P-08-84

Forsmark site investigation

Bird monitoring in Forsmark 2008

Martin Green
Department of Animal Ecology, Lund University

December 2008

Svensk Kärnbränslehantering AB
Swedish Nuclear Fuel
and Waste Management Co

Box 250, SE-101 24 Stockholm
Phone +46 8 459 84 00

ISSN 1651-4416
SKB P-08-84

Site investigations Forsmark

Bird monitoring in Forsmark 2008

Martin Green
Department of Animal Ecology, Lund University

December 2008

Keywords: AP PF 400-08-001, Site investigations, Forsmark, Monitoring, Birds, 2008.

Abstract

This report summarizes the monitoring of selected listed (Swedish Red List and/or the EU Birds Directive) breeding birds in Forsmark 2002–2008. Monitoring of eleven listed species was conducted in the regional model area, including the candidate area in 2008 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 2008 closely follows patterns recorded in earlier years. No dramatic changes in bird numbers occurred compared to 2007.

Black-throated divers occurred in the same numbers as in previous years and their breeding success was again good. The breeding success has improved considerably over the studied period and the local population produces a sufficient number of young to be sustainable.

Honey buzzards and ospreys bred in normal numbers. Breeding success of honey buzzards was again good and that of ospreys was moderate. Also the white-tailed eagles showed a moderate breeding success, similar to the average during the study period, but lower than during the period preceding this. Breeding success has lately dropped also in adjoining reference areas. In the early years of the period these produced more young than Forsmark. The situation in Forsmark is thus now at the same level as on a larger geographic scale. Reasons behind this general pattern may be increased general human presence around areas where eagles breed, disturbance from forestry activities, increased competition between eagles due to increased general population density and exchange of mates within pairs.

The results for forest hens follow the patterns recorded in previous years. Black grouse numbers continued to increase. Numbers of capercaillies and hazelhens remained relatively unchanged. Worth noting is that tracks of capercaillies were recorded within the candidate area for the first time since 2002.

After last years lousy breeding success (no young produced at all), the ural owls had an average year and half of the resident pairs produced young. The broods were unexpedly large, given that it was not a peak rodent year, with three-four young per brood. The number of occupied territories of lesser spotted woodpeckers was identical to 2007. The wrynecks had a peak year with the highest recorded number of occupied territories during the study years. The red-backed shrikes tend to increase in the area.

None of the monitored species has decreased in numbers in Forsmark during the seven 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. The only exception from this general pattern seems to be the breeding success of eagles which remains lower than before the site investigations started. However, as mentioned above, this pattern is also found in reference areas surrounding Forsmark and seems to represent a more general tendency.

Sammanfattning

Denna rapport sammanfattar övervakningen av bestånden av häckande fåglar i Forsmark 2002–2008. Under 2008 genomfördes inventering av elva utvalda listade arter (upptagna i Svenska rödlistan och/eller EU:s Fågeldirektiv) inom regionala modellområdet, inklusive kandidat-området på samma sätt som under tidigare år. Syftet med rapporten är att belysa och utvärdera eventuella effekter på de häckande fågelbestånden från de nu avslutande platsundersökningarna.

Resultaten från 2008 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 ånyo god, precis som under de närmast föregående åren. 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 häckade i normala antal. Häckningsframgången var god för bivråkarna och moderat för fiskgjusarna. Områdets havsörnar hade även de en moderat häckningsframgång, precis som tidigare sedan platsundersökningarna startade. Under senare år har även häckningsframgången i omgivande referensområden sjunkit till en lägre nivå än innan 2002, och det nuvarande läget i Forsmark tycks sammanfalla med vad som händer på en större geografisk skala. Anledningarna bakom den generella nedgången i häckningsframgång hos örnarna är troligen flera. Ökad allmän mänsklig närvaro i örnbebodda områden, störningar från skogsbruk, ökad populationstäthet och därmed konkurrens mellan örnar samt utbyte av partners inom örnpar kan samtliga vara tänkbara faktorer bakom det funna mönstret.

Skogshönsen följde i princip tidigare års mönster med fortsatt ökning av orre och relativt oförändrade antal av tjäder och järpe. Notera att ingen fullskaleinventering av tjäder genomfördes under 2008. Notabelt är att spår av tjäder hittades inom kandidatområdet för första gången sedan 2002.

Efter fjolårets absoluta bottenår hade slagugglorna ett mellanår där hälften av paren lyckades med häckningarna. Ungkullarna var i dessa fall förvånansvärt stora (tre–fyra ungar per kull). Antalet bebodda revir av mindre hackspett var identiskt med föregående år. Göktytorna uppvisade en ny rekordförekomst med det högsta antalet bebodda revir som noterats under de undersökta åren. Antalet törnskator i området tenderar att öka.

Generellt sett har ingen av de uppföljda arterna minskat i antal i Forsmark under platsundersökningsåren. 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. Enda undantaget från detta generella resultat verkar vara örnarnas häckningsframgång, men här finns som sagt tecken på generella förändringar över större geografisk skala även utanför Forsmark.

Contents

1 Introduction

This document reports the results from the bird monitoring in Forsmark for 2008. The bird surveys started in 2002 and have now been going on for seven years. For some of the species presented here good data are available from 2003 onwards, allowing comparisons during a six-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 400-08-001. 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 SKB GIS database, where they are traceable by the Activity Plan number (AP PF 400-08-001). The use of the data is restricted since it concerns sensitive species. 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, 2008/ 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 into 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.

