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Monitoring Forsmark

Bird monitoring in Forsmark 2012

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March 2013

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Abstract

This report summarizes the monitoring of selected listed (Swedish Red List and/or the EU Birds directive) breeding birds in Forsmark 2002–2012. Monitoring of eleven listed species was conducted in the regional model area, including the candidate area in 2012 in the same way as in earlier years.

The results from 2012 generally follow patterns recorded in earlier years. 2012 was in general a better bird year compared to 2010 and 2011 and most species (82%) showed increasing or stable numbers from 2011 to 2012. Only two species (18 %) decreased in numbers between the last two years. All in all, six species (55 %, black-throated diver, honey buzzard, black grouse, ural owl, wryneck and red-backed shrike) show no significant trends since the start of the bird monitoring (2002/2003/2004 depending on species). During this period three species (27 %, white-tailed eagle, osprey and lesser spotted woodpecker) have increased in numbers while just two (18 %, capercaillie and hazelhen) have decreased.

A new pair of black-throated divers was discovered in 2012 and seven resident pairs were registered. Breeding success was very good, the second best during the study period. Population development follows the national pattern, but breeding success seems to be better in Forsmark than in the country as a whole. Honey buzzards and ospreys occurred in good numbers, and breeding success for ospreys was good. No signs of successful breedings of honey buzzards were recorded, but this may mean little as no detailed monitoring of breeding success is made for this species. The white-tailed eagles had their best breeding year since the start of the SKB bird monitoring, meaning that during the last two years local breeding success has been back at the level recorded before the site investigations started.

The three grouse species (black grouse, capercaillie and hazelhen) again showed somewhat varying patterns between the last two years as well as in the long run. The black grouse increased from the low level recorded in 2011. Capercaillie numbers in the parts of the area covered decreased slightly. Hazelhens increased in the candidate area, but did not change in the remaining parts of the regional model area. Overall, both capercaillie and hazelhen show negative trends in the area at large, but not in the candidate area. Numbers of black grouse has not changed in general, but instead has varied in what seems to be a cyclic pattern. Black grouse have however disappeared from the candidate area during the study years.

The ural owl territory being closest to, but still outside, the candidate area that has been vacant for the last two years was occupied again in 2012. Five pairs were found in the whole Forsmark area. No significant change in numbers has been recorded during 2002–2012. Breeding success in 2012 was very poor.

The wrynecks decreased somewhat from 2011, but the overall trend shows no change in numbers. Lesser spotted woodpeckers increased in numbers up to the record level of 21 territories. Red-backed shrikes finally increased slightly between 2011 and 2012 and there is no significant trend in shrike numbers around Forsmark during the study period.

Sammanfattning

Denna rapport sammanfattar övervakningen av bestånden av häckande fåglar i Forsmark 2002–2012. Under 2012 genomfördes inventering av elva utvalda listade arter (upptagna i Svenska rödlistan och/eller EU:s Fågeldirektiv) inom regionala modellområdet, inklusive kandidatområdet, på samma sätt som under tidigare år.

Mönstren som noterats under tidigare år följdes i stort under 2012. Året var generellt ett bättre fågelår jämfört med de två närmast föregående åren och huvuddelen av de övervakade arterna (82%) ökade eller var stabila i antal jämfört med 2011. Bara två arter (18 %) minskade i antal mellan 2011 och 2012. Sammantaget är det sex arter (55 %, storlom, bivråk, orre, slaguggla, göktyta och törnskata) som har varit stabila i antal sedan starten av SKB:s fågelövervakning (2002/2003/2004 beroende på art). Under samma period har tre arter (27 %, havsörn, fiskgjuse och mindre hackspett) ökat i antal och två arter (18 %, tjäder och järpe) har minskat i antal.

Ett nytt storlomspar hittades under 2012 och totalt sju par fanns i området. Häckningsframgången var mycket god, den näst bästa under hela studieperioden. Utvecklingen i Forsmark följer det nationella mönstret men häckningsframgången har varit högre i Forsmark under senare år jämfört med landet i stort. Bivråk och fiskgjuse förekom i goda och numera ganska normala antal. Fiskgjusarna lyckades väl med häckningarna medan inga tecken noterades när det gällde lyckade bivråkshäckningar. Det senare ska inte tas alltför allvarligt eftersom ingen organiserad övervakning av häckningsutfall sker för den arten. Havsörnarna hade den bästa häckningsframgången sedan SKB:s fågelövervakning startade. Därmed har häckningsframgången under de två senaste åren varit tillbaka på den nivå som noterades innan platsundersökningarna inleddes.

Skogshönsen uppvisade ännu en gång skilda mönster. Orren ökade i antal från den låga nivån som noterades 2011. Antalet tjädrar minskade något och järpen ökade i antal i kandidatområdet, men var stabil i det regionala modellområdet utanför kandidatområdet. Totalt sett över hela studieperioden så uppvisar både tjäder och järpe minskande antal totalt sett, men inte inom eller intill kandidatområdet. Antalet orrar har inte förändrats regelbundet åt något håll, men uppvisar vad som liknar en cyklisk trend. Orren har däremot inte noterats inom kandidatområdet under de senaste två åren.

Slaguggleviret som ligger närmast kandidatområdet och som stått obebott under de två senaste åren var åter bebott 2012. Totalt hittades fem bebodda revir under året och det finns ingen säkerställd förändring i området 2002–2012. Häckningsresultaten var usla och endast en större unge registrerades.

Antalet göktytor minskade något från 2011, men den övergripande trenden visar inte på några förändringar. Mindre hackspetten ökade i antal och tangerade åter rekordnivån 21 bebodda revir. Törnskatorna var något fler 2012 jämfört med 2011 och det finns inte heller för denna art någon säkerställd förändring under studieperioden.

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1 Introduction

This document reports the results from the bird monitoring in Forsmark for 2012. The bird surveys started in 2002 and have now been going on for eleven years. For the species presented here good data are available from 2002, 2003 or 2004 onwards, allowing comparisons during a period of nine-eleven years. The aim of this report is to continue to follow the population development of certain listed bird species (according to the Swedish Red List and/or the EU Birds directive) in the Forsmark area after the now finished site investigations. The surveys were made according to activity plan AP SFK-10-027. The project has been conducted by the Department of Biology, Lund University. The report covers the whole regional model area, including the candidate area.

Original data from the reported activity are stored in the primary database Sicada and the SKB GIS database, where they are traceable by the Activity Plan number (AP SFK-10-027). Only data in SKB´s databases are accepted for further interpretation and modelling. The data presented in this report are regarded as copies of the original data. Data in the databases may be revised, if needed.

2 Objective and scope

The site investigations in Forsmark started in 2002 and finished in 2007. SKB has from the start of the investigations aimed at monitoring the effects from all the ongoing activities on the bird fauna in the area. This in order to ensure that the site investigations were carried out in such a way that disturbances to the fauna, especially sensitive and vulnerable species, could be held at a minimum level (without hindering the essential parts of site investigations).

Forsmark is an area rich in birds, holding high densities of both common species and more rare ones (Green 2003, 2004, 2005, 2006, 2007, 2008a, 2008b, 2009, 2011, SKBdoc 1332931) such as species listed in the Swedish Red List (Gärdenfors 2010) and European Union's Birds directive (Council Directive 79/409/EEC, Annex 1). It is inevitable that site investigations as those conducted by SKB in 2002–2007 affect the bird fauna in some way. The initial idea was that the investigations were not only likely to affect the specific sites where drilling was made or new roads were constructed. In addition to these direct impacts, involving small, but none the less direct losses of available areas for birds (both directly in a pure physical sense and indirectly through high, long-lasting levels of disturbance), the general level of human activity in the area was greatly increased with more traffic on the roads, more people out in the landscape measuring and sampling different objects etc. In Forsmark this meant a quite dramatic change from the pre-site investigation period, as the area then had a rather low level of human disturbance.

For eleven selected listed species (Swedish Red List and the EU:s Birds directive) the objective of the monitoring is to follow the population development in the whole regional model area. In addition to looking at overall numbers for these species, the programme aims at investigating breeding success when this is possible.

After the site investigations were terminated in 2007, SKB has proceeded with the plans for locating a geological repository for spent nuclear fuel in the Forsmark area. It was decided that the bird monitoring should continue for the time being in order to have background data for evaluating possible consequences on the bird fauna of such a repository.

