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Site investigations Forsmark

Bird monitoring in Forsmark 2009

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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 2002–2009. Monitoring of eleven listed species was conducted in the regional model area, including the candidate area in 2009 in the same way as in earlier years. The aim of the monitoring, and the report, is to evaluate possible effects from the now finished site investigations on the breeding bird fauna.

The results from the monitoring in 2009 closely follow patterns recorded in earlier years. No dramatic changes in bird numbers occurred compared to 2008.

Number of Black-throated diver pairs was normal and breeding success was moderate this year. The breeding success of divers has improved considerably over the studied period and the local population produces a sufficient number of young to be sustainable.

Honey buzzards and ospreys occurred in normal numbers, but breeding success was poor, probably due to cold and rainy weather in June. Breeding success of white-tailed eagles was good, at the same level as the one recorded before the site investigations started.

The numbers of displaying black grouse males decreased somewhat in the area at large, but stayed at an unchanged level within the candidate area. Capercaillies were present in exactly the same numbers as in the year before at both leks being controlled. The species was again observed within the candidate area, indicating that the situation is similar to the one recorded at the start of the site investigations. Hazelhen numbers continued to increase within the candidate area, from the low level observed during the most intensive years of the site investigations.

The ural owls had a moderate breeding year but the numbers of occupied territories were again at the highest level recorded during the study period. Lesser spotted woodpeckers occurred in the same numbers as in the latest years, and the situation for the species has now been very stable around Forsmark for a couple of years. Wrynecks had a record-year with the highest number of recorded territories so far. The number of red-backed shrikes increased somewhat within the candidate area but decreased in areas outside of this. The decrease was especially obvious under power lines where the vegetation probably was too high to attract shrikes this year.

None of the monitored species has decreased in numbers in Forsmark during the study years. The small possible negative impacts caused by the site investigations have all been very temporary and the situation has now returned to a stage similar to the one before these started.

Sammanfattning

Denna rapport sammanfattar övervakningen av bestånden av häckande fåglar i Forsmark 2002–2009. Under 2009 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. Syftet med rapporten är att belysa och utvärdera eventuella effekter på de häckande fågelbestånden från de nu avslutade platsundersökningarna.

Resultaten från 2009 års övervakning följer i stort de mönster som registrerats under tidigare år. Inga dramatiska förändringar skedde i bestånden av någon av de studerade arterna.

Storlommarna uppträdde i normala antal och häckningsframgången var moderat. Artens häckningsframgång har förbättrats under de år som övervakningen pågått och det finns idag inga tecken som tyder på att den lokala populationen inte skulle vara självbärande.

Bivråk och fiskgjuse förekom i goda antal, något över medel för alla studerade år, men häckningsframgången var låg, troligen som ett resultat av den kalla och regniga försommaren. Havsörnarna hade däremot en god häckningssäsong och årets utfall var en tangering av den tidigare bästa säsongen sedan starten av platsundersökningarna.

Antalet orrar minskade något i det regionala modellområdet men höll sig på en stabil nivå i kandidatområdet. Antalet tjädrar var totalt sett oförändrat på de två spelplatser som följs upp. Tjäder sågs ånyo inom kandidatområdet och spår sågs även inom detta område. Järpen fortsatte att öka inom kandidatområdet, från den låga nivå som rådde när platsundersökningarna var som mest intensiva. Antalet järpar i övrigt var oförändrat från 2008.

Slagugglorna hade ännu ett mellanår, även om antalet revirhävdande par tangerade den tidigare högstanivån under perioden. Endast två par fick dock ut ungar vilket är ett klent, om än inte bottenresultat. Antalet bebodda revir av mindre hackspett var identiskt med föregående år och det finns en mycket stor stabilitet i vilka revir som varit bebodda under de senaste tre åren. Göktytorna hade ytterligare ett rekordår med höga antal i hela området. Antalet törnskator ökade inom kandidatområdet men minskade något i övriga delar. Sistnämnda framförallt i kraftledningsgatorna som nu har alltför tät vegetation för att attrahera törnskator.

Generellt sett har ingen av de uppföljda arterna minskat i antal i Forsmark under platsundersökningsåren eller åren därefter. De små negativa effekter som kan ha orsakats av platsundersökningarna förefaller ha varit väldigt tillfälliga i omfattning och situationen har återgått till läget innan undersökningarna startades.

Contents

1 Introduction

This document reports the results from the bird monitoring in Forsmark for 2009. The bird surveys started in 2002 and have now been going on for eight years. For some of the species presented here good data are available from 2003 onwards, allowing comparisons during a seven-year period. The aim of this report is to evaluate the effects of the now finished site investigations on the breeding bird fauna in the area for a number of selected listed species (according to the Swedish Red List and/or the EU Birds Directive). The surveys were made according to activity plan AP PF 400-08-011. The project has been conducted by the Department of Animal Ecology, 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, where they are traceable by the Activity Plan number (AP PF 400-08-011). 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. Such revisions will not necessarily result in a revision of the P-report, although the normal procedure is that major data revisions entail a revision of the P-report. Minor data revisions are normally presented as supplements, available at www.skb.se.

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, b/ such as species listed in the Swedish Red List /Gärdenfors 2005/ and European Unions Birds directive 79/409/EEG: Annex 1, (www.naturvardsverket.se). It is inevitable that site investigations as those conducted by SKB 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 had a rather low level of human disturbance then.

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.

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 by a thick broken 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 with a thick unbroken line in Figure 2-1.

Direct impacts from activities within the site investigations were only likely to occur in the candidate area and the close surroundings of this, while indirect effects could be possible also in the regional model area. For some species however, the regional model area mainly functions as a reference area to the candidate area.