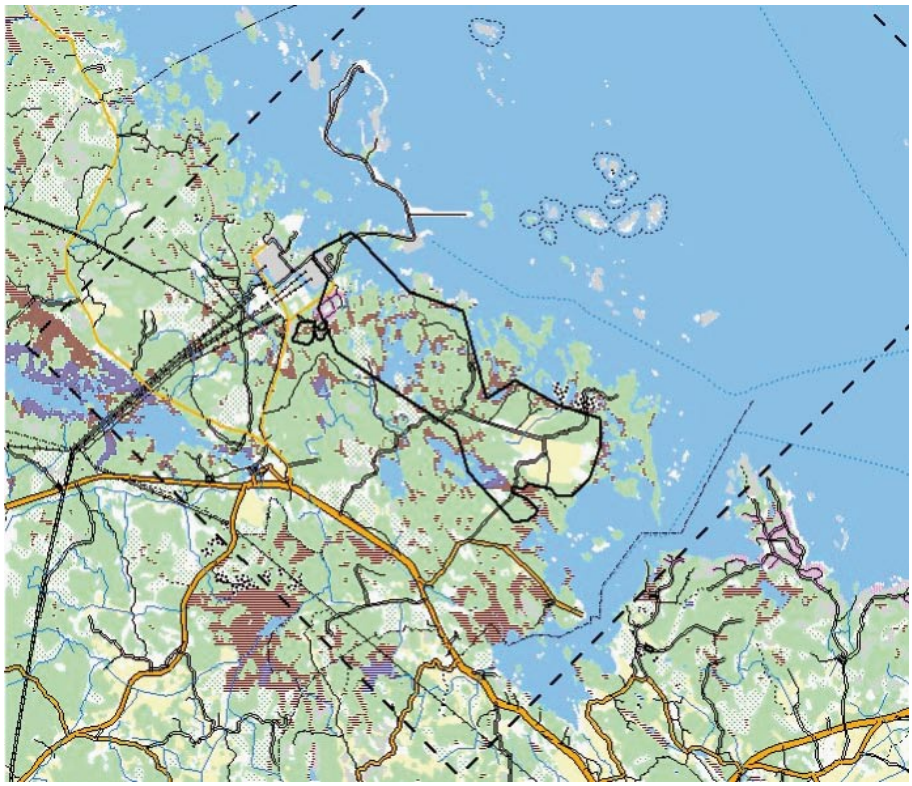


Figure 2-1. *Map of the survey area in Forsmark. The regional model area is shown with a thick broken line and the candidate area is illustrated with a thick unbroken line.*

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 applied are described in detail in activity plan AP PF 400-08-001. 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. 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 2008 by visiting known nesting places/territories used in 2002–2007, 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 local time during the field work.

Table 4-1. Listed species (Swedish Red List and/or EU: Birds Directive) selected for monitoring in Forsmark in 2004–2008.

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 2008 was carried out during the period 2008-03-25 – 2008-08-01. All organised field work was performed 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 conducted by Martin Green, Department of Animal Ecology, 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 days field work the data were transferred to pre-made paper forms. Data were then entered into Excel-files from paper forms whereupon the files were 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 now for the second time statistically tested in this report. 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) six 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 400-08-001. 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 2002–2008 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)

Six pairs of black-throated divers were recorded in the area during 2008, as in most of the earlier investigated years. There is no statistically significant trend in diver numbers over the period (Spearman rank correlation: $r_s = 0.29$, $p = 0.53$, $N = 7$). One pair of divers was again present in Bolundsfjärden this year, after the absence in 2007 (see /Green 2008/). Otherwise distribution was normal with three pairs in lakes and three pairs in coastal parts, see Figure 5-1.

Breeding success was again good, three pairs were successful and altogether raised five large young. The number of successful breeding attempts per year has increased significantly between 2002 and 2008 (Spearman rank correlation: $r_s = 0.84$, $p = 0.017$, $N = 7$) and so has the number of produced large young per year (Spearman rank correlation: $r_s = 0.83$, $p = 0.021$, $N = 7$). 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.

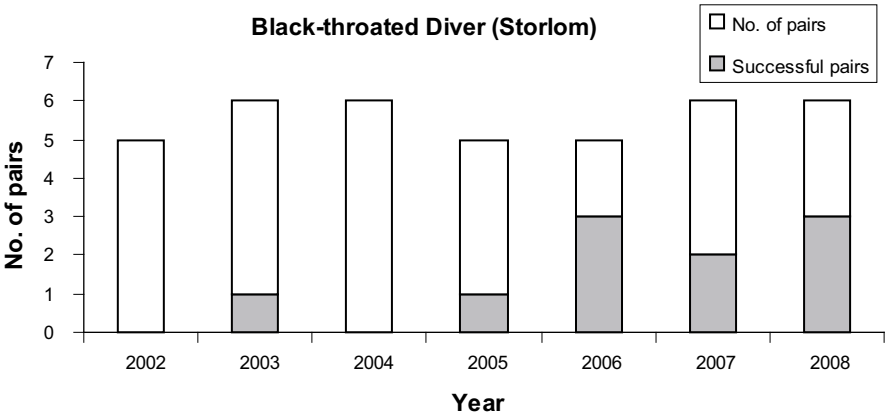


Figure 5-1. *Number of resident pairs of black-throated divers in Forsmark 2002–2008. Shading shows the number of successful pairs. Minimum numbers are shown, total numbers of pairs in 2005 might have been seven and there might have been four successful pairs in 2006.*

Local breeding success in Forsmark 2008 (0.83 large young/resident pair) is a comparatively good figure, actually the second highest during the study period. In 2006, at least 1.4 large young/resident pair was produced. Of the successful breedings in 2008, two were in lakes and one in coastal waters. Seen to the whole seven-year period, on average 0.49–0.54 large young/pair and year were produced in Forsmark.