Within the bird surveys, the Forsmark area has been divided in two parts:

The regional model area (area of possible large-scale effects). In Forsmark the land area of the regional model area is about 60 km^2. This area is shown within green lines line in Figure 2-1.

The candidate area. A smaller area which was the core area of the site investigations. The size of the area in Forsmark is about 10 km^2. The candidate area is shown within red lines in Figure 2-1.

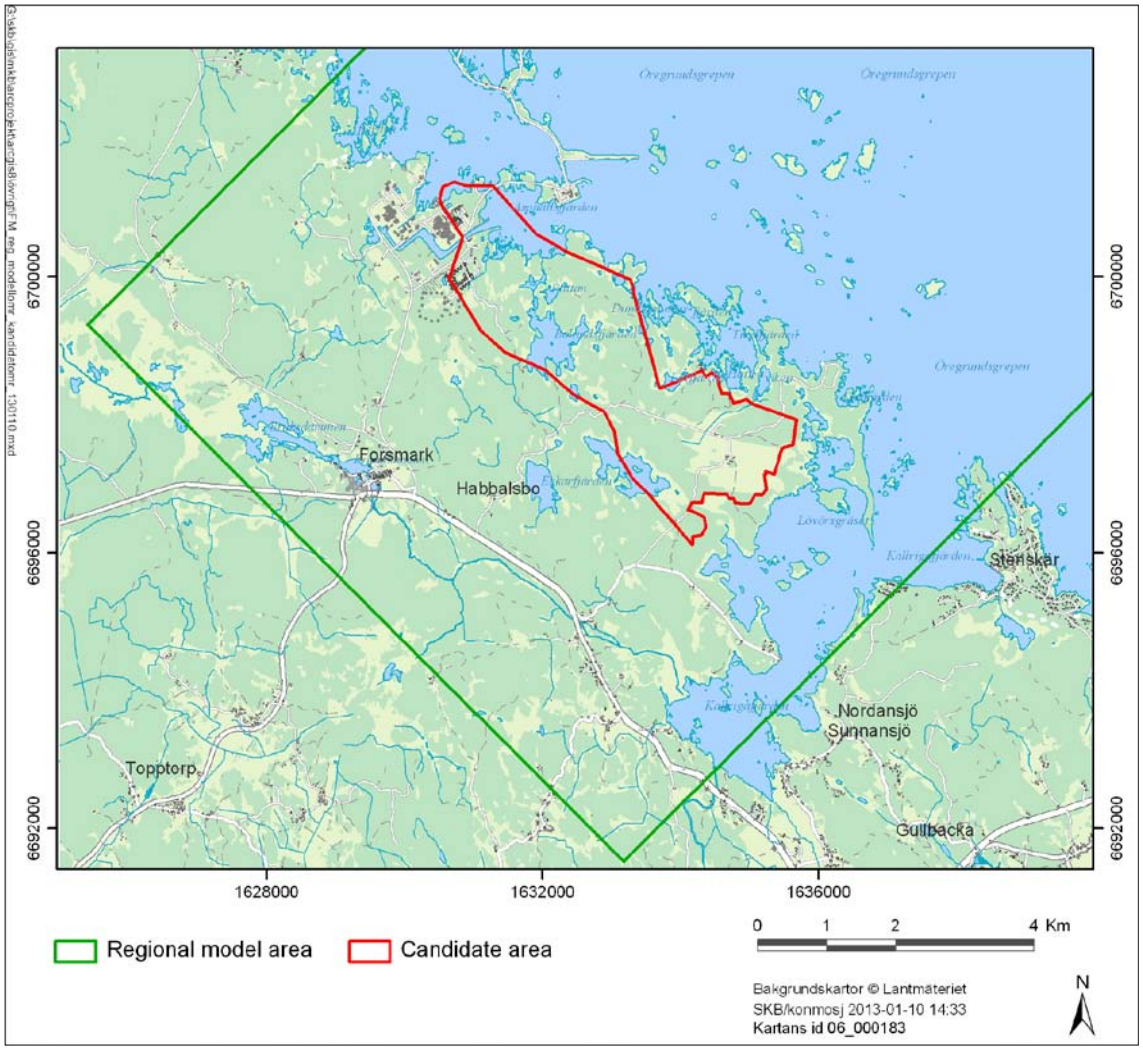

Figure 2-1. *Map of the survey area in Forsmark. The regional model area is shown with a green line and the candidate area is illustrated with a red line.*

3 Equipment

3.1 Description of equipment

The following equipment was used when conducting the bird surveys.

- GPS (Garmin GPS 60).
- Binoculars and telescope.
- Field maps showing each day's work.
- Note books and paper forms.
- Vehicles for transport to and from the study area.
- Cell phone (safety equipment when working alone in the field).

4 Methods

The methods used are described in detail in activity plan AP SFK-10-027. An overview of the methods used for monitoring purposes is presented below.

4.1 Listed species (Swedish red list; EU Birds directive, Annex 1)

The species occurring in Forsmark and included in the Swedish Red List and/or the EU:s Birds directive are shown in Appendix 1. Starting from 2004, a selection of these species is monitored on a yearly basis. During 2002–2003, all listed species were monitored, although the project was still in the exploratory phase then, resulting in that all species did not receive proper coverage in the very first year(s). The species in question are shown in Table 4-1. Selection of monitoring species was made according to a set of different criteria. A species was included for further monitoring if one or more of the following criteria was met: **i)** Forsmark is a vital area for the species in a larger (e.g. national) perspective; **ii)** The species in question is suspected to be sensitive to disturbances and thus possibly affected in a negative way by the site investigations; **iii)** The species showed a negative population trend at the national level at the start of the site investigations (but not necessarily in Forsmark); **iv)** Forsmark holds high densities of the species.

These species were monitored in 2012 by visiting known nesting places/territories used in 2002–2011, combined with visits to habitats suspected to possibly hold the species in question. Visits to nest sites/territories/suitable habitats were made during relevant periods, when presence of the birds is expected to be easy to detect. Detailed monitoring of breeding results was made for some species, i.e. black-throated diver, white-tailed eagle, osprey and ural owl. All observations of the selected listed species were registered with data on bird species, number of birds, position (from GPS or recorded on field maps) and date during the field work.

Table 4-1. Listed species (Swedish Red List and/or EU: Birds directive) selected for monitoring in Forsmark in 2004–2012.

English name	Swedish name
Black-throated Diver	Storlom
Honey Buzzard	Bivråk
White-tailed Eagle	Havsörn
Osprey	Fiskgjuse
Black Grouse	Orre
Capercaillie	Tjäder
Hazelhen	Järpe
Ural Owl	Slaguggla
Wryneck	Göktyta
Lesser spotted Woodpecker	Mindre hackspett
Red-backed shrike	Törnskata

4.2 Execution

The monitoring field work in 2012 was carried out during the period 2012-03-26 – 2012-07-26. All organised field work apart from the eagle work was carried out by Martin Green. Alf Sevastik and Peter Hunger assisted with additional information on bird observations in the area during the relevant period. The white-tailed eagle work was carried out within the ongoing national project concerning this species by Björn Helander, Swedish Museum of Natural History, Stockholm. Organisation, data handling, analysis work and interpretations were carried out by Martin Green, Dep. of Biology, Lund University.

4.3 Data handling

In the field all registered birds of the selected species were recorded in notebooks with data on species, number of individuals and position together with additional data on bird behaviour and circumstances where such data were relevant. Observations were registered with as exact position as possible individually taken directly from the GPS in the field. Positions for selected listed species have the same resolution as the GPS-system. After each day's field work the data were transferred to pre-made paper forms. Data were then entered into an Excel-file from paper forms whereupon the file was cross-checked against the field notes by the project leader. This base-file with data on species, numbers and positions can then be used for different GIS applications, for evaluating bird densities and further calculations.

4.4 Analyses and interpretations

For most species the actual numbers of recorded territories/nests/pairs are reported and shown in figures. For hazelhen and red-backed shrike, however, population change is shown in the form of a chain-index. The reason for not using the recorded number of territories directly in this case is that the monitored areas have not remained exactly the same during all the years. To come around this problem, but still be able to compare the population development in an easily understandable way, a chain index is constructed. The chain index is created by comparing *areas checked equally well* in two following years and calculating the change in per cent between these two and then applying that change to the index of the start year, which is set to one (1), or in all other cases to the index of the preceding year. The procedure is repeated in a rolling scheme until the last year of the time-series is reached. In the red-backed shrike case the calculation was made as follows (in this case with the regional model area, excluding the candidate area as an example).