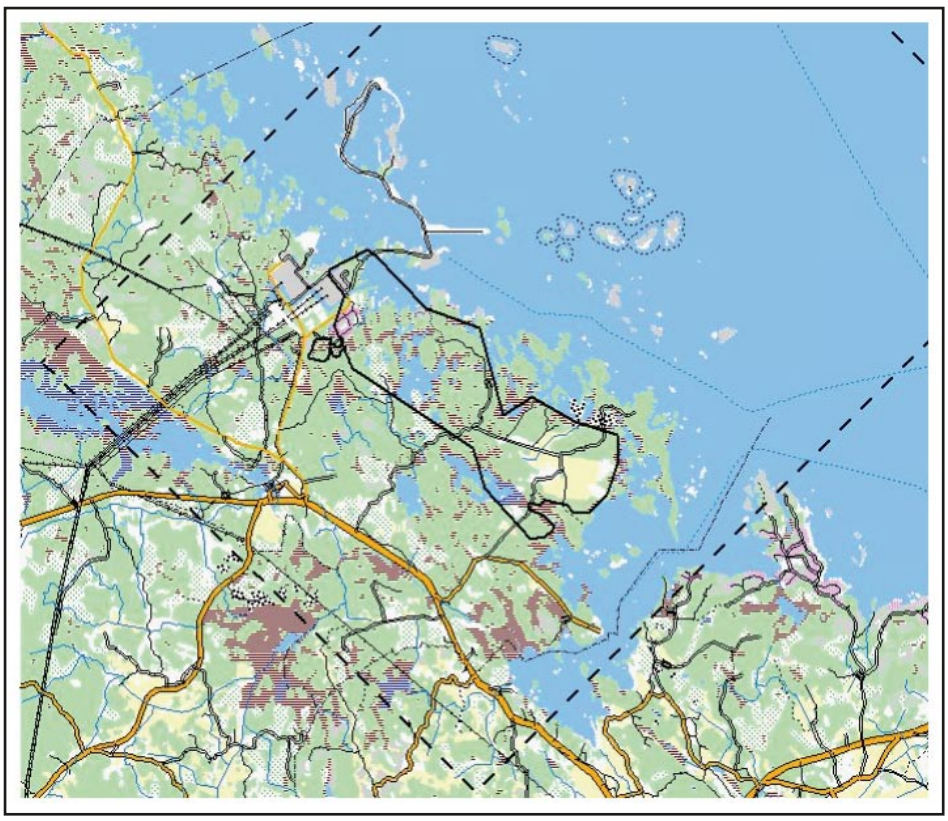

Figure 2-1. *Map of the survey area in Forsmark. The regional model area is shown with a thick broken line and the candidate area is illustrated with a thick unbroken line.*

3 Equipment

3.1 Description of equipment

The following equipment was used when conducting the bird surveys:

- GPS (Garmin 12 or 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 phones (safety equipment when working alone in the field).

4 Methods

The methods used are described in detail in activity plan AP PF 400-08-011. 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, resulting in that all species did not receive proper coverage in the very first year. 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 ongoing 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 2009 by visiting known nesting places/territories used in 2002–2008, 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 following up 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.

4.2 Execution

The monitoring field work in 2009 was carried out during the period 2009-03-23–2009-07-29. 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 Animal Ecology, Lund University.

Table 4-1. Listed species (Swedish Red List and/or EU: Birds Directive) selected for monitoring in Forsmark in 2004–2009.

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

4.3 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 of field work the data were transferred to pre-made paper forms. Data were then entered into an Excel-file from paper forms where upon 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

Changes in numbers of territories at the species level for selected listed species are since a few years back tested statistically, and this approach is used in this report as well. The same procedure is also used for comparing breeding results in a few cases. The rationale for this is that with a time series of (in most cases) seven years, testing is possible. Statistical power will however still be low (i.e. there is a low probability of finding statistically significant results even though true, biologically significant changes may have occurred), due to the short time frame. Another way to put it is that large differences are required (strong trends) to reach statistical significance.

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 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 percent between these two. Then the procedure is repeated for the next two following years and the new change (in percent) is added/subtracted to/from the figure. 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. This is the basis for all future comparisons.
- In our first year with a reasonable coverage of shrikes in Forsmark (2003), 27 occupied territories were recorded. Of these, 14 were in areas covered equally well also in the following year (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).
- In 2004, our second year of good coverage, 41 occupied territories were recorded. Of these, 20 were in parts checked equally well in 2003.
- The index for 2004 is calculated as: ((20–14)/14) + 1 = 1.43. Interpreted as a 43% increase in numbers between 2003 and 2004.
- All the 41 recorded territories in 2004 were in areas covered equally well also in 2005.
- 48 occupied territories were recorded in these parts in 2005.
- The index for 2005 is then calculated as: ((48–41)/41) + 1.43 = 1.60. Interpreted as a 17% increase in numbers between 2004 and 2005 (and a 60% increase from 2003 to 2005).
- And so on.

For statistical tests of trend data the Spearman rank correlation test /Sokal and Rohlf 1997/ 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 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 SPSS 16.0. for Windows (SPSS inc.).

4.5 Nonconformities

The activity was performed according to the plans and there were no nonconformities.

5 Results

Data from this survey are stored in the SKB GIS database and are traceable by the Activity plan number AP PF 400-08-011. 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 (for listed species). A complete list of English, Latin and Swedish names for all listed bird species possibly breeding in Forsmark during 2002–2009 is given in Appendix 1.

5.1 Listed species

The following section gives a summary of the population development during the last six to seven years for some of the species listed as endangered, threatened or vulnerable according to the Swedish Red List /Gärdenfors 2005/, and/or species listed in the European Unions' Birds Directive Annex 1 (79/409/EEG) 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)

Diver numbers has remained very stable in Forsmark during all the study years, see Figure 5-1. Six pairs of black-throated divers were recorded in the area during 2009 (annual average 2002–2008 = 5.6–5.8 pairs/year). There is no statistically significant trend in diver numbers over the period (Spearman rank correlation: $r_s = 0.39$, $p = 0.33$, $N = 8$). Three pairs were found in lakes and three pairs along the coast in 2009, which is the normal pattern for the area.

Breeding success was similar to other years after 2005, two pairs were successful and together raised three large young. The number of successful breeding attempts per year has increased significantly between 2002 and 2009 (Spearman rank correlation: $r_s = 0.78$, $p = 0.02$, $N = 8$) and so has the number of produced large young per year (Spearman rank correlation: $r_s = 0.74$, $p = 0.04$, $N = 8$). The reason behind this pattern remains unknown and bearing in mind that we only have data from a limited number of years it may be that the first years of the study just by pure chance happened to be bad breeding years.

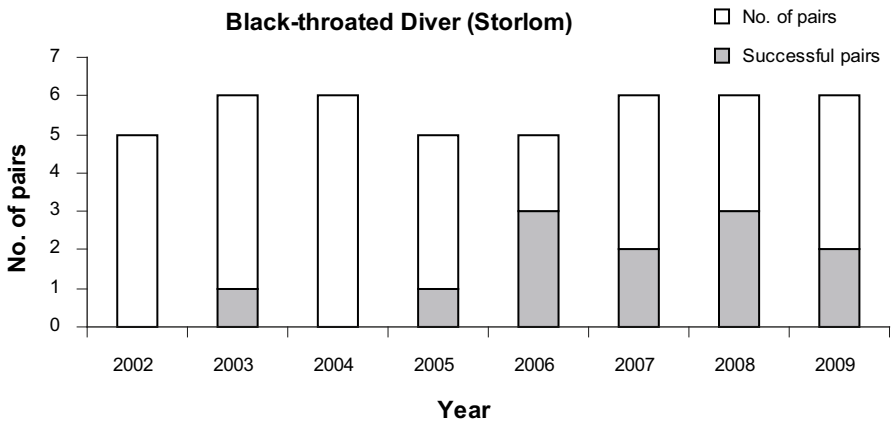

Figure 5-1. *Number of resident pairs of black-throated divers in Forsmark 2002–2009. Shading shows the number of successful pairs. Minimum numbers are shown, total numbers of pairs in 2005 might have been seven and there might have been four successful pairs in 2006.*

Local breeding success in Forsmark 2009 (0.50 large young/resident pair) is very close to the average for the studied period (0.49–0.53 large young/resident pair). Both successful breedings in 2009 were in lakes, while no young were produced in coastal waters.

