) and for a few species on nation-wide censuses (see Table 2). These estimates differ considerably for many species from earlier estimates (Ulfstrand & Högstedt 1975, Andersson & Staav 1980).

For waterbirds in northern Sweden we have used the etimates of Haapanen & Nilsson (1979), while for southern Sweden we have based our estimates on provincial censuses (SOF 1990).

The population sizes of Crane in provinces in south Sweden are well known from censuses. In north Sweden the density is about 0.009 pairs/km^2 outside mires (Forslund unpubl.). Our estimates of population sizes of shorebirds in the alpine zone are based on surveys in the Ammarnäs region (Svensson et al. 1984), assuming this to be a representative area of the alpine zone. For many shorebird species there are also provincial surveys which could be used in our estimates (see SOF 1990).

The population size of the Hen Harrier was estimated by Nilsson (1981), while that of the Osprey is based on provincial estimates (Ahlgren unpubl.). For the Short-eared Owl we have assumed the population size to be twice that found on mires (pers. obs.).

The population size of the Black-headed Gull was earlier estimated at 270 000 pairs (Fredriksson 1979) but has since then decreased considerably (SOF 1990). The same applies to the Slavonian Grebe for which Regnell's (1981) estimate of 2500 pairs now is too high (SOF 1990). For Common Gull we have used the estimates of Andersson & Staav (1980) and for the Arctic Tern we assumed the population to be smaller than previously estimated (Andersson & Staav 1980) since the number seems to be lower in the alpine zone (unpubl.). Population sizes of passerines have been estimated either from provincial estimates (SOF 1990) or by densities in different habitats (e.g. Karlsson & Kjellén 1988).

Generally the accurancy of these estimates can be assumed to decrease with the abundance of the species

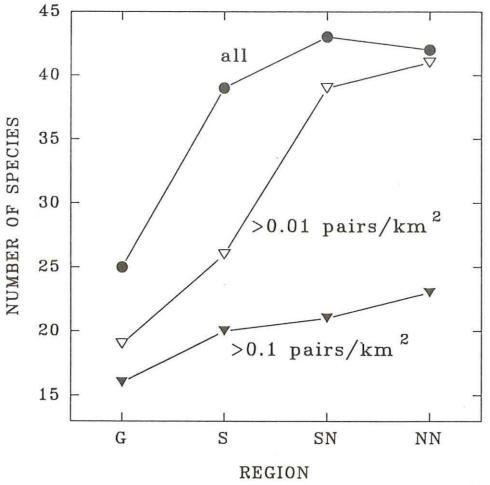

Fig. 2. Species richness, related to population density, on mires in different regions of Sweden.

Artantal, relaterat till populationstäthet, på myrar i olika delar av Sverige.

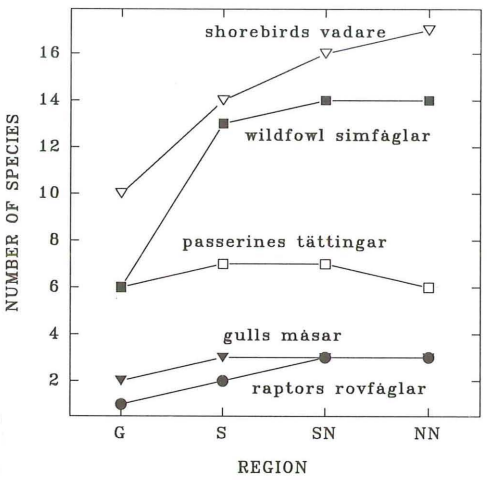

Fig. 3. Species richness of different taxonomic groups on mires in different regions of Sweden.

Artantal för olika taxonomiska grupper på myrar i olika delar av Sverige.

and the number of different habitats inhabited by the species. A typical example of this is the Green Sandpiper, which apart from breeding on mires also breeds on small wetlands in forests (SOF 1990).