- Index for the start year is set to 1. 2004 is here used as the start year as from this year onwards red-backed shrikes have been monitored in the same way although the exact area covered may have differed between years. 2004 is hence the basis for all future comparisons.
- In 2004, 39 territories of shrikes were registered in parts covered equally well also in the following year (2005).
- In 2005 no less than 51 territories were recorded in these parts (index calculations can only be made when at least two years of data are collected, since it is made in a back-wards calculating mode).The index for 2005 is calculated as: (51/39)×1) = 1.31. Interpreted as a 31% increase in numbers between 2004 and 2005.
- In 2006, 53 territories were recorded in the parts also covered in 2005. The index for 2006 is then (53/51)×1.31 = 1.35, an increase with 4 % since the year before (and a 35 % increase since 2004)
- And so on.

For statistical tests of trend data the Spearman rank correlation test (Sokal and Rohlf 1995) was used. This test is a non-parametric correlation test where one simply tests whether a variable y (number of bird pairs in most of our cases) has changed in a significant direction (upwards or downwards) in relation to variable x (year in this case). Statistical results presented are the correlation coefficient $\mathbf{r_s}$ which varies between –1 and 1. A value of 0 means that there is no correlation at all, the higher the value of $\mathbf{r_s}$, the stronger the positive correlation (increase in this case), the lower the value of $\mathbf{r_s}$, the stronger the negative correlation (decrease in this case). **p** is the probability that the true result is actually different from the obtained result, or to put it in other words, the probability to find the significant result by random. **N** is the number of data points entered into the correlation. Hence, a high or low $\mathbf{r_s}$ value (close to 1 or –1) means that there is a strong correlation and will yield a low **p**-value. Non-parametric tests were used to avoid assumptions about data distributions. All tests were performed in the software IBM SPSS Statistics 20.

4.5 Nonconformities

The activity was performed according to the plans and there were no nonconformities regarding the monitoring of selected listed species. However, the monitoring of the complete bird fauna planned to be conducted in 2012 had to be postponed until 2013 due to lack of available field workers. This is a survey using line- and point transects, previously performed in 2002–2004 and 2007, covering a large part of the regional model area where all present bird species are counted (see AP SFK-10-027). Prime priority will be given to perform this task during 2013.

5 Results

Data from this survey are stored in the SKB GIS database and are traceable by the Activity plan number AP SFK 10-027. The use of the data is restricted since it concerns sensitive species.

English names of the birds are used throughout the results section. Swedish names are given in the species headlines. A complete list of English, Latin and Swedish names for all listed bird species possibly breeding in Forsmark during 2002–2012 is given in Appendix 1.

5.1 Listed species

The following section gives a summary of the population development during the last seven to nine years for some of the species listed as endangered, threatened or vulnerable according to the Swedish Red List (Gärdenfors 2010), and/or species listed in the European Union's Birds directive (Council Directive 79/409/EEC, Annex 1) within the regional model area in Forsmark. For some of these species, breeding results have also been monitored and are hence reported.

The text about the breeding results of white-tailed eagles in Forsmark and surrounding reference areas is written by Björn Helander, Swedish Museum of Natural History, Stockholm.

Black-throated Diver *Gavia arctica* Storlom (EU Annex 1)

The black-throated divers had a good year in Forsmark in 2012. A new resident pair was observed and the breeding success was one of the highest recorded during the eleven years (see Figure 5-1 and Figure 5-2). During the study years the number of present pairs has been varying between five and seven and there is no significant trend in diver numbers in the area ($r_s = 0.47$, $p = 0.15$, $N = 11$). In 2012, three pairs were found in lakes and four pairs along the coast, a normal distribution in comparison with earlier years.

Two of the lake pairs and two of the coastal pairs together produced seven large young, an average of one large young per present pair. This is the best breeding result for the divers in Forsmark since 2006 and the second best year overall. The average for the whole study period is 0.54 large young/present pair, which is higher than, but of the same magnitude as, the average for the whole of Sweden 1994–2011 (0.42–0.46) (Eriksson 2012). Breeding success measured as the number of successful pairs per year has increased over the study period ($r_s = 0.70$, $p = 0.02$, $N = 11$) and there is a tendency for an increase also in the number of produced large young per year ($r_s = 0.56$, $p = 0.08$, $N = 11$).

Unlike in Forsmark there is a tendency for a decrease in the production of young in Svealand at large, but not in Götaland and Norrland. This tendency is mainly a result of that the proportion of broods with more than one young is decreasing in Svealand. In Sweden the overall proportion of larger broods (2-3 young) is 33–42 % (Eriksson 2012). In Forsmark this proportion is much higher, 65 %!

The absence of trends in diver numbers in Forsmark during the last ten years is in accordance with the pattern on the national level for the same period. The Swedish population of black-throated divers has remained stable during this time (Lindström and Green 2013). In summary, diver numbers in Forsmark follow the national pattern but breeding success during later years seems to be better than both the national level and especially than what has been recorded elsewhere in Svealand.

The diver data set from Forsmark now cover a period so long that it may be interesting to make a few comparisons within the area as well. A more detailed analysis shows that pairs in lakes do much better than their neighbours that try to breed along the coast, even though bird numbers are stable in both cases.

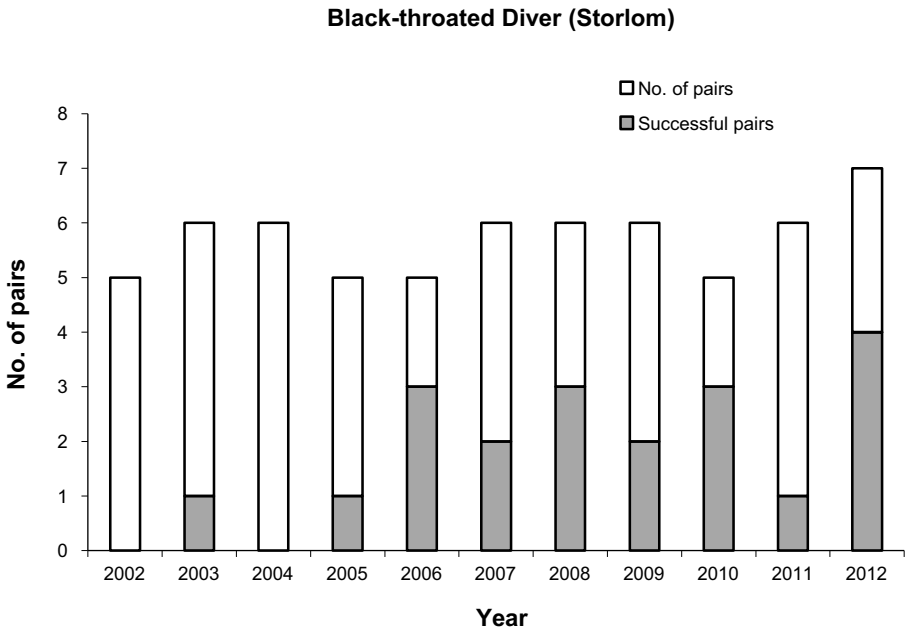

Figure 5-1. *Number of resident pairs of black-throated divers in Forsmark 2002–2012. Shading shows the number of successful pairs. Minimum numbers are shown, total numbers of pairs in 2005 might have been seven and there might have been four successful pairs in 2006.*