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 has remained stable during this time /Ottvall et al. 2008/.

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

Numbers of honey buzzard territories decreased somewhat from nine in 2007 to seven in 2008 (Figure 5-2). Hidden behind these figures is however the fact that the number of pairs in a larger area around Forsmark remained unchanged between the years (pers obs.). Hence, the decrease within the regional model area was more a question of that a few pairs this year chose to breed just outside the regional model area unlike last year. Seen over all seven study years, numbers in Forsmark tended to increase but not significantly so (Spearman rank correlation: $r_s = 0.70$, $p = 0.08$, $N = 7$). Bearing in mind that the number of pairs in the first years of the site investigation period probably was underestimated, the conclusion is that numbers have remained stable during 2002–2008 (see /Green 2008/).

Breeding success was not monitored in detail in 2008, but incidental observations indicated that breeding success again was good. At least four pairs together produced at least four young, giving a minimum local breeding success of 0.57 young/territorial pair. During the last five years, annual minimum breeding success has varied between 0.38 and 0.75 large young/pair (0.56 on average).

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 at 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/.

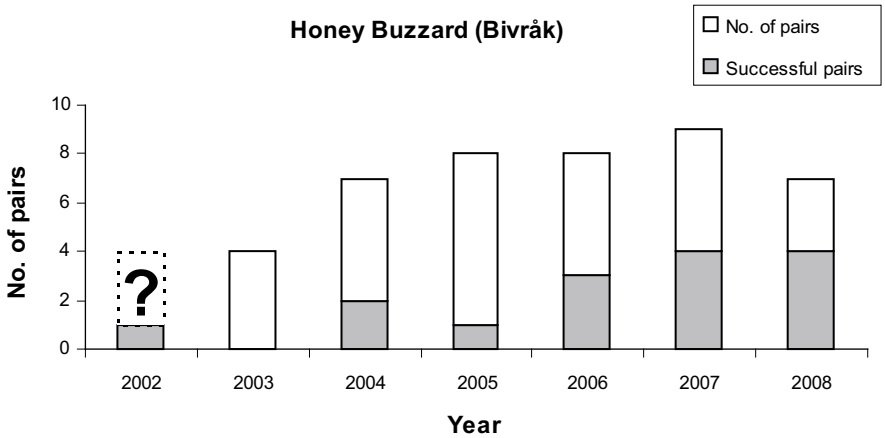


Figure 5-2. *Number of territorial pairs of honey buzzards within the regional model area in Forsmark 2002–2008. Shading shows number of successful pairs. The exact number of territorial pairs in 2002 is not known. An (at the time) well based estimate is shown.*

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

Table 5-1 below summarises breeding success of white-tailed eagles in the Forsmark area and surrounding reference areas since 1998. In 2008, breeding performance in Forsmark was again less successful than before 2002 (reference period from before the site investigations began within the candidate area). The breeding success in Forsmark has declined from an average of 85% before 2002 to on average 44% during the recent study period, a reduction by almost half.

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. Breeding success dropped abruptly in the Forsmark area already in 2002. More recently, a decline has occurred also in the reference areas, most notable in Reference area N. In 2008, breeding success was lower also in Reference area S, and there was little difference between the study areas in breeding success this year. As commented on previously, reasons for the lowered success in reference area N include human disturbance, forestry activities during the incubation period, and replacements of mates in the adult pairs (natural turnover of adults followed by replacements is commonly resulting in temporary breaks in the succession of breeding attempts in eagle territories).

During the study period, factors of disturbance in the Forsmark area excludes forestry but includes 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.

Table 5-1. Per cent successfully breeding pairs of white-tailed eagles in 1998–2001 and 2002–2008 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	2002–2005	2006	2007	2008	2006–2008	N
Forsmark area	85	25	33	50	75	50	25	50	50	42	40
Reference area S	79	100	80	100	83	86	50	80	60	62	57
Reference area N	72	83	71	86	29	67	29	33	60	39	63

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

Osprey *Pandion haliaetus* Fiskgjuse (EU Annex 1)

Seven pairs of ospreys were recorded around Forsmark in 2008, see Figure 5-3. Four of these successfully produced large young, a somewhat lower proportion than in the years 2004–2007. There is no significant trend in either population size or in number of successful pairs over the years (Spearman rank correlation: $r_s = 0.15$, $p = 0.74$, $N = 7$ for population size, $r_s = 0.40$, $p = 0.39$, $N = 7$ for number of successful pairs).

The four successful pairs together produced six large young. Average breeding success was hence 0.86 large young/territorial pair, the lowest figure since 2003 and well below the average for the whole period 2003–2007 (1.25 large young/pair), see Figure 5-4.

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/.