Results

Species richness

The number of breeding species found on mires increases towards the north. If we only consider the most abundant species (i.e. with densities >0.1 pairs per km^2) the number increases slowly, from 16 in Götaland to 22 in North Norrland (Fig. 2). If we also include species that are ten times less abundant, species richness increases steeply, from 18 in Götaland to 41 in North Norrland (Fig. 2). The increase in slope indicates that many species breeding in the north have low densities. Taking into account also the rarest species, the increase in species richness between the two southern regions is large, from 25 in Götaland to 40 in Svealand, north of which the number of species only increases slightly (Fig. 2), indicating that many species with a more northerly distribution also can be found in the northern part of Svealand (c.f. Kolmodin & Nilsson 1982).

The increase in species richness at higher latitudes is mainly caused by a large increase in the number of breeding wildfowl species between Götaland and Svealand, and a gradual increase in the number of shorebird species (Fig. 3). The number of passerine species hardly differs between different regions.

Population densities

The population densities of different species vary regionally but no general trend for all species can be observed (Table 1). The species with the overall highest densities are Meadow Pipit, Yellow Wagtail, Whinchat, Wood Sandpiper and Golden Plover. Many other species have very low densities and on average more than 100 km^2 of peatland is required in order to find a single breeding pair (Table 1).

The population densities of Golden Plover, Green Sandpiper and Meadow Pipit show a decreasing trend towards the north while the population density of 23 other species increases towards the north (Table 1). Some species like Mallard, Teal, Crane, Lapwing and Curlew do not show any obvious geographical trend in density.

Considering different taxonomic groups, the densities of birds of prey (including the Short-eared Owl), wildfowl and shorebirds (including the Crane) increase towards the north while the densities of passerines decrease (Fig. 4). The density of gulls (including Arctic Tern) increases more than twofold between Götaland and Svealand, therafter decreases in the north towards the same density as in Götaland (Fig. 4). Taking all species into account, the density seems to be fairly equal in different geographical regions (Fig. 4). However, one should bear in mind that these results are heavily assumption-dependent. If our estimates of census efficiency are altered for species with an uneven geographical distribution the trends reported here may very well be different.

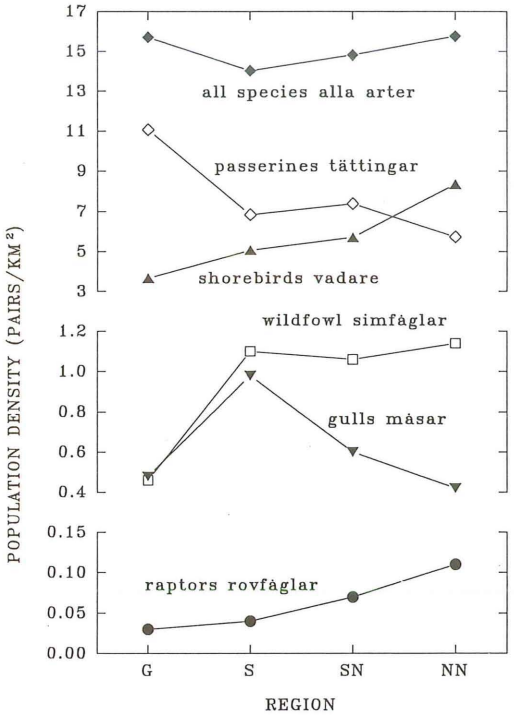

Fig. 4. Population densities of different taxonomic groups on mires in different regions of Sweden.

Populationstätheter för olika taxonomiska grupper på myrar i olika delar av Sverige.

Population sizes on mires

Eleven species (24%) have population sizes of less than 1 000 pairs on mires (Table 2). Most of these species are wildfowl which is not surprising since open water is very limited on many mires. Both the diurnal raptors (Hen Harrier and Osprey) have small populations on mires and both are also quit rare in Sweden as a whole.

Half of the species (22) have populations of 1 000 to 10 000, and 25% (11) have populations of more than 10 000 pairs on mires (Table 2).