The absence of trends in diver numbers in Forsmark during the last seven years is in accordance with the pattern on the national level for the last ten years. The Swedish population of black-throated divers have remained stable during this time /Ottvall et al. 2008/.

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

At least eight honey buzzard territories were recorded within the regional model area in 2009, a completely normal number. Seen over all eight study years, numbers in Forsmark tended to increase but not significantly so (Spearman rank correlation: $r_s = 0.68$, $p = 0.06$, $N = 8$), cf Figure 5-2. Bearing in mind that the estimated number of pairs in the first years of the site investigation period probably were underestimates, the conclusion is that numbers have remained stable during 2002–2009 (see /Green 2008a, b/). This is also supported by that there is absolutely no significant change in numbers during the years with good coverage of honey buzzards in the area (2004–2009, $r_s = 0.22$, $p = 0.68$, $N = 6$).

Breeding success of honey buzzards is not monitored in detail in Forsmark, but no observations in 2009 indicated that there were any successful pairs at all. This was not unexpected since June had prolonged parts with very cold and wet weather. In years with such conditions, honey buzzard breedings normally fail at an early stage.

The honey buzzard is classified as 'Endangered' (starkt hotad) in the Swedish Red List. National population size has declined with 50–70% during the last three decades and was estimated to about 5,000 pairs in 2004 /Tjernberg and Svensson 2007/. The main causes of the decline are thought to be large-scale landscape changes due to both agriculture and forestry, at the same time as conditions along the migration routes and in the wintering areas have deteriorated. Recorded tendencies at the national level are that the decline has levelled out in recent years and that the national population has remained stable during the last ten years /Ottvall et al. 2008/.

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

The breeding success of white-tailed eagle in the Forsmark area and surrounding reference areas since 1998 is summarized in Table 5-1. Breeding success this year was nearly the same as the average for 1998–2001, a reference period from before the site investigations started within the candidate area. The overall breeding success in Forsmark has declined from an average of 85% before the site investigations commenced in 2002, to on average 48% thereafter.

As has been indicated in previous reports, a clear increase in human activity has resulted in increased disturbance around nest sites in the Forsmark area as well as in the reference areas. In the reference areas, human disturbance and forestry activities during the incubation period have been factors probably affecting breeding success negatively. In Forsmark there has been no forestry activity during this study period, but a stronger increase in human activity than elsewhere related to the site investigations within the candidate area. Disturbance from these investigations has decreased after the actual drilling activities were terminated in early 2007.

During the last four-year period (2006–2009), there is no clear evidence of a difference in breeding success among eagle pairs within the Forsmark area as compared to eagle pairs in the reference areas.

Osprey *Pandion haliaetus* Fiskgjuse (EU Annex 1)

Eight pairs of ospreys were recorded around Forsmark in 2009 (see Figure 5-3), a figure close to the average for the whole study period (7.4 pairs/year). There is no significant trend in population size in Forsmark over the years (Spearman rank correlation: $r_s = 0.31$, $p = 0.45$, $N = 8$).

Breeding success was low and only two pairs produced young (25% success rate), the lowest proportion over all the eight years. Still there is no significant trend in number of successful pairs over the years (Spearman rank correlation: $r_s = –0.08$, $p = 0.84$, $N = 8$). A likely explanation for the

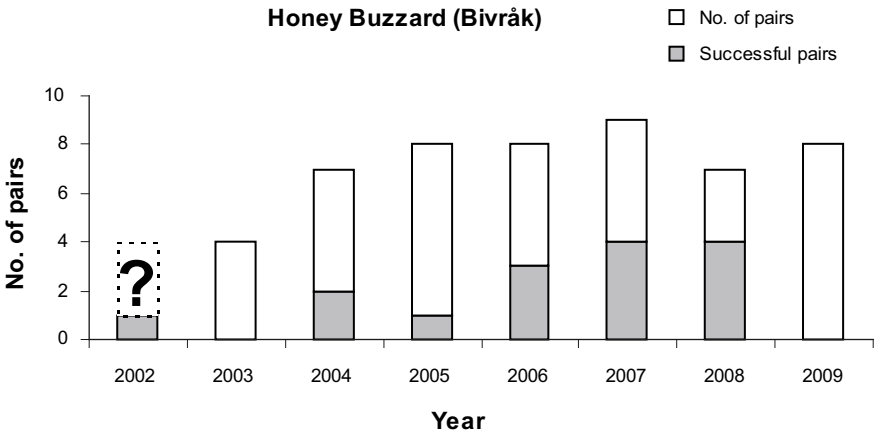

Figure 5-2. *Number of territorial pairs of honey buzzards within the regional model area in Forsmark 2002–2009. Shading shows number of successful pairs. The exact number of territorial pairs in 2002 is not known. An (at the time) well based estimate is shown.*

Table 5-1. Per cent successfully breeding pairs of white-tailed eagles in 1998–2001 and 2002–2009 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	2002–2006	2007	2008	2009	2007–2009	N
Forsmark area	**85**	25	33	50	75	25	**42**	50	50	75	**58**	44
Reference area S	**79**	100	80	100	83	50	**83**	80	60	80	**73**	62
Reference area N	**72**	83	71	86	29	29	**59**	33	60	33	**42**	69