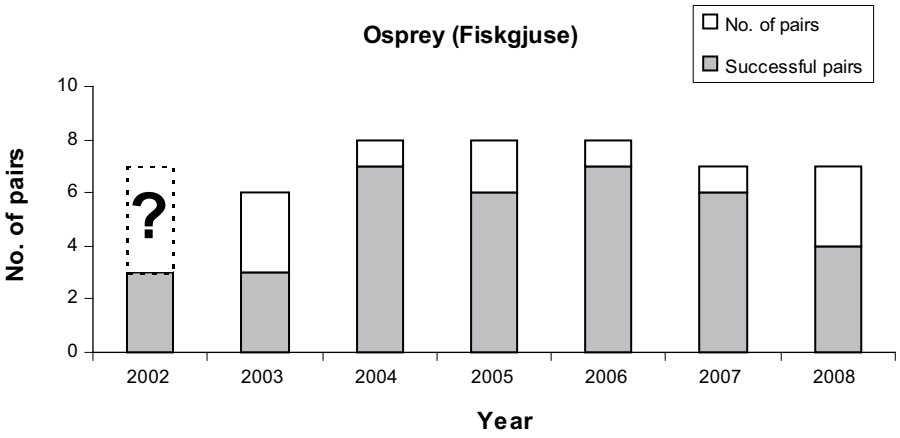


Figure 5-3. *Number of nesting attempts (territorial pairs) of ospreys in Forsmark 2002–2008. Number of successful nests (shaded parts) is shown as well. The exact number of territorial pairs in 2002 is not known. A well based estimate is shown.*

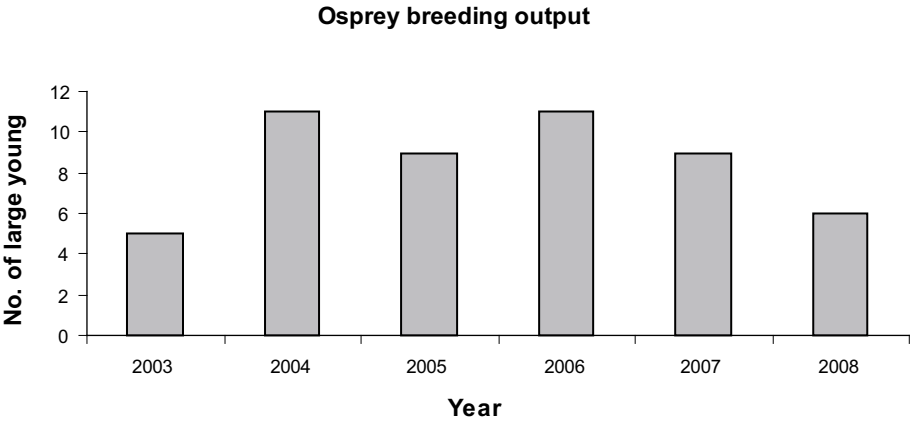


Figure 5-4. *Number of large young of ospreys produced in Forsmark 2003–2008. Number of large young per breeding attempt was 0.83 in 2003, 1.38 in 2004, 1.12 in 2005, 1.38 in 2006, 1.29 in 2007 and 0.86 in 2008.*

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

Regional numbers of black grouse (Figure 5-5) continued to increase after the slight dip in numbers in 2007 (see /Green 2008/). Numbers have increased significantly between 2002 and 2008 (Spearman rank correlation: $r_s = 0.89$, $p = 0.007$, $N = 7$). The patterns differ between the candidate area and the regional model area outside the candidate area. While numbers in the regional model area show a continuous increase over the whole period, numbers in the candidate area increased up until 2006, whereupon fewer birds have been present in these parts. As explained in last year´s report /Gren 2008/, the probable reason behind this pattern is that many of the clear cuts (a habitat favoured by lekking black grouse) within the candidate area are now covered in too high vegetation for being suitable for the birds, since no forestry activity has been going on there during the site investigation period, in contrast to the situation in the rest of the area. The patterns found probably follow normal population dynamics prevailing over a larger geographical scale.

The number of multiple male leks (cf. /Green 2007, 2008/) continued to increase (four in 2006, six in 2007, eight in 2008). Close to 75% of the males do now occur at these leks (Figure 5-6).

The development in Forsmark closely follows the recorded pattern at the national level /Lindström et al. 2008/. Interestingly the pattern in Forsmark is more in accordance with patterns in the northern parts of Sweden than with those in the south.

