

**P-06-46**

## **Forsmark site investigation**

### **Bird monitoring in Forsmark 2005**

Martin Green

Department of Animal Ecology, Lund University

January 2006

**Svensk Kärnbränslehantering AB**

Swedish Nuclear Fuel  
and Waste Management Co  
Box 5864

SE-102 40 Stockholm Sweden

Tel 08-459 84 00  
+46 8 459 84 00

Fax 08-661 57 19  
+46 8 661 57 19



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*Keywords:* AP PF 400-05-017, Site investigations, Forsmark, Monitoring, Birds, 2005.

This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the author and do not necessarily coincide with those of the client.

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# Abstract

This report is the fourth annual report summarizing changes in the breeding bird fauna in Forsmark during the ongoing SKB site investigations. The general aim is to monitor possible effects from the site investigations on bird numbers and breeding results. This report covers a selected number of listed species, included in the Swedish Red List and/or the EU Birds Directive Annex 1. The selected listed species were monitored by check-ups on known territories and/or by visits to species specific suitable habitats both within the candidate area and the regional model area at large.

In general terms, the results from the monitoring in 2005 very much followed results obtained in earlier years. The majority of the monitored listed species had a good year in 2005, with high recorded numbers of territories and a good breeding output (for species where this was followed up). The white-tailed eagles had their best breeding season since the start of the site investigations and the number of produced young was back at the level recorded locally in the years before the site investigations (and at the level recorded in surrounding reference areas during the last years). Honey buzzards and ospreys had another good year, comparable to 2004. The ural owls had their best breeding season during the study period, and all pairs produced fledged young. Black grouse, wryneck and red-backed shrike were all recorded in peak numbers for the years monitored. Tendencies for possible negative effects of the site investigations recorded in earlier years were corroborated in 2005 as well. Black-throated divers continue to have very poor breeding results in the area. Capercaillies seem to avoid areas where the most intensive parts of the site investigations are going on and lesser-spotted woodpecker numbers remained low in the candidate area (although regional numbers increased).

In summary the present analysis shows the following results regarding possible effects from the site investigations on the breeding bird fauna (selected listed species).

- There are no general, large-scale effects from the site investigations on species listed in the Swedish Red List and/or the EU Birds Directive Annex 1, neither in the candidate area nor in the regional model area.
- Most listed species seem to be very tolerant and do not show any signs at all of being disturbed.
- A few listed species may be negatively affected by the site investigations.
- Mitigation measures taken to avoid disturbance of the white-tailed eagles seem to work, and it may also be that the eagles are adjusting to the increased human presence in the area during later years.

# Sammanfattning

Denna rapport sammanfattar populationsförändringar och i en del fall häckningsframgång hos ett urval listade (Svenska Rödlistan och/eller EU:s Fågeldirektiv) fågelarter i Forsmark under perioden 2002 till 2005. Syftet är att utvärdera den eventuella påverkan som SKB:s platsundersökningar kan ha på de häckande fåglarnas numerär och i vissa fall häckningsframgång. Rapporten behandlar ett urval av de arter som är upptagna i den Svenska Rödlistan och/eller i EU:s Fågelskyddsdirektiv Annex 1. Listade arter har följts upp i hela det *Regionala modellområdet* (inklusive *Kandidatområdet*) genom att besöka tidigare kända revir och/eller genom eftersök i lämpliga biotoper för aktuella arter.

Precis som 2004 så var 2005, för de listade arter som följts upp närmare, ett bra år för flertalet arter. Den övervägande majoriteten av dessa uppvisar inte några tecken på negativa förändringar i vare sig populationsstorlek eller häckningsframgång i Forsmark. Det fanns istället flera positiva resultat från det gångna året att glädjas åt. Havsörnarna hade sin bästa häckningssäsong sedan platsundersökningarna startade och uppvisade 2005 en häckningsframgång i nivå med vad som noterats lokalt i Forsmark före 2002 och vad som noterats i omkringliggande referensområden även under platsundersökningsperioden. Bivråk och fiskgjuse hade ännu ett bra år i nivå med de goda resultaten från 2004. Slagugglorna hade sitt bästa häckningsår hittills under undersökningsperioden, och samtliga par fick ut flygga ungar. Orre, göktyta och törnskata uppvisade nya toppnivåer när det gäller antalet revir. De tendenser till eventuella negativa effekter från aktiviteter i samband med platsundersökningarna som noterats tidigare bestod under 2005 med låg häckningsframgång hos storlom, begränsat nyttjande av området av tjäder och en tendens till att undvika kandidatområdet för mindre hackspett.