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

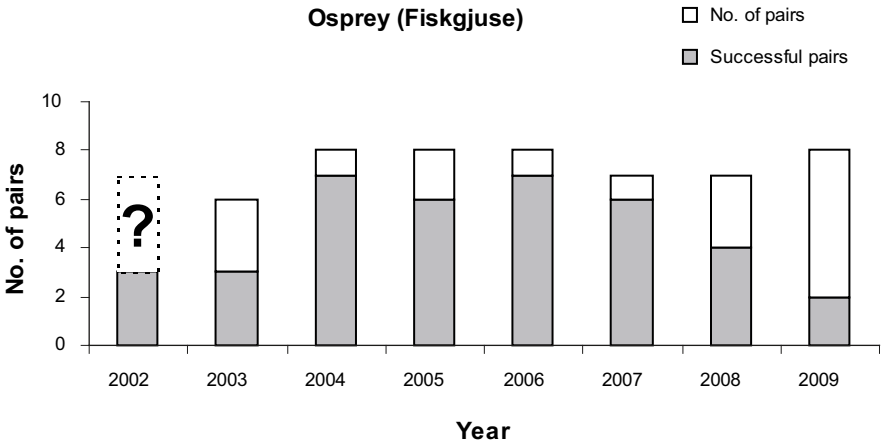

Figure 5-3. *Number of nesting attempts (territorial pairs) of ospreys in Forsmark 2002–2009. Number of successful nests (shaded parts) are shown as well. The exact number of territorial pairs in 2002 is not known. A well based estimate is shown.*

low breeding output in 2009 is, as in the case with the honey buzzards, the long period of cold and wet weather in June. For ospreys this coincided with the hatching period and small osprey young are sensitive to bad weather conditions.

The two successful pairs together produced three large young. Average breeding success was hence only 0.38 large young/territorial pair, the lowest figure for the whole period and well below the average for 2003–2008 (1.16 large young/pair), see Figure 5-4. Despite the seemingly decreasing breeding output for ospreys in Forsmark during the last four years, there is no significant trend in numbers of produced young (Spearman rank correlation: $r_s = –0.36$, $p = 0.42$, $N = 7$).

The seemingly stable osprey population around Forsmark corresponds well to the national pattern of stability in numbers during the last ten years /Ottvall et al. 2008/. It is also interesting to see that osprey numbers in Forsmark are stable despite high densities of breeding and summering white-tailed eagles in the area. Direct or indirect competition between these to large raptors, with the eagles as the likely winners, have been reported as a possible cause behind local decreases in osprey numbers in later years in other areas. The signs (although not significant) of decreased breeding success of ospreys in later years in Forsmark may however be connected to such competition, although there are at the same time signs of that eagles and ospreys can breed successfully at very close distances from each other.

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

Numbers of black grouse decreased in 2009 to the same level as in 2007. Numbers have however in general increased significantly between 2002 and 2009 (Spearman rank correlation: $r_s = 0.72$, $p = 0.04$, $N = 8$), but have seemingly been stable, with some annual variation during later years. As reported earlier, the patterns differ strongly between the candidate area and the regional model area outside the candidate area. While numbers in the regional model area show a strong increase over the whole period (Spearman rank correlation: $r_s = 0.96$, $p<0.001$, $N = 8$), numbers in the candidate area increased up until 2006, where upon fewer birds have been present in these parts yielding no significant trend over the period (Spearman rank correlation: $r_s = –0.06$, $p = 0.89$, $N = 8$). The probable reason behind the found pattern has been described before and remains the same. Black grouse is an early succession species, preferring open areas (i.e. clear-cuts when we are talking about areas affected by modern forestry). No new clear-cuts have been taken up within the candidate area since the site investigations started and older clear-cuts are now covered by too high vegetation for being suitable for the birds. This is in contrast to the situation in parts of Forsmark outside the candidate area, where new clear-cuts are taken up every winter. In other words, the suitable areas for black grouse have decreased within the candidate area, but increased in other parts during the study years. The patterns revealed probably follow normal population dynamics found over a larger geographical scale.

The number of multiple male leks (cf. /Green 2007, 2008a, b/) as well as the number of males at such leks decreased somewhat between 2008 and 2009. Still, the proportion of all males occurring at such leks remained relatively constant (Figure 5-6).

The development in Forsmark closely follows the recorded pattern at the national level /Lindström et al. 2009/. Interestingly the pattern in Forsmark is more in accordance with patterns in the northern parts of Sweden than with those in the south.

Capercaillie *Tetrao urogallus* Tjäder (EU Annex 1)

Numbers of males at the central lek remained at the same level (four) as in 2008 (Figure 5-7), and there is no trend in numbers of males at this lek since 2003 (Spearman rank correlation: $r_s = 0.06$, $p = 0.90$, $N = 7$). This lek is situated outside, but close to, the candidate area and it is likely that it is birds connected to this lek that have home ranges extending into the candidate area.

The northern lek, well outside of the candidate area, has not been monitored in detail all from the start of the bird monitoring, but only since 2006. During these four years, numbers of males have remained stable at six to seven males/year. Seven males were recorded here also in 2009.

Home ranges of capercaillies in the whole regional model area were monitored to almost full extent in 2009 by looking for birds, tracks and droppings (done so also in 2006 and 2007). Home ranges were in general very similar to previous large-scale checks. A male was observed well within the

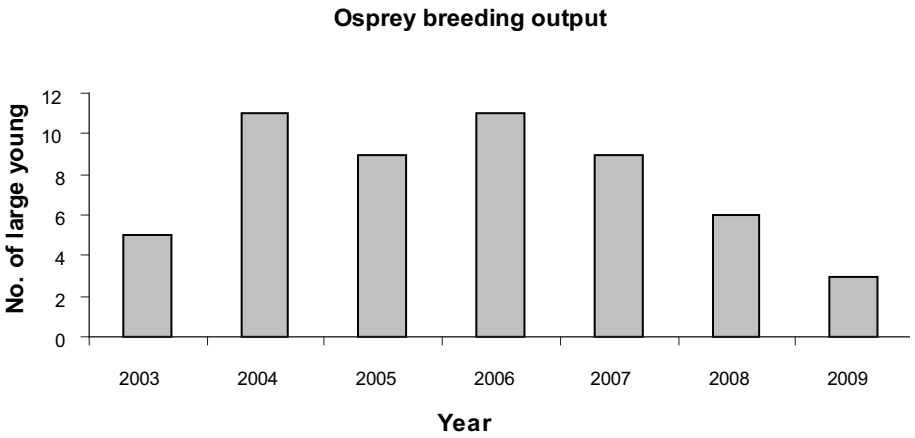

Figure 5-4. *Number of large young of ospreys produced in Forsmark 2003–2009. Number of large young per breeding attempt was 0.83 in 2003, 1.38 in 2004, 1.12 in 2005, 1.38 in 2006, 1.29 in 2007, 0.86 in 2008 and 0.38 in 2009.*