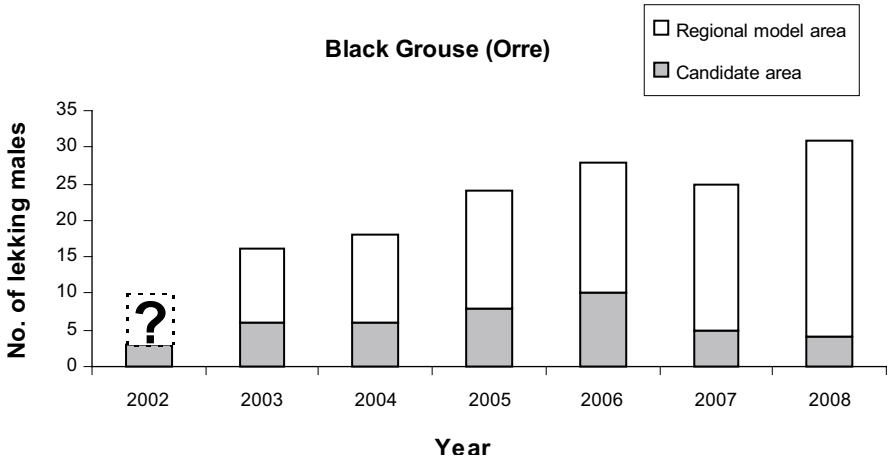
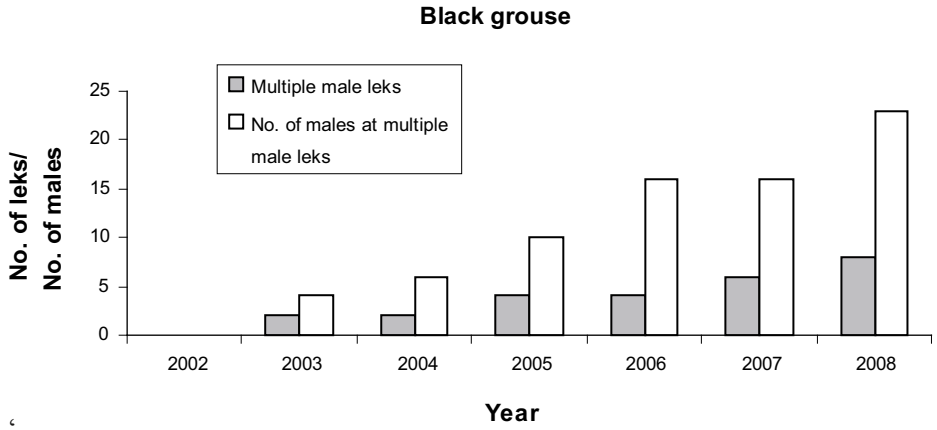


Figure 5-5. *The recorded number of lekking black grouse males in Forsmark 2002–2008. Shaded parts show the numbers within the candidate area. Exact number of lekking males in 2002 is not known. A well based estimate is shown.*



‘

Figure 5-6. *The recorded number of lekking black grouse males in Forsmark 2002–2008 found at leks containing more than one male. Shaded bars show the number of such multiple male leks within the regional model area.*

Capercaillie *Tetrao urogallus* Tjäder (EU Annex 1)

Four males were recorded at the central lek in 2008, a lower figure than in the two closest preceding years, but well within the variation over the full seven year period (Figure 5-7).

Home ranges and numbers of capercaillies in the whole regional model area were not monitored to full extent in 2008 (done so in 2006 and 2007), but some general findings from 2008 are worth mentioning. Tracks of capercaillies were found within the candidate area for the first time since 2002, indicating that we now are back to a situation similar to the one before the most intensive parts of the site investigations started (cf. /Green 2005, 2008/). Records of birds and signs of birds from 2008 indicate that home ranges in general were very similar to the ones recorded during the full survey in 2007. The northern lek held at least seven males this year, the highest number recorded so far during 2002–2007.

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

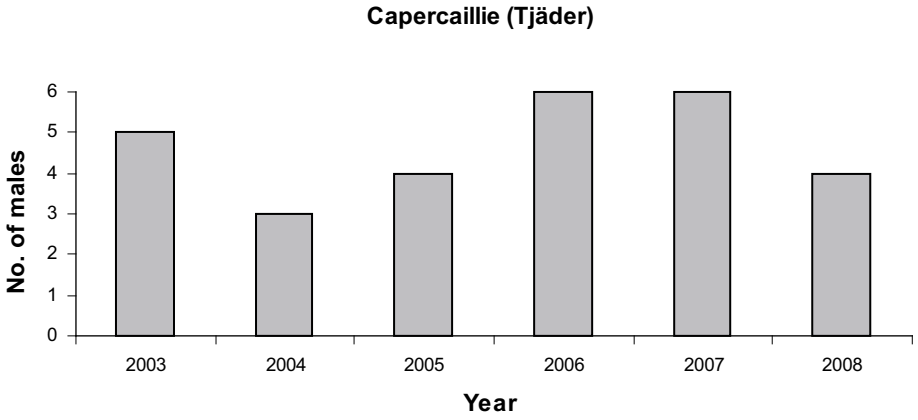


Figure 5-7. *The recorded number of capercaillie males in 'the central area' at Forsmark 2003–2008 (see text).*

Hazelhen *Bonasia bonasia* Järpe (EU Annex 1)

Hazelhen monitoring was in 2008 performed at the same level as in 2004 and 2006–2007 (cf. /Green 2007/). In 2002–2003 all parts of the regional model area were visited but no survey specifically directed at hazelhens was made. Earlier results indicated that the species might be sensitive to disturbances from the site investigations /Green 2004, 2005/.

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).

Recorded numbers within the candidate area tend to increase over the years covered. The index from 2008 (1.46) indicates a 46% increase in numbers compared to 2004. At the same time, indices from the regional model area tend to decrease and an index of 0.85 in 2008 indicates a 15% decrease in numbers compared to 2004. 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). It is also tempting to interpret the tendencies as results of forestry activities in different parts. No active forestry has been conducted within the candidate area since the site investigations started and this has probably been beneficial for hazelhens. At the same time, several new clear cuts have been taken up in the regional model area.

In all, 25 occupied hazelhen territories were registered in 2008, ten in the candidate and 15 in the regional model area.

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. 2008/.