Sammantaget blir slutsatsen av analyserna av platsundersökningarnas eventuella påverkan på häckfågelfaunan som följer:

- Ingen generell, storskalig påverkan har skett på listade arter vare sig inom *Kandidatområdet* eller inom det *Regionala modellområdet*.
- De flesta listade arter förefaller vara mycket toleranta och visar inga tecken på att störas.
- Ett fåtal listade arter uppvisar tecken på att påverkas negativt, om än i relativt liten skala.
- De åtgärder som vidtagits för att undvika störningar av områdets havsörnar verkar fungera tillfredsställande och det kan också vara så att örnnarna kanske börjat vänja sig vid den ökade mänskliga närvaron i området.

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# 1 Introduction

This document reports the results from the bird monitoring in Forsmark for 2005. The bird surveys started in 2002 and for some species the data set hence covers a four-year period. For most of the species presented here however, good data is available from 2003 onwards, allowing comparisons during a three-year period. The aim of this report is to evaluate the effects of the ongoing 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 400-05-017. The project has been conducted by the Department of Animal Ecology, Lund University. The report covers the whole regional model area.

## 2 Objective and scope

The site investigations in Forsmark started in 2002. SKB has from the start of the investigations aimed at monitoring the effects from all the ongoing activities on the fauna in the area. This in order to ensure that the site investigations are carried out in such a way that disturbances to the fauna, especially sensitive and vulnerable species, can 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/ such as species listed in the Swedish Red List /Gärdenfors 2005/ and European Unions Birds directive 79/409/EEG: Annex 1, ([www.naturvardsverket.se](http://www.naturvardsverket.se)). It is inevitable that site investigations as those conducted by SKB will affect the bird fauna in some way. The investigations are not only likely to affect the specific sites where drilling is made or new roads are 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 is greatly increased with more traffic on the roads, more people out in the landscape sampling different things etc. In Forsmark this means a quite dramatic change from the pre-site investigation period, as the area had a rather low level of human disturbance then.

For certain 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.

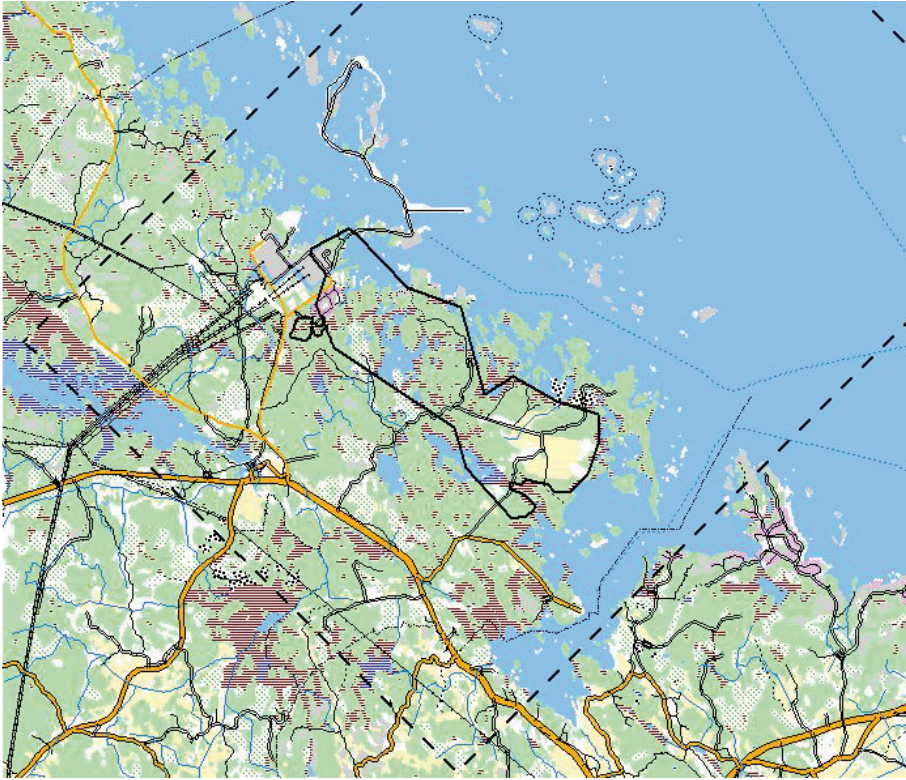
The results shown in this report still only concern short-time effects ( $\leq 1$  generation) from the site investigations. The long-time effects ( $> 1$  generation) will not be possible to analyse for some years yet. Hence, the results presented here should be taken as indications of possible effects more than as firm conclusions about long-time effects.