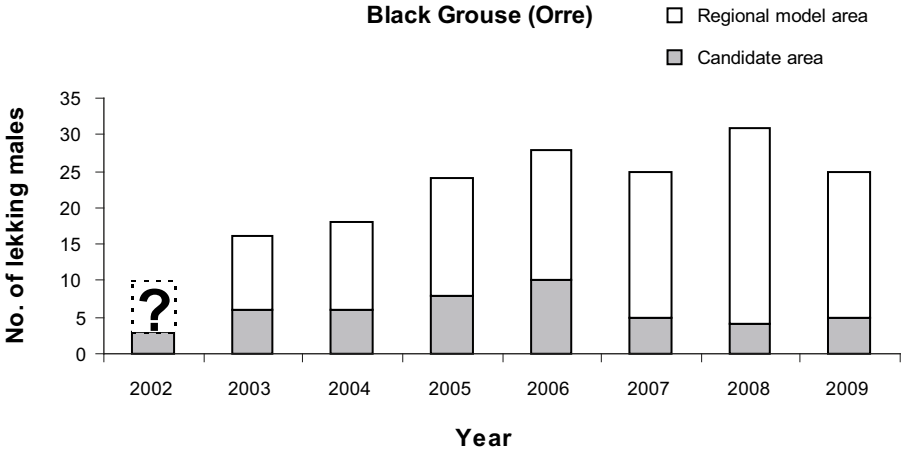

Figure 5-5. *The recorded number of lekking black grouse males in Forsmark 2002–2009. Shaded parts show the numbers within the candidate area. Exact number of lekking males in 2002 is not known. A well based estimate is shown.*

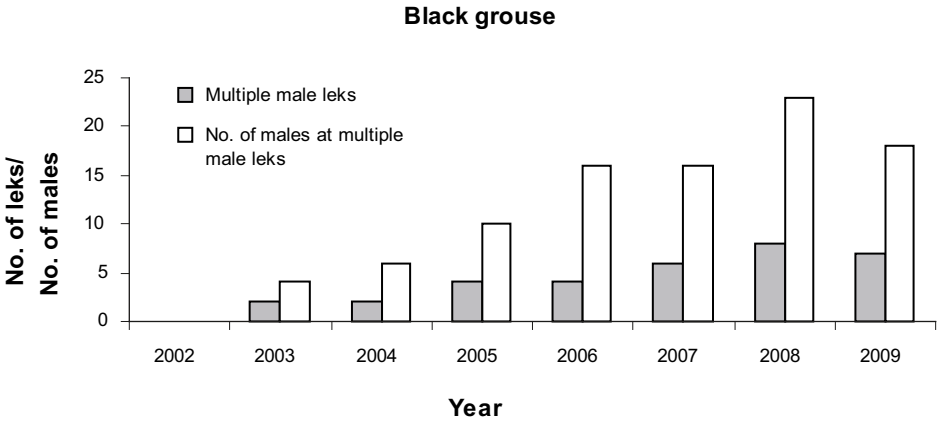

Figure 5-6. *The recorded number of lekking black grouse males in Forsmark 2002–2009 found at leks containing more than one male. Shaded bars show the number of such multiple male leks within the regional model area.*

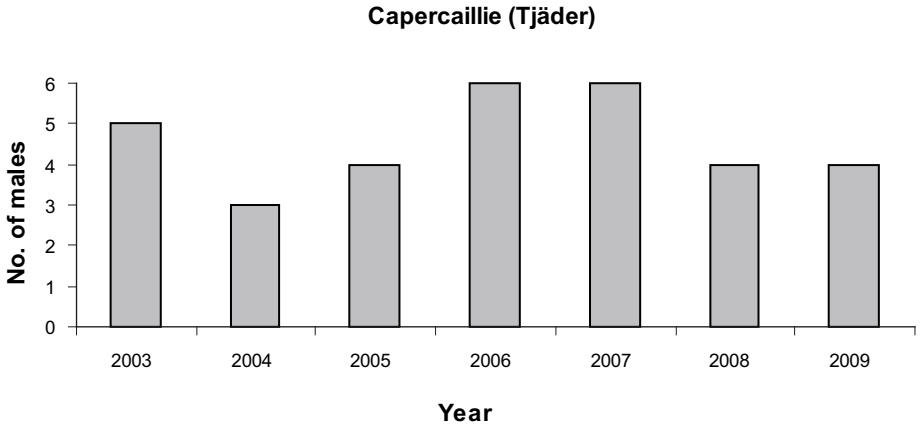

Figure 5-7. *The recorded number of capercaillie males in 'the central area' at Forsmark 2003–2009 (see text).*

candidate area, the first observation of a bird there since 2002 (tracks seen in 2008). Tracks of a female were also observed inside the candidate area and the situation now seems to be back at the pre-site investigation level (cf. /Green 2005, 2008a, b/).

Also capercaillie numbers in Forsmark closely follow the national patterns /Lindström et al. 2009, Ottvall et al. 2008/. As for black grouse, population development in Forsmark seems more related to patterns in northern Sweden than to those in the southern parts.

Hazelhen *Bonasia bonasia* Järpe (EU Annex 1)

In total, 25 territories of hazelhen were registered in 2009, a figure in close accordance with other years of detailed monitoring. As a different number of sites (known territories or sites classified as suitable for hazelhens identified from vegetation maps) were visited in different years, population development for hazelhens is shown with an index (Figure 5-8).

The pattern from last year became even more obvious in 2009. Numbers within the candidate area has been increasing slowly since the most intensive parts of the site investigations were finished, while numbers in the remaining parts have decreased slightly. Index in the candidate area was 62% higher in 2009 compared to 2004. Index in the remaining parts was 15% lower in 2009 compared to 2004.

As reported earlier, the increase in the candidate area in part probably reflects a re-distribution of birds from the most intensive site investigation years when hazelhens seemed to avoid certain parts of the area (see earlier reports /Green 2004, 2007). The complete absence of forestry activities within the candidate area since the early 2000s is probably also beneficial for the species. The small decrease in the regional model area outside the candidate area can probably be attributed to ongoing forestry (clear cutting) in these parts.

National numbers of hazelhens have probably not changed much during the last ten years /Ottvall et al. 2008/, even though there are indications of an increase at least in the northern parts of the country /Lindström et al. 2009/.

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

Once again the numbers of territorial pairs in and around the regional model area reached the peak level of seven pairs, well above the average of 5.1 pairs/year in 2002–2008 (Figure 5-9). Seven territorial pairs were also present in 2006. There is a significant overall increase in ural owl numbers around Forsmark during the period (Spearman rank correlation: $r_s = 0.86$, $p = 0.006$, $N = 8$).

Breeding success was relatively low in 2009, although it was not a complete failure year. Two pairs together produced four large young, but most pairs failed this year. There are no trends in the number of successful pairs (Spearman rank correlation: $r_s = 0.17$, $p = 0.69$, $N = 8$), or in the number of produced large young (Spearman rank correlation: $r_s = 0.30$, $p = 0.47$, $N = 8$) between 2002 and 2009, see Figure 5-10.