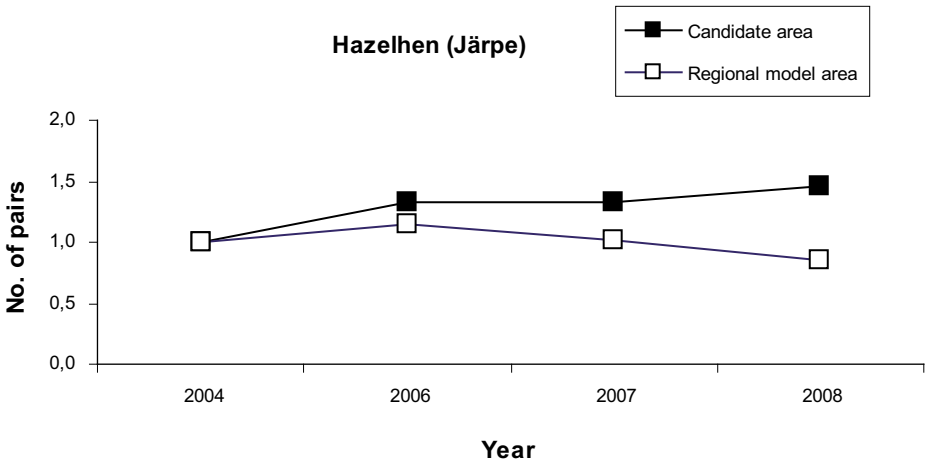


Figure 5-8. *Population development of hazelhens in Forsmark 2004–2008 shown as a chain index. Index for year 2004 is set to 1. See text for further explanations.*

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

Ural owls had a fairly good year in Forsmark in 2008. Number of resident pairs was on the same level as in 2007 (six), and three of these together produced ten large young. Breeding success of owls follows rodent numbers in general and after the bottom year in 2007, with very low numbers of the favourite prey of ural owls (bank voles); rodents were probably more abundant again in 2008. This means that 2008 was something of an 'in between year' for the large owls in the area, not a peak year but not a bottom year either (see Figures 5-9 and 5-10).

Over the seven years ural owl numbers have increased significantly around Forsmark (Spearman rank correlation: $r_s = 0.84$, $p = 0.017$, $N = 7$), but there are no trends in the number of successful pairs (Spearman rank correlation: $r_s = 0.20$, $p = 0.57$, $N = 7$), or in the number of produced large young (Spearman rank correlation: $r_s = 0.45$, $p = 0.31$, $N = 7$). As reported earlier, no territory has still been recorded within the candidate area during the study years. One of the pairs does however regularly hunt close to this, and in 2008 they also chose a nest site closer to the candidate area than in earlier years.

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/.

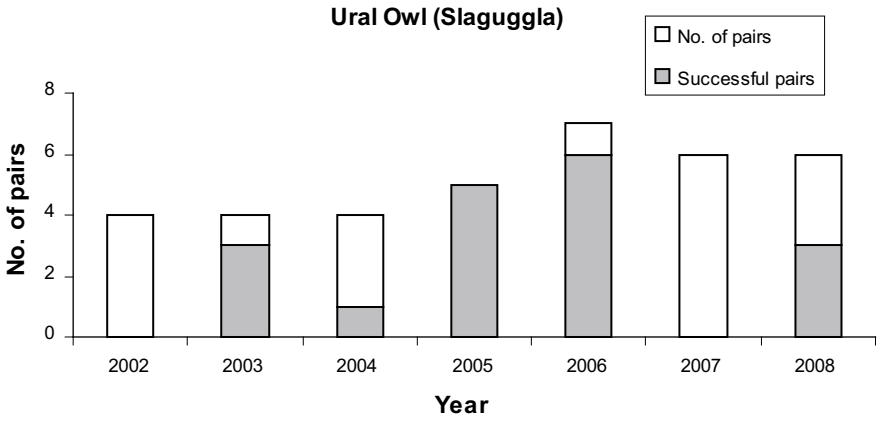


Figure 5-9. *Number of territorial pairs of ural owl within the regional model area in Forsmark 2002–2008. Shown is also the number of successful pairs (shaded).*

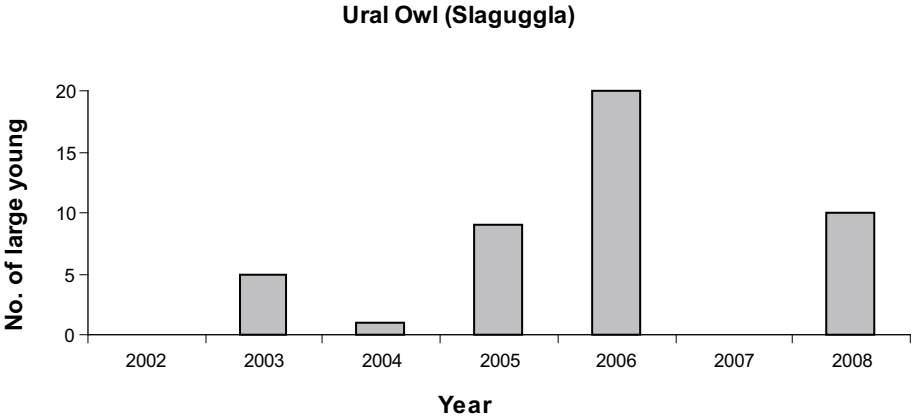


Figure 5-10. *Number of large ural owl young produced per year in Forsmark 2002–2008.*

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

Wryneck numbers were high in 2008, reaching the highest number of occupied territories during the study period. No less than 64 territories were recorded in 2008, five more than in the earlier peak year in 2005. Numbers were high in both the candidate area and in the remaining parts of the regional model area (Figure 5-11). There is a non-significant tendency for a positive trend in wryneck numbers within the area during 2003–2008 (Spearman rank correlation: $r_s = 0.77$, $p = 0.07$, $N = 6$ for the whole area). Looking at the candidate and regional model area outside this separately show non-significant results for both; Spearman rank correlation: $r_s = 0.71$, $p = 0.11$, $N = 6$ for the candidate area; Spearman rank correlation: $r_s = 0.31$, $p = 0.54$, $N = 6$ for the regional model 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. 2008, 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 later figure is probably more realistic.