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<sup>2</sup>. This area is shown by a thick broken line in Figure 2-1.

**The candidate area**. A smaller area which is the core area of the site investigations. The size of the area in Forsmark is about 10 km<sup>2</sup>. The candidate area is shown with a thick unbroken line in Figure 2-1.

Direct impacts from activities within the site investigations are 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 function 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).
- Binoculars.
- Field maps showing each days work.
- Note books and protocols.
- 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 400-05-017.

### 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. Since the Swedish Red List was updated in 2005, with some earlier listed species being removed from the list and some new species being added /Gårdenfors 2005/, both species being red-listed before and after 2005 are shown together with the latest updates on estimated local population size in Forsmark.

Starting from 2004, a selection of these species is monitored on a yearly basis. 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 shows a negative population trend at the national level (but not necessarily in Forsmark); iiiii) Forsmark holds high densities of the species.

These species were monitored in 2005 by visiting known nesting places/territories used in 2002–2004, 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, that is 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 2004–5. The hazelhen (järpe) was also selected for monitoring, but could not be monitored within the project during 2005 due to lack of resources.**

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

## 4.2 Execution

The monitoring field work in 2005 was carried out during the period 2005-04-19–2005-08-05. The major part of the field work was done by Martin Green. Alf Sevastik assisted in some of the field work. The white-tailed eagle work was carried out within the ongoing national project concerning this species by Björn Helander. Organisation, data handling, analysis work and interpretations were carried out by Martin Green, Dep of Animal Ecology, Lund University.

## 4.3 Data handling

In the field all registered birds of interest were recorded in notebooks and on field maps with data on species, number of individuals and time together with additional data on bird behaviour and circumstances where such data were relevant. Observations were registered with exact position taken directly from the GPS in the field. After each day's field work the bird, position and time data were transferred to pre-made protocols. Data were then entered into an Excel-file (from protocols) whereafter the file was cross-checked against the field notes by the project leader. Positions have the same resolution as the GPS-system. 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 species level are compared and discussed but not 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 only three-four years, any such test is non-sensical. Statistical testing will be possible after a time series of five years, although statistical power will 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.

For most species the actual numbers of recorded territories/nests/pairs are reported and shown in figures. For the 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 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 is 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 2003–2004.
- 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).

## **4.5 Nonconformities**

The activity was performed according to the plans (no nonconformities).

## 5 Results

Data from this survey is stored in SKB's GIS database. The use of the data is restricted since it concerns sensitive species.

English names of the birds are used throughout the results section. Swedish names are given in the species headlines. A complete list of English, Latin and Swedish names for all listed bird species possibly breeding in Forsmark during 2002–2005 is given in Appendix 1.

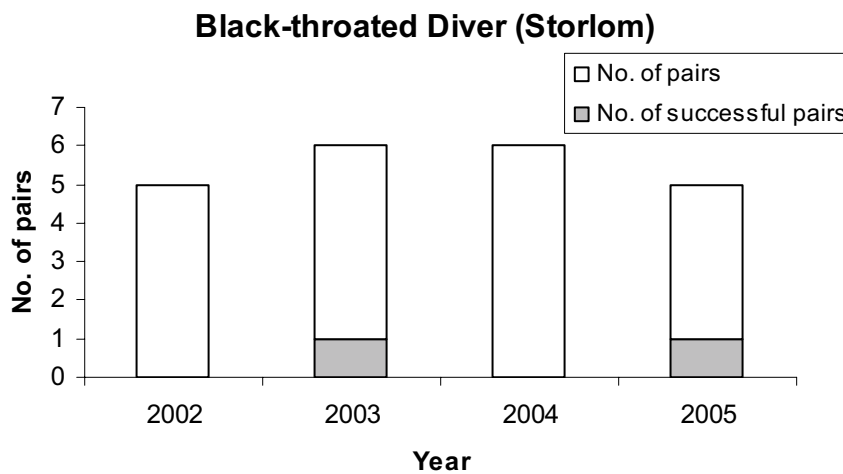
### 5.1 Listed species

The following section gives a summary of the population development during the last three (in a few cases four) years for some of the species listed as endangered, threatened or vulnerable according to the Swedish Red List /Gårdenfors 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 eagle in Forsmark is written by Björn Helander.