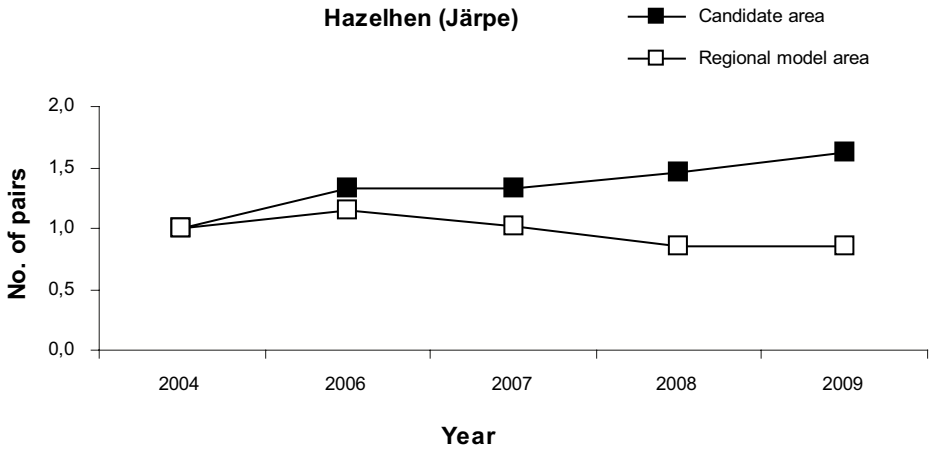

Figure 5-8. *Population development of hazelhens in Forsmark 2004–2009 shown as a chain index. Index for year 2004 is set to 1. See text for further explanations.*

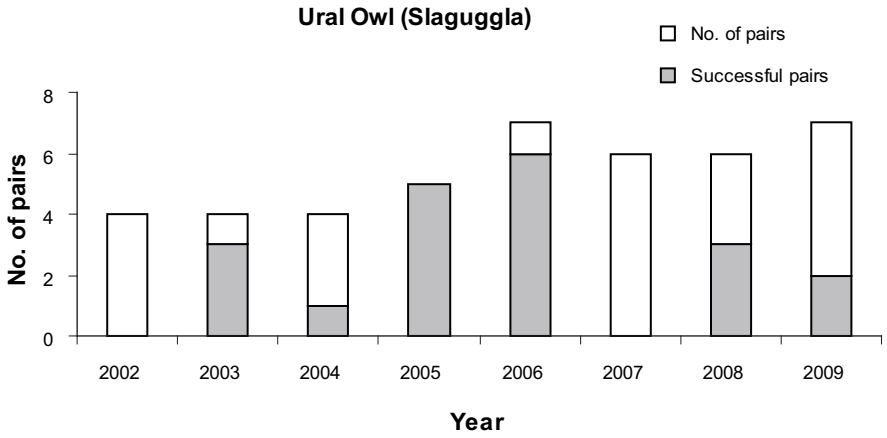

Figure 5-9. *Number of territorial pairs of ural owl within the regional model area in Forsmark 2002–2009. Shown is also the number of successful pairs (shaded).*

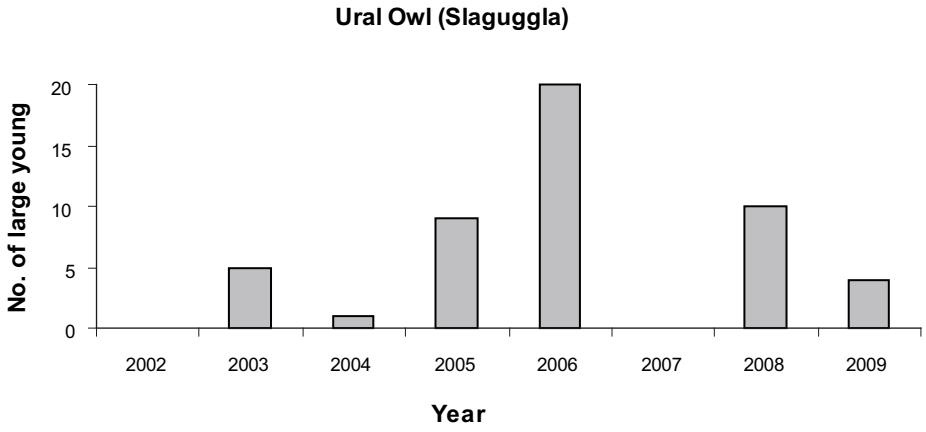

Figure 5-10. *Number of large ural owl young produced per year in Forsmark 2002–2009.*

Still no territory has been recorded within the candidate area during the study years, but one of the pairs has slowly been moving closer to the candidate area during later years. In 2009, observations were made less than 500 m from the candidate area.

Ural owl numbers on the national level are now thought to have levelled out after a long-time increase, at least in the south-central parts, where Forsmark is situated, during the last decades /Ottvall et al. 2008/.

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

Numbers of wrynecks reached a new all time high level in 2009. A total of 69 territories were recorded, 14 in the candidate area and 55 in the remaining parts of the regional model area, see Figure 5-11. Total wryneck numbers have increased significantly during the seven study years (Spearman rank correlation: $r_s = 0.86$, $p = 0.01$, $N = 7$). Looking at the candidate area and regional model area outside this separately, a significant increase for the candidate area (Spearman rank correlation: $r_s = 0.82$, $p = 0.02$, $N = 7$) but not for the regional model area outside the candidate area (Spearman rank correlation: $r_s = 0.57$, $p = 0.18$, $N = 7$) is noted. There are no obvious explanations for this difference between the two parts of the Forsmark area.

The wryneck is classified as 'Near-Threatened' (missgynnad) in the Swedish Red List /Gärdenfors 2005/. Wrynecks decreased strongly in Sweden between 1975 and the early 1990-ies. During the last decade numbers have increased again but are still way below the level some 30 years ago /Lindström et al. 2009, Ottvall et al. 2008/. The reason behind the large decline was probably loss of suitable habitats as a large proportion of small-scale farms in largely forested areas were abandoned in the mid 1900-s. National population size is estimated to be 5,500–15,000 pairs /Tjernberg and Svensson 2007/. After the increase in later years the latter figure is probably more realistic.

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

Lesser spotted woodpecker numbers in Forsmark have now remained at a high and very stable level for the last three years. In all these years 21 occupied territories were recorded, four in the candidate area and 17 in the regional model area outside the candidate area. No less than 16 of these territories have been occupied during all three years (including the four ones within the candidate area).