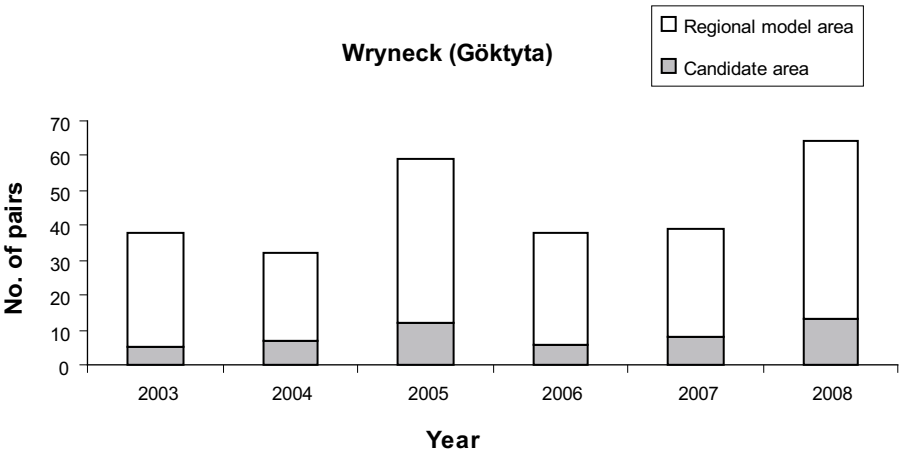


Figure 5-11. *Number of occupied wryneck territories in well monitored parts of Forsmark in 2003–2008. Shading shows the number of occupied territories within the candidate area.*

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

Lesser spotted woodpecker numbers in Forsmark remained at the high level record in 2007. In both years 21 occupied territories were recorded, four in the candidate area and 17 in the regional model area outside the candidate area (Figure 5-12).

There is a significant increasing overall trend in numbers around Forsmark during 2003–2008 (Spearman rank correlation: $r_s = 0.97$, $p = 0.001$, $N = 6$ for the whole area) for the regional model area excl. the candidate area (Spearman rank correlation: $r_s = 0.93$, $p = 0.008$, $N = 6$) but no significant change for the candidate area (Spearman rank correlation: $r_s = 0.72$, $p = 0.11$, $N = 6$).

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/.

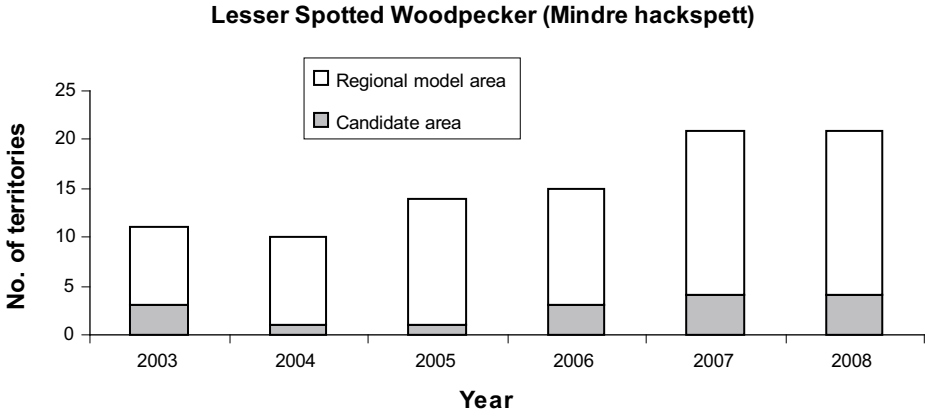


Figure 5-12. *Number of occupied territories of lesser spotted woodpeckers in areas monitored in all four years 2003–2008 in Forsmark. Shading shows numbers of occupied territories in the candidate area.*

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

Numbers of occupied shrike territories remained fairly stable between 2007 and 2008. As previously, 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 24% increase in red-backed shrike numbers within the candidate area between 2003 and 2008, and a 52% increase in the regional model area outside the candidate area. None of these trends are however statistically significant (Spearman rank correlation: $r_s = 0.35$, $p = 0.50$, $N = 6$ for the candidate area; $r_s = 0.52$, $p = 0.29$, $N = 6$ for the regional model area). The interpretation of these figures is that although general population development tends to be positive, what we can say with any statistical confidence is that the local population is stable.

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. 2008, 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 the breeding area are driving the population development, similar patterns would be expected irrespective of chosen breeding habitat. At present there are no good data on development in different habitats, but studies indicate that shrikes in clear-cuts may face lower nest predation pressure than shrikes in agricultural landscapes /Söderström 1996/.

In Formark about 80% of the recorded red-backed shrike territories in 2002–2008 were in clear-cuts or under power wires. About 20% were connected to agricultural land.