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

The number of stationary pairs remained on the same level as in earlier years but there were some distributional differences. Two pairs were found in lakes (three pairs in lakes in earlier years), two-four pairs in Kallrigafjärden (two pairs 2002–2004) and one pair at the coast north of the Forsmark power plant in 2005. In total at least five, and possibly seven pairs. One successful breeding was registered in Lake Eckarfjärden, only the second since the start of the site investigations. Two large young were observed there during the summer.



**Figure 5-1.** Number of stationary pairs of Black-throated Divers in Forsmark 2002–2005. Shading shows the number of successful pairs.

Average breeding success this year was 0.29–0.40 large young/pair. In a longer perspective, including all four years of the site investigations, average breeding success in Forsmark has been 0.12–0.14 large young/pair during 2002–2005. This is much lower than the calculated minimum for keeping population size constant in the long run (0.37–0.47 young/pair /Nilsson 1977/. For further discussions on this topic, see /Green 2005/.

Breeding success in Forsmark continues to be low, much lower than general results from Svealand /Eriksson et al. 2002/. It should however be mentioned that we do not really know to what extent the birds are trying to breed at all sites where a stationary presence is recorded within the area. Divers use certain lakes/areas for fishing and others for nesting, and these sites can be quite long distances (many km) apart. As the method used is to register stationary pairs and not nests (the latter method being much more time-consuming) we do not know if the birds recorded are nesting within the area or elsewhere. Another possible explanation for the low breeding output may be that fluctuations in water levels in Forsmark, both in lakes and in coastal areas, are too large to allow many successful breeding attempts. Divers are very sensitive to water level changes during the nesting stage /Eriksson et al. 2005/. An alternative explanation is that the level of human activities in both lakes (primarily due to site investigations) and Kallrigafjärden (recreational activities) are too high. More detailed studies during future monitoring could disentangle this question.

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

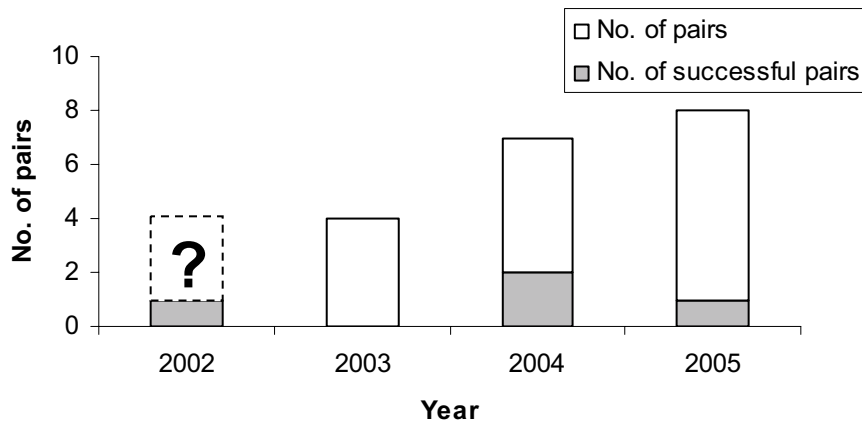
The honey buzzard had a another good year in Forsmark in 2005, at least when regarding the number of territorial pairs. Eight pairs were registered, which is one more than last year (the figure from 2004 has been adjusted from six to seven /cf Green 2005/, as what was then suspected to be two territories, but counted as one, was confirmed to be two different territories in 2005). At least three territories had parts going into the candidate area in 2005, although probable nest sites were situated outside of this.