There is a significant increasing overall trend in numbers around Forsmark during 2003–2009 (Spearman rank correlation: $r_s = 0.93$, $p = 0.001$, $N = 7$ for the whole area), for the regional model area excluding the candidate area (Spearman rank correlation: $r_s = 0.93$, $p = 0.003$, $N = 7$) as well as for the candidate area (Spearman rank correlation: $r_s = 0.79$, $p = 0.03$, $N = 7$), see Figure 5-12.

The lesser-spotted woodpecker is still classified as 'Near-Threatened' (missgynnad) in the Swedish Red List. This is based on that national numbers decreased with about 50% between 1975 and 1990. During the last decade numbers have increased again and are now estimated to be back at, or even larger than, numbers in the mid 1970-ies /Ottvall et al. 2008/. The reason behind the initial decline was loss of dead wood and conversion of mixed and deciduous forests to monoculture conifer forests due to forestry. Recent increases are thought to be a result of increased conservation efforts by general forestry. National statistics indicate that both the amount of dead wood and of deciduous trees has increased again since the new environmental policy of forestry was launched in the mid-1990-ies /http://www-riksskogstaxeringen.slu.se/.

Red-backed shrike *Lanius collurio* Törnskata (Sw. Red List; EU Annex 1)

As in earlier reports, the population development of shrikes in Forsmark is shown below with an index (Figure 5-13). The figure should be read as there has been a 79% increase in red-backed shrike numbers within the candidate area between 2003 and 2009, and a 32% increase in the regional model area outside the candidate area. None of these trends are however statistically significant (Spearman rank correlation: $r_s = 0.60$, $p = 0.16$, $N = 7$ for the candidate area; $r_s = 0.16$, $p = 0.73$, $N = 7$ for the regional model area).

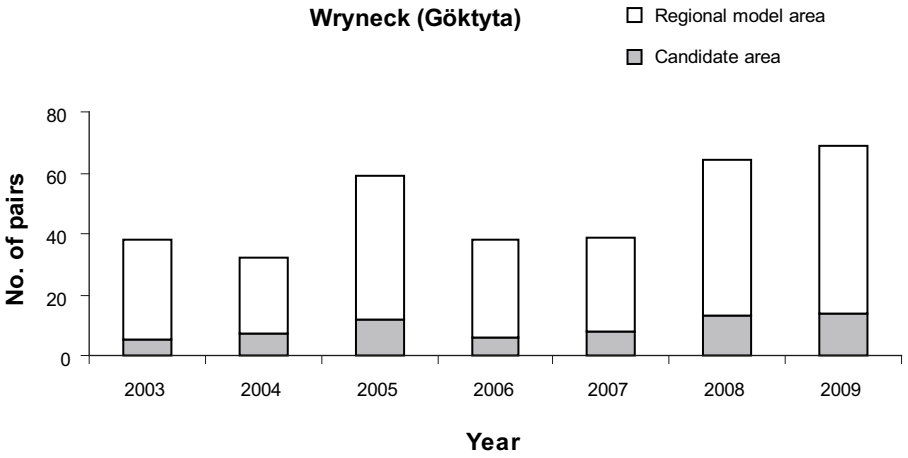

Figure 5-11. *Number of occupied wryneck territories in well monitored parts of Forsmark in 2003–2009. Shading shows the number of occupied territories within the candidate area.*

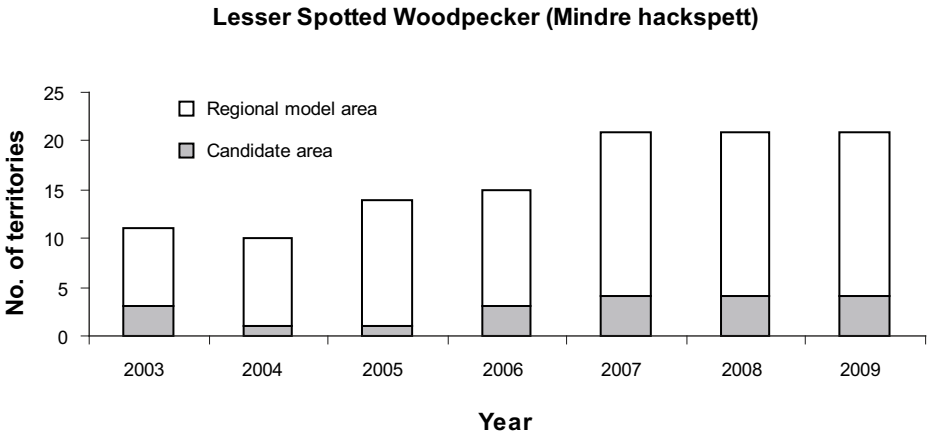

Figure 5-12. *Number of occupied territories of lesser spotted woodpeckers in areas monitored in all seven years 2003–2009 in Forsmark. Shading shows numbers of occupied territories in the candidate area.*

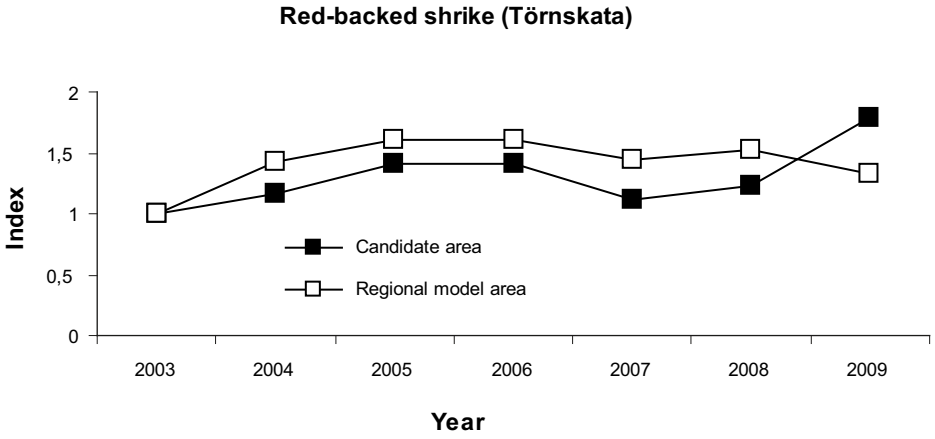

Figure 5-13. *Population development of red-backed shrikes in Forsmark 2003–2009 shown as a chain index. Index for year 2003 is set to 1. See text for further explanations.*

Looking at year to year variation, the patterns in the candidate area and the regional model area outside this differed between 2008 and 2009. While numbers in the candidate area increased, numbers in the regional model area decreased. The decrease in the regional model area was almost completely due to a decrease in numbers in the large power line area running southwest from the power plant. This area is cut every five to eight years in order to keep it free of higher vegetation. Now it was quite many years since the last cutting and the vegetation in 2009 was simply not as suitable for shrikes in this year. The increase in the candidate area was mostly due to more pairs being present on the small clear-cuts in the south-eastern parts.