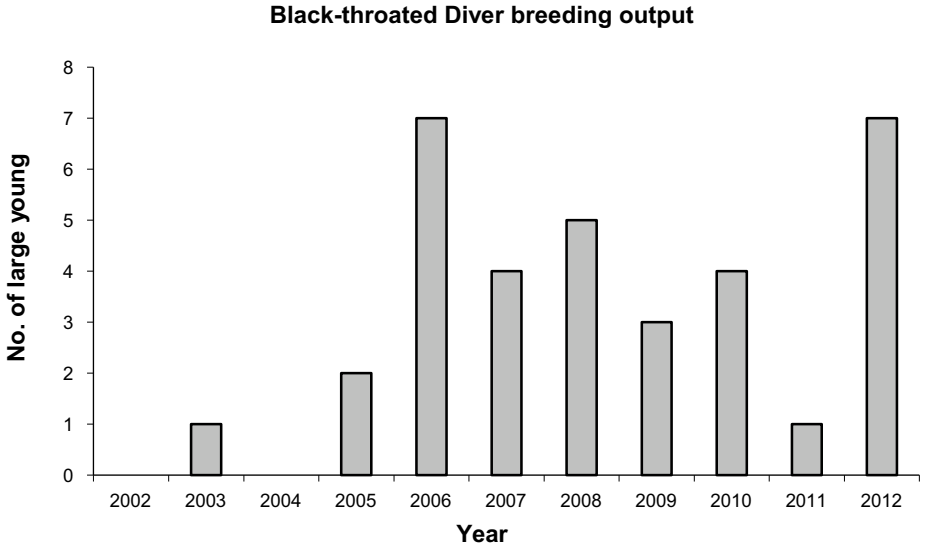

Figure 5-2. *Number of large young of black-throated divers produced in Forsmark 2002–2012. Number of large young per present pair was 0 in 2002, 0.17 in 2003, 0 in 2004, 0.40 in 2005, 1.40 in 2006, 0.67 in 2007, 0.83 in 2008, 0.50 in 2009, 0.80 in 2010, 0.17 in 2011 and 1.00 in 2012.*

The numbers of breeding attempts during the eleven-year period were about the same in the two habitats, 32 in lakes and 31 along the coast. In lakes 41 % of the attempts were successful (= produced large young). The corresponding figure for the coast was only 23 %. Breeding attempts in lakes resulted in on average 0.69 large young/present pair while attempts along the coast resulted in 0.39 large young/present pair. Interestingly there was however no difference in the number of produced young per successful pair between the two habitats. Successful pairs along the coast produced on average 1.71 large young/pair while pairs in lakes produced 1.69 large young/pair. The difference between the habitats thus seems to depend entirely on the proportion of successful attempts. This indicates that it is not harder to rear young along the coast than in lakes, but that there might be a difference in nest survival between the two habitats.

There could be several possible explanations for the found pattern and at present we do not know exactly why pairs in lakes are more successful than pairs along the coast. It seems reasonable that variations in water levels are larger and more pronounced along the coast than in the lakes, and if so a higher proportion of the coastal nests may risk flooding during high water spells. At the same time, nest predation may be higher in coastal habitats than in lakes or the coastal habitat may be secondary to divers, resulting in that old, experienced birds occupy the primary territories in the lakes while younger, inexperienced birds have to do with what they can get (= coastal territories) until vacancies appear in the lakes.

Honey Buzzard *Pernis apivorus* Bivråk (Sw. Red List; EU Annex 1)

Honey buzzard numbers remained at the same level as has been recorded in earlier years. Nine territories with parts within the regional model area were registered in 2012 (see Figure 5-3).

As explained in earlier reports (see Green 2008a, b, 2009, 2011, SKBdoc 1332931) the number of recorded pairs in the early years 2002–2003 were without doubt an underestimate. Hence, from this report onwards the results from these early years are not shown anymore. Instead results from 2004 onwards are shown, i.e. for the period when a good coverage of the local honey buzzards has been attained.

Over this period there has been no significant trend in honey buzzard numbers in Forsmark ($r_s = 0.52$, $p = 0.15$, $N = 9$). As in earlier years the number of recorded successful pairs is shown in Figure 5-3, but it should be noted that no detailed monitoring of breeding results are made for honey buzzards. The presented results are hence just what have been recorded during other field work in the area. No direct signs of any successful breeding, like adults carrying food for young or nests with young were found in 2012, but this does not necessarily mean that successful breeding did not occur in Forsmark also in this year.

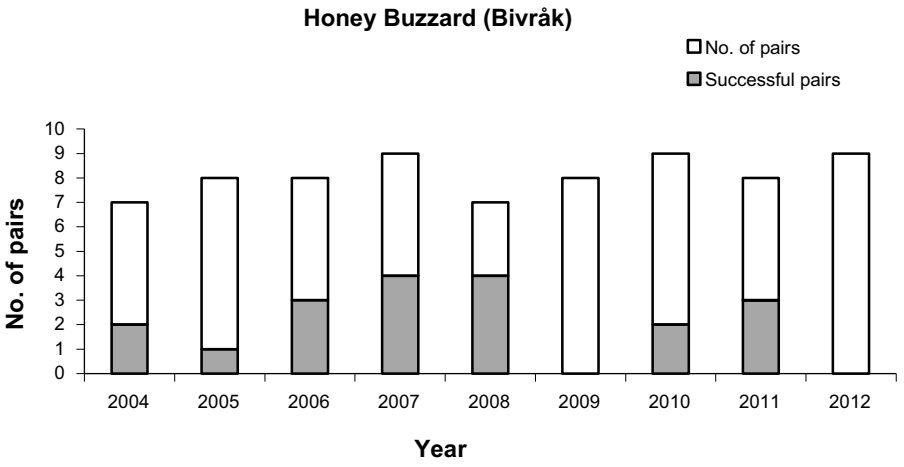

Figure 5-3. *Number of territorial pairs of honey buzzards within the regional model area in Forsmark 2004–2012. Shading shows number of successful pairs.*

The honey buzzard is presently classified as 'Vulnerable' (sårbar) in the Swedish Red List. Earlier it was classified as 'Endangered' (starkt hotad). The national population declined heavily in the 1970-ies and 1980-ies but has remained stable in the last decades (Kjellén 2012). During the same time period as covered by the Forsmark data there has been no significant change in numbers of honey buzzards migrating over Falsterbo (Kjellén 2012). The migration counts at Falsterbo in southern Sweden are by far the best data set covering the national trend of honey buzzards and other migrating raptors.

White-tailed eagle *Haliaeetus albicilla* Havsörn (Sw. Red List; EU Annex 1)

The 2012 breeding season for the white-tailed eagle in the Forsmark area was the best so far since the site investigation activities began in 2002. The breeding outcome in the area in both 2011 and 2012 were near the same as in the years preceding the site investigation period. A slight revision of the dataset has been made in order to include a few more breeding sites in the reference areas for comparison with the Forsmark area. The obvious difference in breeding success between the Forsmark area and the reference areas from the beginning of the study period has decreased over time. The breeding success in the reference area to the north has been quite poor during a number of years, for unknown reasons. The reference area to the south has maintained a fairly stable breeding success over the study period (average 76 %), whereas both the Forsmark area and the reference area to the north average clearly lower (around 55 %).

Table 5-1. Per cent successfully breeding pairs of white-tailed eagle in 1998–2001 (background) and in 2002–2012 in Forsmark and two reference areas north and south of Forsmark, respectively (*n* = number of checked territorial pairs).

Area	1998–2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2002–2012	N
Forsmark area	85	25	33	50	75	25	60	60	60	20	80	83	54	64
Reference area S	79	100	80	100	83	50	80	60	80	33	80	100	76	78
Reference area N	72	83	71	86	28	28	33	60	33	50	60	71	55	87

(Report by Björn Helander, Swedish Museum of Natural History, Stockholm)

Figure 5-4. *White-tailed eagle. Photo Kustbild/Alf Sevastik.*

Osprey *Pandion haliaetus Fiskgjuse (EU Annex 1)*

The same number of osprey pairs was found in Forsmark in 2012 as in 2011, and the local population remained on the highest level recorded during the study period (see Figure 5-5). This means that there is now a significant increase in osprey numbers in Forsmark over the eleven years ($r_s = 0.70$, $p = 0.02$, $N = 11$). The increase is however small and on average 7.7 pairs has been recorded per year.

Breeding results were close to the average for the whole study period and seven pairs produced ten large young (1.11 large young/territorial pair in 2012 compared to 1.05 overall, see Figure 5-6). There is no significant trend in number of successful pairs ($r_s = 0.35$, $p = 0.30$, $N = 11$) or in the numbers of produced young ($r_s = 0.05$, $p = 0.89$, $N = 10$) over the years covered.

On the national level osprey numbers have been stable during the same period as the Forsmark study has been running (Lindström and Green 2013, Kjellén 2012).