Population sizes in Sweden

About one fourth of the species have an estimated population size exceeding 100 000 pairs and 14 species a population size of about 5 000 pairs or less (Table 2). In this last group we find Red-throated Diver, Slavonian Grebe, Bean Goose, Whooper Swan, Pintail, Scaup, Long-tailed Duck, Common Scoter, Hen Harrier, Osprey, Broad-billed Sandpiper, Jack Snipe, Short-eared Owl and Great Grey Shrike. Most of them are species with a pronounced northern distribution, and some of them are quite common in northern Siberia.

Proportion breeding on mires

From a conservation point of view, species with a considerable proportion of their total national breeding population on mires are especially interesting. Four species, Bean Goose, Broad-billed Sandpiper, Jack Snipe, and Spotted Redshank, have virtually all or a very large fraction of their total Swedish population breeding on mires in the north while a further seven species, Red-throated Diver, Hen Harrier, Crane, Whimbrel, Curlew, Greenshank and Wood Sandpiper, have more than 50% of their total population breeding on mires (Table 2). Most of these species are also quite rare in Sweden as a whole and breed in other types of wetland habitats that also are threatened by various human activities. For most species (24) less than 25% of their total Swedish population is found on mires (Fig. 5).

Discussion

Species richness

The number of species on mires in Sweden increases with latitude, as in Finland (Järvinen & Sammalisto 1976), and contrary to what might be expected (MacArthur 1972). Also in other areas the same pattern is observed when migrating birds are included; whereas if only non-migratory species are included a pattern of decreasing species richness emerges (Stevens 1989). Even if this pattern arises only when migratory birds are included, as in our case where all bird species are migratory, we still have to explain why there are more species breeding in the north. Since there is a strong correlation between mire size and species richness on mires (Kolmodin & Nilsson 1982, Boström & Nilsson 1983), one possible explanation is that surveyed mires on average were larger in the north. However, this explanation does not seem to hold. The average size of surveyed mires in South and North Norrland differs considerably but species richness does not. Furthermore, the species richnesses reported here are not average figures within a region but maximum ones. It would thus probably be enough to census a few large mires in order to obtain the species richnesses reported here. A second and perhaps more plausible explanation is that the structure of mires changes with latitude. The vegetation structure on northern mires is more like a combination of bogs and shore meadows while mires in the south to a large extent consist of bog vegetation only. Species richness on wet meadows in south Scandinavia is higher than on bogs (Larsson 1969, Soikkeli & Salo 1979). The higher vegetation diversity

Table 2. Population size (pairs) on mires, in all Sweden, and proportion on mires.

Populationsstorlek (par) på myrar, i hela Sverige och andel på myrar.