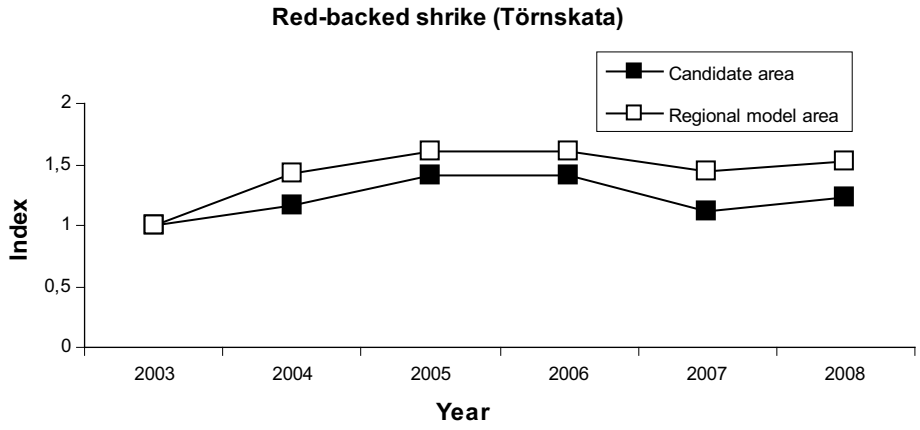


Figure 5-13. *Population development of red-backed shrikes in Forsmark 2003–2008 shown as a chain index. Index for year 2003 is set to 1. See text for further explanations.*

Summary

Table 5-2 presents a summary of general population changes of the monitored species in Forsmark between 2007 and 2008.

Table 5-2. General population changes of selected listed species in Forsmark between 2007 and 2008. 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 2008 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	Good
Honey Buzzard	–	0	–	Good
White-tailed Eagle			0	Decent
Osprey	0	0	0	Moderate
Black grouse	+	0	+	
Capercaillie	? (+)	+	? (+)	
Hazelhen	–	+	0	
Ural owl	0	0	0	Moderate
Wryneck	+	+	+	
Lesser Spotted Woodpecker	0	0	0	
Red-backed shrike	+	+	+	

6 Discussion and conclusions

After six to seven years of monitoring, patterns recorded during a specific year tend to be very similar to what has been recorded earlier. No dramatic changes normally occur and reports like these tend to be repetitions of what has been said earlier, which is also the case with this report. The underlying question to answer when the monitoring activities started was if selected listed bird species were affected in any way by the site investigations. This question has been quite convincingly answered 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, 2008/. General changes in the local bird fauna have instead followed large-scale patterns at the national level.

Interestingly, some of the few possible negative impacts from the site investigations seem to have been very temporary. Capercaillies and hazelhens showed signs of changed local distributions (but not numbers) during the early years of the surveys in that they seemingly avoided the parts of the area where the most intensive parts of the site investigations were carried out. Tracks of capercaillies where again observed within the candidate area in 2008 for the first time since 2002. Hazelhens seemed to be back at the sites used before the site investigations even earlier (see /Green 2008/). The situation was similar for lesser spotted woodpeckers, where numbers within the candidate area were low during a few years of the intensive site investigation period, but then returned to earlier levels when human presence in the area decreased again.

Local breeding success of white-tailed eagles is still below the levels before the site investigations started, but so is breeding success in surrounding reference areas. Even though there are indications of that the eagles were disturbed by site investigation activities during the early parts of the period, the situation during later years indicate that something has happened also at a larger scale. 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.

7 References

Green M, 2003. Fågelundersökningar inom SKB:s platsundersökningar 2002. Platsundersökning Forsmark. SKB P-03-10. Svensk Kärnbränslehantering AB.

Green M, 2004. Bird monitoring in Forsmark 2002–2003. Forsmark site investigation. SKB P-04-30. Svensk Kärnbränslehantering AB.

Green M, 2005. Bird monitoring in Forsmark 2002–2004. Forsmark site investigation. SKB P-05-73. Svensk Kärnbränslehantering AB.

Green M, 2006. Bird monitoring in Forsmark 2005. Forsmark site investigation. SKB P-06-46. Svensk Kärnbränslehantering AB.

Green M, 2007. Bird monitoring in Forsmark 2006. Forsmark site investigation. SKB P-07-02. Svensk Kärnbränslehantering AB.

Green M, 2008. Bird monitoring in Forsmark 2007. Forsmark site investigation. SKB P-08-25. Svensk Kärnbränslehantering AB.

Gärdenfors U, (ed.) 2005. Rödlistade arter i Sverige 2000. ArtDatabanken, SLU, Uppsala.

Lindström Å, Green M, Ottvall R, Svensson S, 2008. Övervakning av fåglarnas populationsutveckling. Årsrapport för 2008. Rapport, Ekologiska inst., Lunds Universitet och Naturvårdsverket, Lund.

Ottvall R, Edenius L, Elmberg J, Engström H, Green M, Holmqvist N, Lindström Å, Tjernberg M, Pärt T, 2008. Populationstrender för fågelarter som häckar i Sverige. Naturvårdsverket Rapport 5813.

Sokal R R, Rohlf F J, 1997. Biometry, the principles and practice of statistics in biological research. W H Freeman and Company, New York.

Söderström, B. 1996. Törnskatornas biologi – andra internationella konferensen om törnskator i Eilat, mars 1996. Vår Fågelvärld 5/1996. pp. 24–25.

Tjernberg, M, Svensson, R. (red.) 2007. Artfakta – rödlistade vertebrater i Sverige. Artdatabanken, SLU, Uppsala.

/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	31
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	3–4
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	7
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 passerinim	EU	15–20
Ural Owl	Slaguggla	Strix uralensis	EU	6
Tengmalms Owl	Pärluggla	Aegolius funereus	EU	0–2
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	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 naevi	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.