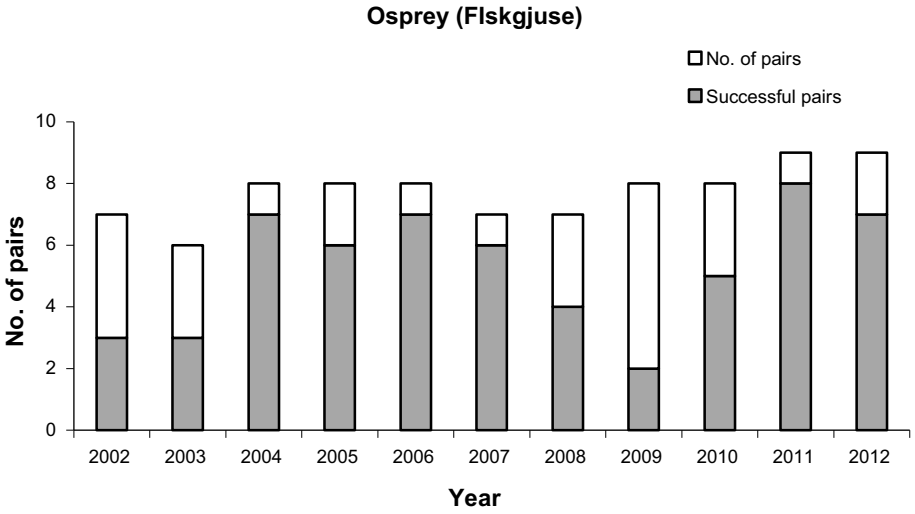

Figure 5-5. *Number of nesting attempts (territorial pairs) of ospreys in Forsmark 2002–2012. Number of successful nests (shaded parts) are shown as well. The exact number of territorial pairs in 2002 is not known. A well based estimate is shown.*

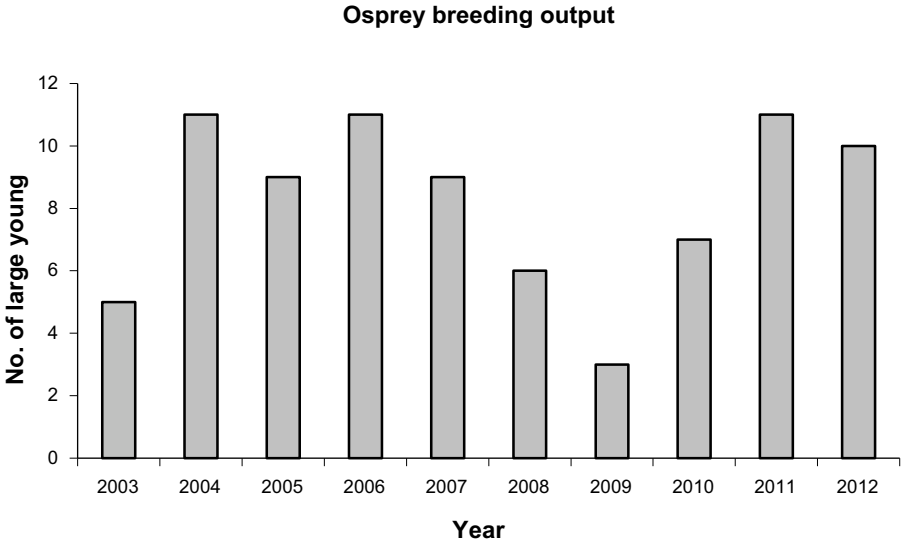

Figure 5-6. *Number of large young of ospreys produced in Forsmark 2003–2012. Number of large young per breeding attempt was 0.83 in 2003, 1.38 in 2004, 1.12 in 2005, 1.38 in 2006, 1.29 in 2007, 0.86 in 2008, 0.38 in 2009, 0.88 in 2010, 1.22 in 2011 and 1.11 in 2012.*

Figure 5-7. *Osprey. Photo Kustbild/Alf Sevastik.*

Black grouse *Tetrao tetrix* Orre (EU Annex 1)

Number of displaying black grouse increased slightly compared to the low level recorded in 2011. Seventeen males were registered in 2012; while only thirteen were counted in 2011 (see Figure 5-8). The number of black grouse recorded in 2012 is still well below the average for the whole study period (20 males/year) and there are only three years in the eleven-year period when lower numbers have been recorded (2002, 2003 and 2011).

Future years will show if the increase noted in 2012 is the start of a new cycle where numbers will increase up to a new peak like the one in 2006–2008. If so, a full period of the local black grouse cycle seems to be nine years. The black grouse trend in Forsmark during the study period is not significant ($r_s = 0.16$, $p = 0.64$, $N = 11$), but note that trying to describe a linear trend for a species with a cyclic population pattern is relatively useless, unless numbers are clearly decreasing or increasing in the long run (irrespective of the cycle). In this perspective, an eleven-year period is probably too short for properly describing any long-term trend. There is however still a tendency for a significant increase in numbers in the regional model area outside of the candidate area ($r_s = 0.53$, $p = 0.09$, $N = 11$), and there is a significant decrease within the candidate area ($r_s = –0.61$, $p < 0.05$, $N = 11$). No black grouse at all were observed within the candidate area in 2012, just as in 2011.

The overall decrease (actually the disappearance) from the candidate area is probably linked to that no cutting of forest has been made within this area since the start of the site investigations. Being an early succession species, the black grouse do simply not find any suitable habitats (at least not for lekking males) in the area at present.

The patterns in Forsmark with an increase in numbers 2002–2008 followed by a decrease thereafter is exactly the same as has been found on the national level. National results also show an increase between 2011 and 2012, just like in Forsmark (Lindström and Green 2013).

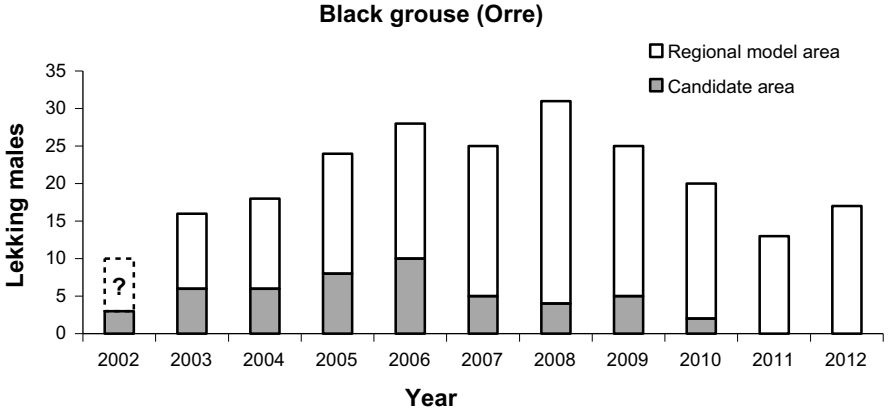

Figure 5-8. *The recorded number of lekking black grouse males in Forsmark 2002–2012. Shaded parts show the numbers within the candidate area. Exact number of lekking males in 2002 is not known. A well based estimate is shown.*

Capercaillie *Tetrao urogallus* Tjäder (EU Annex 1)

Capercaillie use of the central areas within and around the candidate area was monitored by recording observations of birds, tracks and droppings. Snow cover during late winter and early spring was much less of a problem compared to the two preceding years and coverage of these parts can be regarded as good. Two of the leks in the regional model area were visited and the number of males present at these was counted.

Capercaillie use of the central parts was similar to the one recorded in 2011, meaning that birds used parts both inside and close to the candidate area. Tracks and droppings of at least one male and several females were recorded within the candidate area. If anything, the southern parts of the central area, outside of the candidate area, seemed to be less used in 2012 than in 2011, in a similar way as in 2010.

Number of males at the central lek decreased to four (Figure 5-9). There is no significant trend in numbers of males at this lek since 2003 ($r_s = –0.14$, $p = 0.71$, $N = 10$). The lek is situated outside, but relatively close to, the candidate area.

Four males were also recorded at the northern lek, well outside of the candidate area. This is a lower number than recorded in the years 2006–2009 when six-seven males were observed annually.

Capercaillie numbers in Forsmark do not seem to follow any cyclic pattern like the one recorded for black grouse. At the national level numbers increased from 2003 until 2008 where after a decrease has taken place. The overall pattern 2003–2012 is still a positive one. National results do not indicate any major changes in capercaillie numbers between 2011 and 2012 (Lindström and Green 2013).