	Götaland	Svealand	Norrland	Total on mires *på myrar*	Total all Sweden *hela Sverige*	% on mires *på myrar*
Red-throated Diver *Gavia stellata*	15	200	500	720	1300	55
Slavonian Grebe *Podiceps auritus*	0	10	215	230	1000	24
Whooper Swan *Cygnus cygnus*	10	10	200	220	500[1]	44
Bean Goose *Anser fabalis*	0	20	740	760	760	100
Wigeon *Anas penelope*	0	90	4800	4900	26000	19
Teal *A. crecca*	420	1100	11320	12900	50000	26
Mallard *A. platyrhynchos*	880	1410	8860	11200	125000	9
Pintail *A. acuta*	0	0	370	370	1000	37
Tufted Duck *Aythya fuligula*	10	180	4330	4550	35000	13
Scaup *A. marila*	0	20	1140	1200	4000	30
Long-tailed Duck *Clangula hyemalis*	0	15	730	750	2000	38
Common Scoter *Melanitta nigra*	0	20	730	750	3000	25
Velvet Scoter *M. fusca*	0	50	2380	2350	20000	12
Goldeneye *Bucephala clangula*	350	1230	8570	10200	60000	17
Hen Harrier *Circus cyaneus*	0	0	800	800	1500[2]	53
Osprey *Pandion haliaetus*	50	70	270	400	3000[3]	13
Crane *Grus grus*	200	1400	7200	8800	12500	70
Golden Plover *Pluvialis apricaria*	2200	1100	4200	7500	70000[4]	11
Lapwing *Vanellus vanellus*	625	1250	2800	4700	100000	5
Temminck's Stint *Calidris temminckii*	0	0	250	250	6500	4
Dunlin *C. alpina*	0	0	2100	2100	51000	4
Broad-billed Sandpiper *Limicola falcinellus*	0	15	3660	3700	3700	100
Ruff *Philomachus pugnax*	10	10	23000	23000	57000	40
Jack Snipe *Lymnocryptes minimus*	0	15	2410	2500	2500	100
Snipe *Gallinago gallinago*	1350	1450	27700	31000	150000	21
Whimbrel *Numenius phaeopus*	10	200	5900	6100	10000	61
Curlew *N. arquata*	660	700	6100	7500	14600	51
Spotted Redshank *Tringa erythropus*	0	0	5000	5000	6000	83
Redshank *T. totanus*	70	10	880	1000	10000	10
Greenshank *T. nebularia*	0	850	12700	13600	20000	68
Green Sandpiper *T. ochropus*	700	660	1100	2500	30000	8
Wood Sandpiper *T. glareola*	570	2830	40500	45000	60000	75
Red-necked Phalarope *Phalaropus lobatus*	0	20	4100	4100	15000	27
Black-headed Gull *Larus ridibundus*	450	1170	2150	3800	100000	4
Common Gull *L. canus*	500	1000	2000	3500	145000[5]	2
Arctic Tern *Sterna paradisaea*	0	10	1600	1600	15000	11
Short-eared Owl *Asio flammeus*	0	25	2175	2200	5000	44
Skylark *Alauda arvensis*	1150	1560	1170	3900	2600000[6]	1
Meadow Pipit *Anthus pratensis*	20000	15000	50000	85000	650000	13
Yellow Wagtail *Motacilla flava*	1150	7050	74600	83000	170000	49
Whinchat *Saxicola rubetra*	5700	2300	8400	17000	175000	10
Sedge Warbler *Acrocephalus schoenobaenus*	0	15	625	650	15000	4
Great Grey Shrike *Lanius excubitor*	5	80	1000	1100	5000	22
Reed Bunting *Emeriza schoeniclus*	400	1100	25700	27500	800000	3

[1]Arvidsson 1987, [2]Nilsson 1981, [3]Ahlgren i brev, [4]Alexandersson i manus, [5]Andersson & Staav 1980, [6]Karlsson & Kjellén 1988

and higher wetness of northern mires may thus imply that more niches are available for birds. It is probable that the wetter mires in the north have a higher habitat diversity and a higher production of invertebrate food (Boström & Nilsson 1983). Something that can be taken as an indication of this is the fact that the number of wildfowl and shorebird species increases towards the north.

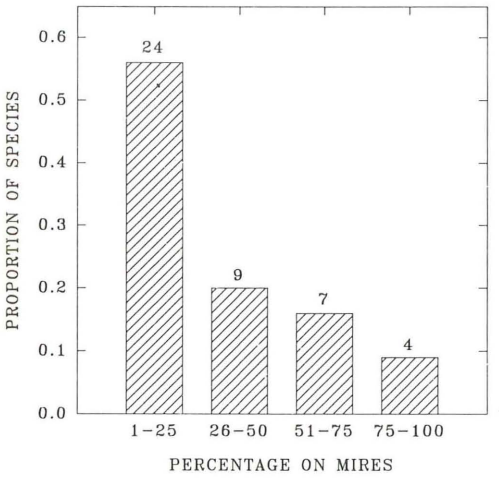

Fig. 5. The proportion of species related to the percentage of their total population sizes in Sweden breeding on mires.