The red-backed shrike is classified as 'Near-Threatened' (Missgynnad) in the Swedish Red List /Gärdenfors 2005/. National numbers have according to existing data decreased strongly over the last 30 years /Lindström et al. 2009, Ottvall et al. 2008/. The reason for the decrease at a general level is thought to be habitat loss, as many semi-natural grazing pastures have disappeared during later decades. Questions are however now being raised about whether this actually mirrors the national situation correctly. Recent analyses have shown that maybe up to 80% of the Swedish red-backed shrikes occur in other habitats than semi-natural grazing pastures, i.e. clear-cuts etc. If so, numbers recorded in agricultural areas may not show the situation in other habitats. On the other hand, if factors outside of the breeding area are driving the population development, similar patterns would be expected irrespective of chosen breeding habitat. The latest studies indicate that shrikes in clear-cuts may face lower nest predation pressure than shrikes in agricultural landscapes /Söderström 1996/ but also that there are no differences in national trends between areas with a high and low proportion of agricultural land (own data).

In Formark about 80% of the recorded red-backed shrike territories in 2002–2009 were in clear-cuts or under power wires. About 20% were connected to agricultural land.

5.2 Summary of population changes at Forsmark

Table 5-2 displays general population changes in Forsmark of the species presented in this report.

Table 5-2. General population changes of selected listed species in Forsmark between 2008 and 2009. 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 2009 in general terms is shown for divers, raptors and owls.

Species	Regional model area	Candidate area	Whole area	Breeding output 2008
Black-throated Diver	0	0	0	Moderate
Honey Buzzard	+	0	+	Poor
White-tailed Eagle			0	Good
Osprey	+	0	+	Poor
Black grouse	–	+	–	
Capercaillie	0	0	0	
Hazelhen	0	+	+ (?)	
Ural owl	+	0	0	Moderate
Wryneck	+	+	+	
Lesser Spotted Woodpecker	0	0	0	
Red-backed shrike	–	+	– (?)	

6 Discussion and conclusions

Patterns recorded in 2009 very closely follow the ones that have been recorded, reported and discussed in earlier years and there are actually very few things to add to the previous discussion here. The question about if selected listed bird species in any way were affected by the site investigations has been answered quite convincingly on a general level in earlier reports. The answer was no, there were no large general impacts on the breeding bird fauna around Forsmark from the site investigations /Green 2002, 2003, 2004, 2005, 2006, 2007, 2008a, b/. The main take-home message is instead that general changes in the local bird fauna are following large-scale patterns at the national (or even larger?) level.

The few species that may have been affected (disturbed) by the site investigation activities now seem to recolonize areas that were avoided during the most intensive site investigation years. These patterns were recorded already in the preceding years and were even stronger in 2009 with increasing numbers of hazelhens and more signs of capercaillie activity within the candidate area.

Breeding success of eagles in Forsmark has been lower in most years following the start of the site investigations compared to years before this (locally) and compared to at least one of the reference areas. In 2009 the breeding success in Forsmark was again at a similar level as in the pre-site investigation years and it will be interesting to follow if this could be a start of a period with higher breeding output again. However, as explained in earlier reports there are probably a combination of factors behind this pattern, including everything from an increase in human presence, also in the reference areas, to forestry activities, increased density of eagles and replacements of mates within pairs perhaps making breeding success lower on a more general level. If so, we should perhaps not expect breeding output in Forsmark to reach the level of earlier periods on any more permanent scale.

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/http://www-riksskogstaxeringen.slu.se/

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 2002–2008. The listing follows the updated version of the Red List /Gärdenfors, 2005/.

English name	Swedish name	Latin name	Listing	Estimated population size (pairs/territories) in Forsmark (regional model area)
Whooper Swan	Sångsvan	Cygnus cygnus	EU	5
Shoveler	Skedand	Anas clypeata	SRL	6
Pochard	Brunand	Aythya ferina	SRL	1
Velvet Scoter	Svärta	Melanitta fusca	SRL	7
Hazelhen	Järpe	Bonasia bonasia	EU	30
Black Grouse	Orre	Tetrao tetrix	EU	25
Capercaillie	Tjäder	Tetrao urogallus	EU	11–13
Quail	Vaktel	Coturnix coturnix	SRL	1–3
Black-throated Diver	Storlom	Gavia arctica	EU	6
Slavonian Grebe	Svarthakedopping	Podiceps auritus	SRL, EU	0–1
Bittern	Rördrom	Botaurus stellaris	SRL, EU	3
Honey Buzzard	Bivråk	Pernis apivorus	SRL, EU	7–9
White-tailed Eagle	Havsörn	Haliaeetus albicilla	SRL, EU	4
Marsh Harrier	Brun kärrhök	Circus aeruginosus	EU	0–1
Osprey	Fiskgjuse	Pandion haliaetus	EU	8
Spotted Crake	Småfläckig sumphöna	Porzana porzana	SRL, EU	1–3
Corncrake	Kornknarr	Crex crex	SRL, EU	0–1
Crane	Trana	Grus grus	EU	30
Curlew	Storspov	Numenius arquata	SRL	3
Turnstone	Roskarl	Arenaria interpres	SRL	10
Lesser Black-backed Gull	Silltrut	Larus fuscus	SRL	97
Common Tern	Fisktärna	Sterna hirundo	EU	95
Arctic Tern	Silvertärna	Sterna paradisaea	EU	234
Stock dove	Skogsduva	Columba oenas	SRL	10
Pygmy Owl	Sparvuggla	Glaucidium passerinum	EU	15–20
Ural Owl	Slaguggla	Strix uralensis	EU	7
Tengmalms Owl	Pärluggla	Aegolius funereus	EU	0–2
Wryneck	Göktyta	Jynx torquilla	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	3–5
Wood Lark	Trädlärka	Lullula arborea	EU	2–3
Skylark	Sånglärka	Alauda arvensis	SRL	20
Wheatear	Stenskvätta	Oenanthe oenanthe	SRL	6
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
Marsh Tit	Entita	Parus palustris	SRL	20
Red-backed Shrike	Törnskata	Lanius collurio	SRL, EU	80–100
Nutcracker	Nötkråka	Nucifraga caryocatactes	SRL	12
Linnet	Hämpling	Carduelis cannabina	SRL	4
Scarlet Rosefinch	Rosenfink	Carpodacus erythrinus	SRL	50
Ortolan Bunting*	Ortolansparv*	Emberiza hortulana	SRL, EU	0*

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