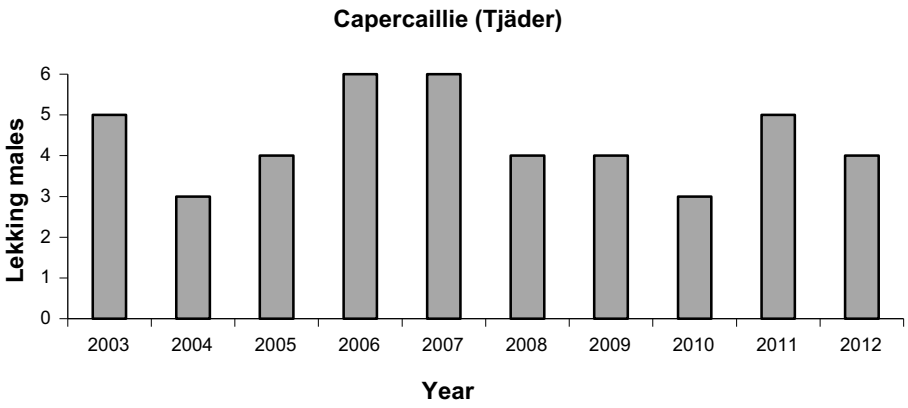

Figure 5-9. *The recorded number of capercaillie males in 'the central area' at Forsmark 2003–2012 (see text).*

Figure 5-10. *Capercaillie. Photo Kustbild/Alf Sevastik.*

Hazelhen *Bonasia bonasia* Järpe (EU Annex 1)

The data set collected for hazelhen during all the years was revised for this report. The reason behind this was that a calculation error made in an earlier year was discovered. In general this revision, and the earlier error, did not affect any of the general patterns, but the trend curves and the statistical outcome changed somewhat as a result of the revision.

The hazelhen is monitored by a sampling procedure since not all known territories or places with suitable habitat can be visited in any one year. Full coverage of the regional model area is not possible within the framework of the bird monitoring in Forsmark as it would require too much effort to perform. The exact number of territories/suitable areas visited every year differs, partly due to the snow situation in late winter-early spring and partly due to other time constraints. Still, an evaluation of the annual effort shows a surprisingly stable pattern. On average 29 territories/suitable areas are visited every year (range 24–33). Corresponding figures for the candidate area and the remaining part of the regional model area outside of the candidate area are eight and 21 (range 5–11 and 16–24 respectively). During these checks 15–25 occupied territories have been recorded per year (average 20), probably representing around 2/3 of the hazelhens present in the area. In 2012 hazelhens were recorded in 21 territories.

Index for the candidate area increased between 2011 and 2012 (Figure 5-11), while it remained unchanged compared to 2011 for the regional area outside of the candidate area. The increase in the candidate area resulted in a small increase in the overall index for both parts combined. Hazelhen numbers within the candidate area has not changed significantly during the study period ($r_s = –0.58$, $p = 0.13$, $N = 9$) although numbers have been relatively low during later years. The indices indicate a quite strong and continuous decrease in the regional model area outside of the candidate area since 2006 ($r_s = –0.94$, $p < 0.001$, $N = 9$) and the decrease in these parts leads to an overall decrease in hazelhen numbers for the whole area ($r_s = –0.88$, $p = 0.002$, $N = 9$).

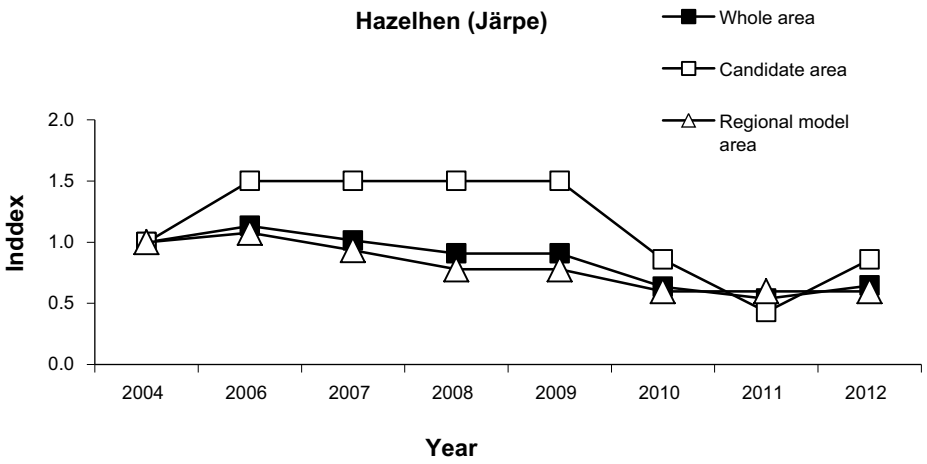

Figure 5-11. *Population development of hazelhens in Forsmark 2004–2012 shown as a chain index. Index for year 2004 is set to 1. See text for further explanations.*

The difference between the candidate area and the remaining parts of the regional model area is probably tightly connected to the differences in active forestry between these two. With no cutting activities at all conducted in the candidate area during the period, the hazelhens do not show any significant trend. With traditional, large-scale cutting actions done in several territories in the regional model area outside of the candidate area, hazelhen numbers in these parts have decreased. Hazelhens do not use open, newly cut areas at all and birds present in such will abandon areas where the forest has been cut.

Nationally, hazelhens numbers have increased during the last ten-year period (Lindström and Green 2013).

Ural owl *Strix uralensis* Slaguggla (EU Annex 1)

Five active territories of ural owls were recorded in 2012, more or less exactly as the average for the whole study period (5.3 pairs/year). Once again ural owls were present in the territory being closest to the candidate area. This territory was vacant in 2010–2011, but occupied in all years 2002–2009. There is no significant trend in ural owl numbers in Forsmark 2002–2012 ($r_s = 0.35$, $p = 0.28$, $N = 11$, Figure 5-12), although numbers increased up until 2006 and then decreased from 2009 onwards. No birds were registered outside of the territories of the resident birds this year.

Owl activity during spring and summer was low, probably reflecting low breeding effort due to low numbers of the main prey, rodents, in the area. Just one of the pairs produced young and furthermore this pair only produced one single large young. This means that 2012 was one of the worst breeding seasons for ural owls in the area since the start of the bird monitoring. Such low or even lower breeding output was also recorded in 2002, 2004 and 2007 (Figure 5-13).

There are no significant trends in the number of successful pairs ($r_s = 0.02$, $p = 0.96$, $N = 11$), or in the number of produced large young ($r_s = 0.03$, $p = 0.93$, $N = 11$) during 2002–2012.

According to the relatively new national monitoring program for night active birds much fewer ural owls were recorded in 2012 compared 2010–2011, probably mainly due to lower vocal activity (and not to a true decrease in present birds) which in turn is a result of low numbers of rodents and hence much fewer breeding attempts (Lindström and Green 2013).

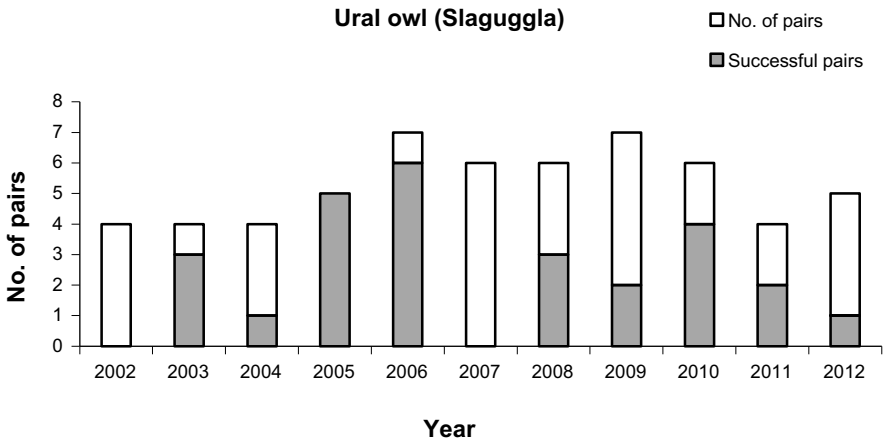

Figure 5-12. *Number of territorial pairs of ural owl within the regional model area in Forsmark 2002–2012. Shown is also the number of successful pairs (shaded).*