Proportionen arter i relation till den procentuella andelen av den totala populationsstorleken i Sverige som häckar på myrar.

Population densities

Population densities may be correlated with mire size. On bogs larger than 0.5 km^2 there was no apparent difference in densities but on smaller bogs densities were lower (Boström & Nilsson 1983, Nilsson 1986). The accuracy of our estimates of population densities will then depend on the distribution of censused mires of different sizes in our regional samples. Unfortunately it is impossible to analyse if there is a significant difference in size distribution of censused mires since our estimates are based on provincial data and not on specific mires. However, since the results of our estimates do not differ much from those obtained by Boström & Nilsson (1983), this may not be a serious problem.

The total population density of birds on mires does not change with latitude, but the densities of wildfowl, shorebirds and raptors are higher on northern mires while that of passerines is lower (cf. the results of Boström & Nilsson 1983, based on a subsample of surveyed mires used in this paper). This implies that bird biomass increases with latitude (Boström & Nilsson 1983), indicating a better food availability through a higher production of invertebrates in the north (cf. Krogerus 1960). The reason for the increase in densities of wildfowl and shorebirds could be the greater proportion of more productive wet fens in the north (cf. Hakala 1971). Shorebird density increased with the abundance of pools on bogs (Arvidsson 1980, Kolmodin & Nilsson 1982, Boström & Nilsson 1983). Other features, such as the length of the forest-mire boundary, may be important for particular species (Boström & Nilsson 1983).

Furthermore, experiments with simulated wader nests have shown higher nest predation pressure in the south (Berg et al. 1992). Therefore, the higher density of waders and waterfowl in the north may also be due to a lower nest predation rate there.

Population sizes and conservation aspects

The main reason for making our estimates of population sizes, both on mires and nationally, was to identify species with small total populations and with a large proportion of their populations on mires. We found that four species have virtually all individuals on mires and an additional seven species have a large proportion confined to mires. Seven of these eleven species have populations of less than 10 000 pairs in Sweden, and are thus of special interest to conservation for the reason of rarity. But also for more abundant species, less confined to mires, there is reason to preserve viable populations in order to maintain genetic variation (Lande & Barrowclough 1987). In order to discern valuable mires for birds we will have to determine the demands of different species on their peatland environment by analysing their distribution in relation to different environmental variables such as size, wetness, openess, etc.

Acknowledgements

We acknowledge the tremendous census work carried out by many amateur ornithologists all over Sweden, makning this paper possible. Jon Loman and Henrik Smith made valuable comments on the manuscript.

References

Andersson, Å. & Staav, R. 1980. *Den häckande kustfågelfaunan i Stockholms län 1974-1975.* Stockholms läns landsting, Regionplanekontoret. Nacka.

Arvidsson, B. 1980. Fågellivet på myrar i Södra Älvsborg. *Gavia* 6:73-83.

Arvidsson, B.L. 1987. Distribution and population size of Whooper swan in Sweden. *Vår fågelvärld* 46:248-255. In Swedish with English summary.

Berg, Å., Nilsson, S.G. & Boström, U. 1992. Predation on artificial wader nests on large and small bogs along a south-north gradient. *Ornis Scand.* 23: 13-16.

Boström, U. 1978. The effects of wetland drainage on the bird fauna. *Anser, suppl.* 3:52-56. In Swedish with English summary.

Boström, U., Kolmodin, U. & Nilsson, S.G. 1984. Exploateringshot och fågelinventeringsläge för Sveriges myrar. *Vår Fågelvärld* 43:417-421.

Boström, U. & Nilsson, S.G. 1983. Latitudinal gradients and local variations in species richness and structure of bird communities on raised peat-bogs in Sweden. *Ornis Scand.* 14:213-226.

Bylin, K. 1980. A comparison of different methods for censusing breeding cranes *Grus grus*. *Vår Fågelvärld* 39:21-24. In Swedish with English summary.

Du Rietz, G.E. 1949. Huvudenheter och huvudgränser i Svensk myrvegetation. *Svensk Bot. Tidskr.* 43:247-309.

Eriksson, P. & Henricsson, T. 1990. Bean goose, Anser fabalis, in the south of Swedish Lapland. *Vår Fågelvärld* 49:7-14. In Swedish with English summary.

Fisher, A.G. 1960. Latitudinal variations in organic diversity. *Evolution* 14:64-81.

Fredriksson, S. 1979. The black-headed gull *Larus ridibundus* in Sweden. *Vår Fågelvärld* 38:173-200. In Swedish with English summary.

Gerell, R. 1988. The avifauna of the farmland, a historical survey. In Andersson, S. (ed.). Fåglar i jordbrukslandskapet. *Vår Fågelvärld, suppl.* 12:245-254. In Swedish with English summary.

Haapanen, A. & Nilsson, L. 1979. Breeding waterfowl populations in northern Fennoscandia. *Ornis Scand.* 10:145-220.

Hakala, A. 1971. A quantitive study of the bird fauna of some open peatlands in Finland. *Ornis Fennica* 48:1-11.

Järvinen, O. & Sammalisto, L. 1976. Regional trends in the avifauna of Finnish peatland bogs. *Ann. Zool. Fennici* 13: 31-43.

Karlsson, J. & Kjellén, N. 1988. Skylark Alauda arvensis L. In Andersson, S. (ed.). Fåglar i jordbrukslandskapet. *Vår Fågelvärld, suppl.* 12: 245-254. In Swedish with English summary.

Kolmodin, U., Arvidsson, B., Boström, U., De Jong, A. & Nilsson S.G. 1987. Efficiency of single visit bird censuses on mires: a synthesis of Swedish studies. *Vår Fågelvärld* 46: 430-438. In Swedish with English summary.

Kolmodin, U. & Nilsson, S.G. 1982. Density and species richness of breeding birds on mires in Dalarna, central Sweden. *Vår Fågelvärld* 41:1-12. In Swedish with English summary.

Krogerus, R. 1960. Ökologische Studien über nordische Moorarthropoden. *Soc. Scient. Fenn. Comm. Biologicae* 21: 1-238.

Lande, R. & Barrowclough, G.F. 1987. Effective population size, genetic variation, and their use in population management. Pages 87-124 in Soulé, M.E. (ed.). *Viable populations for conservation.* Cambridge Univ. Press, Cambridge.

Larsson, T. 1969. Land use and bird fauna on shores in southern Sweden. *Oikos* 20: 136-155.

MacArthur, R.H. 1972. *Geographical ecology.* Harper & Row, New York.

Mörnsjö, T. 1971. Peatland types and their regional distribution in south Sweden. *Geologiska Föreningen i Stockholm. Förhandlingar.* 93: 587-600.

Nilsson, S.G. 1977. Composition and density of the bird community on raised peat-bogs in Southwestern Sweden. *Fauna och Flora* 72: 227-233. In Swedish with English summary.

Nilsson, S.G. 1981. The size of the breeding populations of diurnal raptors in Sweden. *Vår Fågelvärld* 40: 249-262. In Swedish with English summary.

Nilsson, S.G. 1986. Are bird communities in small biotope patches random samples from communities in lage samples. *Biol. Cons.* 38: 179-204.

Regnell, S. 1981. The breeding population of the Horned Grebe, *Podiceps auritus*, in Sweden. *Vår Fågelvärld* 40: 13-22. In Swedish with English summary.

SCB. 1987. *The natural environment in figures.* 2nd ed.

Soikkeli, M. & Salo, J. 1979. The bird fauna of abandoned shore pastures. *Ornis Fennica* 56: 124-132.

SOF 1990. *Sveriges fåglar.* Sveriges Ornitologiska Förening. Stockholm.

Stenpil, L. 1982. Torv och torvmark åt alla. *Norrbottens Natur* 38: 38-45.

Stevens, G.C. 1989. The latitudinal gradient in geographical range: how so many species coexist in the tropics. *Am. Nat.* 133: 240-256.