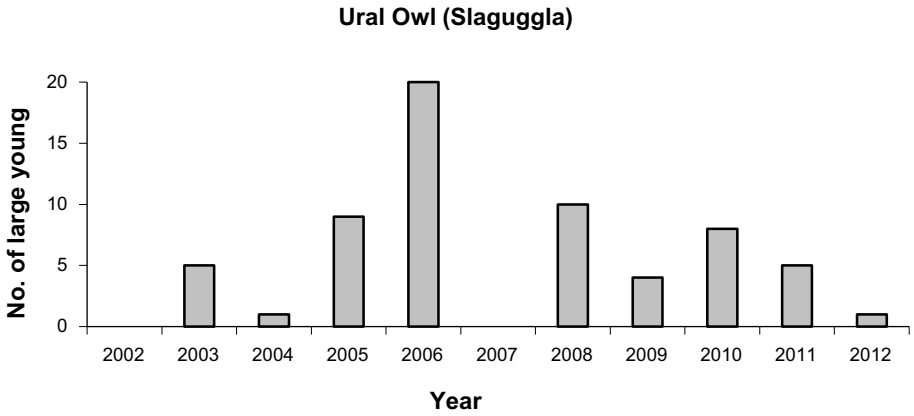

Figure 5-13. *Number of large ural owl young produced per year in Forsmark 2002–2012.*

Wryneck *Jynx torquila* Göktyta (Sw. Red List)

Wryneck numbers decreased from 60 to 46 occupied territories between 2011 and 2012 (Figure 5-14). The recorded number in 2012 is the lowest since 2007 (39) and a little bit below the average for the whole period (50). Numbers decreased both in the candidate area (from 12 to 8) and in the remaining parts of the regional model area outside of this (from 48 to 38). There are no significant changes in wryneck numbers in any of the parts of Forsmark ($r_s = 0.41$, $p = 0.24$, $N = 10$ for the candidate area; $r_s = 0.52$, $p = 0.13$, $N = 10$) or for the whole area ($r_s = 0.50$, $p = 0.14$, $N = 10$) during 2003–2012. The overall pattern is however generally positive and annual average for the last five years (58, 2008–2012) is clearly higher than for first five years (41, 2003–2007) of the study period.

The wryneck is classified as 'Near-Threatened' (missgynnad) in the Swedish Red List (Gärdenfors 2010) although there are clear signs of that numbers have increased from a very low level about fifteen years ago (Lindström and Green 2013).

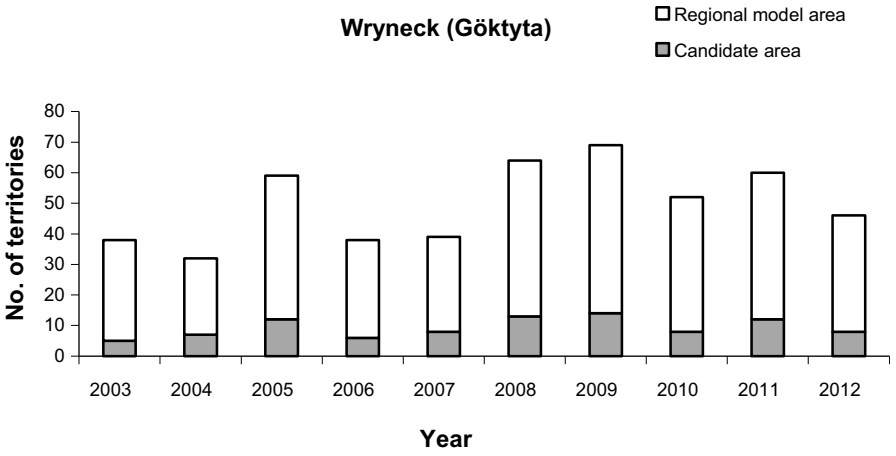

Figure 5-14. *Number of occupied wryneck territories in well monitored parts of Forsmark 2003–2012. Shading shows the number of occupied territories within the candidate area.*

Lesser spotted woodpecker *Dendrocopus minor* Mindre hackspett (Sw. Red List)

After two years with a bit lower numbers of recorded active territories, the lesser spotted woodpecker bounced back up to the high level of 2007–2009 and 21 territories were recorded in 2012 (Figure 5-15). This is the highest number recorded in the area, both at large, in the candidate area (4) and in the remaining parts of the regional model area (17).

Lesser spotted woodpeckers have increased significantly during 2003–2012 in the regional model area outside of the candidate area ($r_s = 0.70$, $p = 0.02$, $N = 10$) as well as in the area at large ($r_s = 0.69$, $p = 0.03$, $N = 10$). Even though the pattern is somewhat positive also in the candidate area, there is no significant trend in these parts ($r_s = 0.48$, $p = 0.16$, $N = 10$).

The lesser-spotted woodpecker is classified as 'Near-Threatened' (missgynnad) in the Swedish Red List (Gärdenfors 2010). National data show an increase in numbers over the last fifteen years. This increase probably followed after a previous period of decline from the 1970-ies to around 1990 and can be seen as a recovery of previous population levels (Lindström and Green 2013).

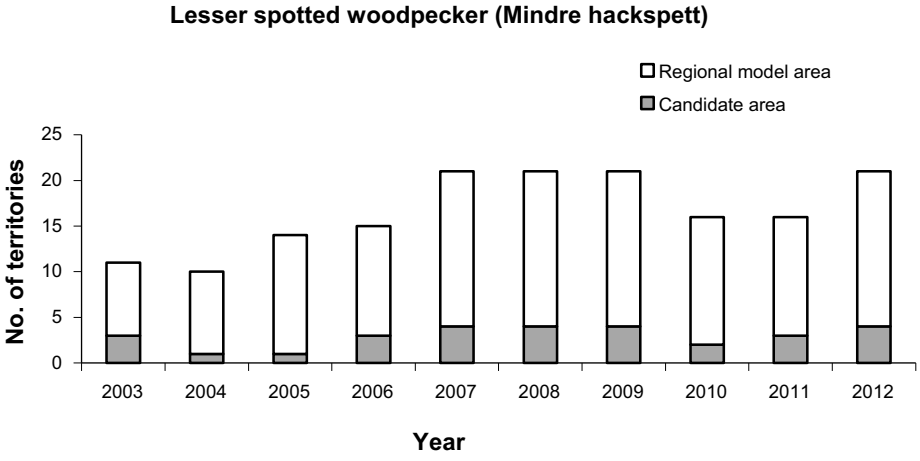

Figure 5-15. *Number of occupied territories of lesser spotted woodpeckers in areas monitored in all eight years 2003–2012 in Forsmark. Shading shows numbers of occupied territories in the candidate area.*

Red-backed shrike *Lanius collurio* Törnskata (EU Annex 1)

Also the red-backed shrike data set has been revised for this report (see hazelhen above), partly for the same reasons but also because the field procedure was somewhat different in the very first year (2003 in this case). Hence 2003, which earlier was used as the reference (start) year has been omitted and the trends presented here start from year 2004. In this way we get a set of data where data collection has been made in the same way every year, although there are some differences between years in how large proportion the known territories or suitable habitats that have been covered.

Numbers of shrikes increased slightly between 2011 and 2012, both in the candidate area and the regional model area outside of this (Figure 5-16). Overall shrike numbers have been stable in Forsmark at large 2004–2012 ($r_s = –0.33$, $p = 0.39$, $N = 9$) and a similar development has been recorded in the regional model area outside of the candidate area ($r_s = –0.23$, $p = 0.55$, $N = 9$). Even if Figure 5-16 implies a negative pattern in the candidate area in the last years, there is no significant trend in this part either ($r_s = –0.40$, $p = 0.28$, $N = 9$).

The red-backed shrike is no longer red-listed in Sweden (Gärdenfors, 2010). National population size has remained stable during the last ten-fifteen years (Lindström and Green 2013).

General population changes of selected species

General population changes of selected listed species in Forsmark between 2011 and 2012 are illustrated in Table 5-2.

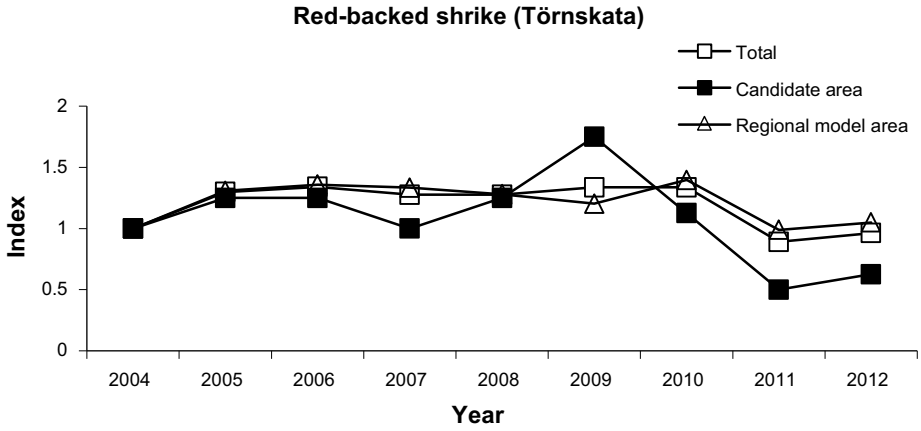

Figure 5-16. *Population development of red-backed shrikes in Forsmark 2004–2012 shown as a chain index. Index for year 2004 is set to 1. See text for further explanations.*

Table 5-2. General population changes of selected listed species in Forsmark between 2011 and 2012 together with the overall local trend for the whole study period (9–11 years depending on species). A "+" means that the number of occupied territories has increased, a "–" means that it has decreased, a "0" that there is no major change and "?" denotes that the situation is unclear. Breeding output 2012 in general terms is shown for divers, raptors and owls.