Svensson, S. 1975. Handledning för Svenska häckfågeltaxeringen med beskrivningar av revirkarteringsmetoden och punkttaxeringsmetoden. Lund.

Svensson, S. 1978. A simplified territory mapping technique for estimating bird numbers on bogs. *Vår Fågelvärld* 37: 9-18. In Swedish with English summary.

Svensson, S., Carlsson, U.T. & Liljedahl, G. 1984. Structure and dynamics of an alpine bird community, a 20-year study. *Ann. Zool. Fennici* 21: 339-350.

Ulfstrand, S. & Högstedt, G. 1976. How many birds breed in Sweden? *Anser* 15: 1-32. In Swedish with English summary.

Sammanfattning

Myrarnas betydelse som häcknigsbiotop för våtmarksfåglar.

Artantalet minskar generellt mot norr och flera hypoteser som förklarar detta fenomen har föreslagits (Stevens 1989). Emellertid ökade antalet fågelarter, liksom fågeltätheten, mot norr på finska myrar (Järvinen & Sammalisto 1976) och samma mönster observerades för de flesta taxonomiska fågelgrupper på högmossar i Sverige (Boström & Nilsson 1983). Myrmark utgör ungefär 12% av landarealen i Sverige, och med ökande oljepriser i mitten av 70-talet aktualiserades olika exploateringsplaner. Som ett svar på detta startades en extensiv fågelinventering på myrar i hela landet. Syftet var främst att hitta de ur fågelsynpunkt mest värdefulla myrarna, men på grund av det stora antalet myrar var det ej realistiskt att inventera samtliga. Ett mål blev därför att urskilja fågelarter som indikerar skyddsvärda myrar. I denna uppsatsen redovisar vi regionala trender i artrikedom och täthet, totala populationsstorleken på myrar och i landet som helhet, och som ett mått på myrarnas relativa betydelse för våtmarksfåglar, andelen av den svenska totalpopulationen som häckar på myrarna.

Metoder

Inventeringarna omfattar 1522 myrar, med en total areal av 2250 km^2, fördelade över hela Sverige (Fig. 1). Inventeringarna, som utfördes mellan 1974 och 1987, omfattar huvudsakligen myrar större än 0.5 km^2 men även vissa mindre myrar blev inventerade. En stor andel av den totala myrarealen består av mindre, relativt fågelfattiga myrar (Tabell 1). Av övriga myrar är en del ointressanta för våtmarksfåglar på grund av dikning och igenväxning. I Götaland kan denna areal beräknas till 40% av totalarealen myr större än 0.5 km^2, i Svealand till 20%, i Södra Norrland till 15% och i Norra Norrland till 10%. Med utgångspunkt från ovanstående beräkningar har mellan 10 och 15% av arealen stora öppna myrar inventerats, men variationen är stor mellan olika regioner (Fig. 1).

Myrarna besöktes vid ett tillfälle under de två första veckorna i juni i södra Sverige eller under slutet av juni till början av juli i norra Sverige. Inventeringarna, som endast utfördes vid god väderlek, skedde längs parallella linjer, med ca 150 meters mellanrum i långsamt tempo (för en utförligare beskrivning, se Boström & Nilsson 1983).

Beräkningar av populationtätheter på myrar gjordes landskapsvis på följande sätt: *antalet inventerade par dividerat med artens inventeringseffektivitet* (ett mått på hur många av det verkliga antalet par som observeras vid denna typ av inventering, se Tabell 1) *multiplicerat med den inventerade arealen.* Populationsstorlekar beräknades genom att multiplicera populationstäthet med arealen öppen myr större än 0.5 km^2.

Våra beräkningar av populationsstorlekar i Sverige baseras huvudsakligen på regionala och lokala inventeringar och beräkningar, i några fall på nationella beräkningar (SOF 1990).

Resultat

Artrikedomen ökar mot norr. Om man bara tar hänsyn till de vanligaste arterna (högre täthet än 0.1 par/km^2) ökar antalet från 16 i Götaland till 22 i Norra Norrland. Om man tar hänsyn till samtliga arter ökar det från 25 arter i Götaland till hela 42 i Norra Norrland (Fig. 2). Ökningen i artantal beror framförallt på att antalet sim- och vadarfåglar blir större mot norr medan antalet tättingar inte nämnvärt förändras med latitud (Fig. 3).

Populationstätheterna för olika arter varierar regionalt men det finns inget generellt mönster för samtliga arter. Ljungpipare, skogssnäppa och ängspiplärka har lägre tätheter på nordliga myrar, 23 andra arter ökar i täthet mot norr medan övriga inte uppvisar något speciellt mönster (Tabell 1). Bland olika taxonomiska grupper ökar tätheten mot norr för rovfåglar, simfåglar och vadare medan tätheten för tättingar minskar. Den sammanlagda populationstätheten tycks dock inte förändras nämnvärt med latitud (Fig. 4).

Elva arter, av vilka de flesta är simfåglar, har populationsstorlekar på myrar som understiger 1000 par, lika många har populationsstorlekar på mer än 100 000 par (Tabell 2).

Ungefär en fjärdedel av arterna har populationsstorlekar på mer än 100000 par i Sverige medan 14 arter har en populationsstorlek runt 5000 par eller mindre. I den sista gruppen återfinns en rad arter med en huvudsaklig utbredning på tundran i norr (Tabell 2).

Fyra arter, sädgås, myrsnäppa, dvärgbeckasin och svartsnäppa, har i det närmaste hela sina populationer på myrar medan ytterligare 7 arter, smålom, blåhök, småspov, storspov, gluttsnäppa och grönbena, har mer än 50% på myrar (Tabell 2, Fig. 5).

Diskussion

Artantalet av fåglar ökar som synes mot norr på myrar tvärtemot vad man förväntar sig (MacArthur 1972). Samma mönster kan observeras i andra habitat när flyttande fågelarter inkluderas. Om de flyttande arterna ej räknas med får vi det förväntade mönstret med minskade artantal mot högre latituder (Stevens 1989). En möjlig förklaring till det högre artantalet på nordliga myrar under häckningstid skulle kunna vara att vegetationsstrukturen är mer komplex och att fler öppna vattenytor finns tillgängliga, vilket möjligen leder till en högre och mer varierad insektsproduktion och därigenom också fler tillgängliga nischer för häckande arter (Boström & Nilsson 1983).

Eftersom populationstätheten delvis är beroende av myrens areal (Nilsson 1986) beror noggrannheten i våra beräkningar och därigenom möjligheten att jämföra olika regioner på att urvalet av olikstora myrar som inventerats är likartat. Tyvärr är det omöjligt att kontrollera detta men våra beräkningar skiljer sig inte mycket från tidigare beräkningar där myrstorlekarna var kända (Boström & Nilsson 1983).

Den sammanlagda populationstätheten verkar inte variera speciellt mycket med latitud. Populationstätheten för simfåglar, vadare och rovfåglar tycks vara högre i norr medan tätheten för tättingar minskar. Detta betyder att biomassan av fåglar är större i norr (fler stora fåglar), något som tyder på att produktionen av insekter är större i norr. Andra faktorer som kan gynna högre tätheter av vissa arter i norr skulle kunna vara en minskad risk för bopredation (Berg et al. 1992).

Myren tycks vara ett speciellt viktigt häcknignshabitat för elva arter som har mer än hälften av sin totala population i denna miljö. Sju av dessa är också ovanliga som häckfåglar i Sverige och är därigenom speciellt intressanta ur skyddssynpunkt. Men även för mer talrika arter, inte lika hårt knutna till myren, finns det goda skäl att bevara livskraftiga populationer på myrarna för att exempelvis bibehålla genetisk variation (Lande & Barrowclough 1987).