Species	Regional model area	Candidate area	Whole area	Overall population change 2002–2012*	Breeding output 2011
Black-throated Diver	0	+	+	0	Very good
Honey Buzzard	(+)	0	(+)	0	?
White-tailed Eagle			0	+	Very good
Osprey	0	0	0	(+)	Very good
Black grouse	+	0	+	0	
Capercaillie	–	0	–?	0	
Hazelhen	0	+	+	–	
Ural owl	+	0	+	0	Poor
Wryneck	–	–	–	0	
Lesser Spotted Woodpecker	+	+	+	+	
Red-backed shrike	+	+	+	0	

*Start year differs between species and varies between 2002 and 2004.

6 Discussion and conclusions

After two rather ‘poor’ years for the birds in Forsmark, compared to the average for the full study period, 2012 was again a rather ‘good’ year. The majority of the monitored species (82 %) increased or were stable in numbers between 2011 and 2012. Breeding success was also good or very good for several of the species for which breeding results were monitored.

As mentioned in earlier reports the general pattern of bird population development in Forsmark is one of stability. There is of course variation between years and comparing any two years do not really say much about how bird numbers fluctuate in the long run. With now almost, or slightly more than, ten years of data for all the monitored species we find that 55 % (6) of the monitored species have shown stable numbers in the area during this period. 27 % (3) species have increased in numbers. For one of those, the osprey, the increase is very small and bordering a stable situation. The other two, white-tailed eagle and lesser spotted woodpecker show larger and ‘true’ increases in accordance with large-scale patterns on the national or in case of the eagles even continental level.

Two species (18 % of the total number) may have decreased in numbers, the capercaillie and the hazelhen. In both cases this is contrary to the national pattern during the same period, and in both cases there is a difference between the candidate area and the remaining parts of the study area. Also in both cases this is probably related to forestry activities as no cutting actions has taken place within the candidate area since the start of the site investigations. In the regional model area outside the candidate area on the other hand normal cutting actions have taken place and a rather high proportion of the mature forest has been cut in later years. This means that species connected to such habitats, as these two, will have less suitable places to live in and hence the local decrease in capercaillie and hazelhen numbers is not really surprising and may be reversed as now middle-aged forest parts will eventually grow into the more mature stage.

This also shows one of the benefits of saving areas from forest cutting. Such areas are important for species connected continuous mature forest and can act as refuges were such species can persist until younger, surrounding forest parts have matured.

The conclusion made in last year’s report (SKBdoc 1332931) that the terrestrial ecosystem around Forsmark is doing relatively fine at the moment is still valid. During 2012 one of the main land owners of the regional model area (Sveaskog) assigned parts of this as an ‘Ekopark’, which means that the forest in these parts will at least partly be managed for conservation purposes and that forestry activities will be made in a more ‘nature-friendly’ way. Together with already existing reserves a quite high proportion of the land area in the regional model area is now managed in a way that will benefit the high nature values existing here. If SKB would manage their land area in a similar way as for example the Sveaskog ‘Ekopark’, the situation for the terrestrial ecosystem in and around Forsmark would have even better future prospects.

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References to SKB's unpublished documents are listed separately at the end of the reference list.

Unpublished documents will be submitted upon request to document@skb.se.

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SKBdoc id, version	Title	Issuer, year
1332931 ver 1.0	Monitoring Forsmark. Bird monitoring in Forsmark 2011	SKB, 2012

Appendix 1

Listed bird species in Forsmark

Table A-1. List of all listed (Swedish Red List, SRL, and EU Birds directive, Annex 1, EU) bird species, possibly breeding in Forsmark and recorded during 2002–2012. The listing follows the updated version of the Red List (Gärdenfors 2010).

English name	Swedish name	Latin name	Listing	Estimated population size (pairs/territories) in Forsmark (regional model area)
Whooper Swan	Sångsvan	Cygnus cygnus	EU	3
Pochard	Brunand	Aythya ferina	SRL	1
Common Eider*	Ejder*	Somateria mollissima*	SRL	144
Velvet Scoter	Svärta	Melanitta fusca	SRL	7
Hazelhen	Järpe	Bonasia bonasia	EU	25–30
Black Grouse	Orre	Tetrao tetrix	EU	17
Capercaillie	Tjäder	Tetrao urogallus	EU	10
Quail	Vaktel	Coturnix coturnix	SRL	1–3
Black-throated Diver	Storlom	Gavia arctica	EU	5–7
Slavonian Grebe	Svarthakedopping	Podiceps auritus	SRL, EU	0–1
Bittern	Rördrom	Botaurus stellaris	SRL, EU	1–3
Honey Buzzard	Bivråk	Pernis apivorus	SRL, EU	7–9
White-tailed Eagle	Havsörn	Haliaeetus albicilla	SRL, EU	5–8
Marsh Harrier	Brun kärrhök	Circus aeruginosus	EU	0–1
Osprey	Fiskgjuse	Pandion haliaetus	EU	8–9
Spotted Crake	Småfläckig sumphöna	Porzana porzana	SRL, EU	0–3
Corncrake	Kornknarr	Crex crex	SRL, EU	0–1
Crane	Trana	Grus grus	EU	30
Curlew	Storspov	Numenius arquata	SRL	3
Common Sandpiper*	Drillsnäppa*	Actitis hypoleucos*	SRL	29
Turnstone	Roskarl	Arenaria interpres	SRL	10
Herring Gull*	Gråtrut*	Larus argentatus*	SRL	272
Lesser Black-backed Gull	Silltrut	Larus fuscus	SRL	97
Common Tern	Fisktärna	Sterna hirundo	EU	95
Black Guillemot*	Tobisgrissla*	Cepphus grylle*	SRL	50
Arctic Tern	Silvertärna	Sterna paradisaea	EU	234
Pygmy Owl	Sparvuggla	Glaucidium passerinim	EU	15–20
Ural Owl	Slaguggla	Strix uralensis	EU	5
Tengmalms Owl***	Pärluggla	Aegolius funereus	EU	0
Nightjar*	Nattskärra*	Caprimulgus europaeus*	SRL	1
Swift*	Tornseglare*	Apus apus*	SRL	200
Wryneck	Göktyta	Jynx toruilla	SRL	40–70
Grey-headed Woodpecker	Gråspett	Picus canus	EU	0–3
Black woodpecker	Spillkråka	Dryocopus martius	EU	12–14
Lesser Spotted Woodpecker	Mindre hackspett	Dendrocopus minor	SRL	21
Three-toed Woodpecker	Tretåig hackspett	Picoides tridactylus	SRL, EU	1–3
Wood Lark	Trädlärka	Lullula arborea	EU	2–3
Skylark	Sånglärka	Alauda arvensis	SRL	30–40
Grashopper Warbler	Gräshoppsångare	Locustella naevia*	SRL	1–2
River Warbler	Flodsångare	Locustella fluviatilis	SRL	0–1
Greenish Warbler	Lundsångare	Phylloscopus trochiloides	SRL	0–1
Red-breasted Flycatcher	Mindre flugsnappare	Ficedula parva	SRL, EU	5
Red-backed Shrike	Törnskata	Lanius collurio	SRL	80–100
Nutcracker	Nötkråka	Nucifraga caryocatactes	SRL	5–10
Linnet	Hämpling	Carduelis cannabina*	SRL	4
Scarlet Rosefinch	Rosenfink	Carpodacus erythrinus*	SRL	50
Ortolan Bunting**	Ortolansparv**	Emberiza hortulana**	SRL, EU	0**

* The species was added to the Swedish red list in 2010.

** Ortolan Buntings occurred at Storskäret up until 2004, but have not been observed during later years.

***Tengmalm´s owl have not been observed in the latest years.