Breeding results could not be monitored in detail in 2005, but at least one pair successfully produced three fledged young (minimum local breeding success 2005 = 0.38 young/pair). Adding the earlier years to the picture gives an overall average local breeding output of 0.35 young/pair and year during 2002–2005. This is lower than figures recorded in southern Uppland 1986–1991 (0.60 young/pair and year /Tjernberg and Ryttman 1994/), but still within the calculated interval for what is needed to keep population size constant (0.34–0.67 young/pair and year /Tjernberg and Ryttman 1994/). Long-time breeding output at a national level in Sweden is estimated to be 0.30 young/pair and year /Tjernberg and Ryttman 1994/. In this context it should be remembered that presented figures on breeding success in Forsmark are minimum ones, more young can have been produced but unrecorded. More detailed studies would allow us to get more correct values on this.

There are so far no signs of any impact from the site investigations on local population size or breeding output of honey buzzards in Forsmark. The figure above shows an increasing trend. Probably the number of pairs from the two early years was under-estimated slightly, but still, the honey buzzard seems to do fine in Forsmark!

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 /Artdatabanken 2005/. 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.

### Honey Buzzard (Bivråk)



**Figure 5-2.** Number of territorial pairs of Honey Buzzards within the regional model area in Forsmark 2002–2005. Shading shows number 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 (Global Red List, Sw Red List; EU Annex 1)

The white-tailed eagle had a good year in 2005 in the Forsmark area. The breeding success improved further compared to 2004 and reached the average background level for a normally reproducing population (based on retrospective studies on the Swedish Baltic coast). The reference area south of Forsmark continued to show a good breeding success. In contrast, the reference area north of Forsmark showed a drastic reduction in breeding success this year. The reason for this is not known. Occasional variations like this may occur in small populations for natural reasons, and there are no indications at this time from an influence of other factors such as human disturbance in that area. Continued monitoring of the white-tailed eagles will reveal if this was a temporary drop in that region (written by BH).

It is interesting to note the marked drop in breeding success in Forsmark in 2002 when the site investigations started followed by a gradual increase back to the normal level during 2003–2005. These results may indicate that mitigation efforts made to avoid disturbance of the eagles are successful and/or that the eagles are slowly getting used to a higher level of human presence in the area. Future monitoring can hopefully shed more light on this.

**Table 5-1. Per cent successfully breeding pairs of White-tailed Eagles in 2005, 2004, 2003, 2002 and 1998–2001 in Forsmark and two reference areas north and south of Forsmark respectively (N = number of checked breeding attempts).**

Area	1998–2001	2002	2003	2004	2005	N
Forsmark	85	25	33	50	75	28
Reference S	79	100	80	100	83	41
Reference N	72	83	67	86	29	44

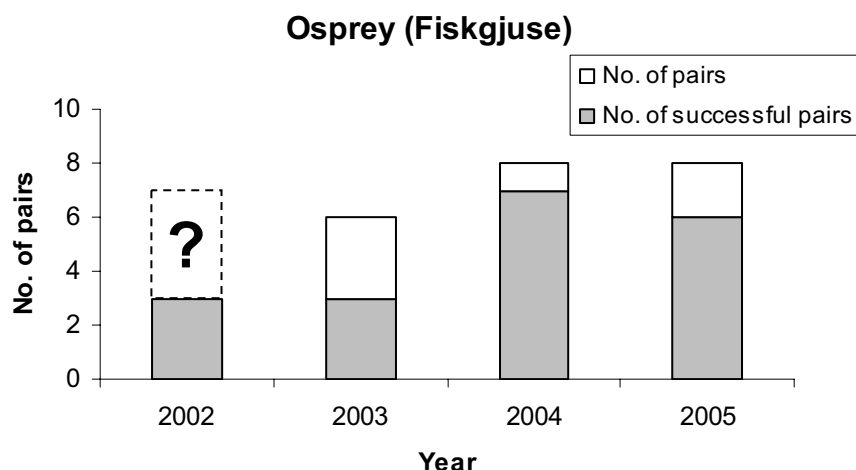
The white-tailed eagle is presently classified as ‘Near Threatened’ (missgynnad) in the Swedish Red List. The species is one of the recent success-stories of Swedish bird conservation. Eagle numbers decreased heavily during the last century due to both persecution and the use of organo-chloric substances (such as DDT and PCB). After these substances were banned, persecution pressure lowered and supplementary winter feeding was conducted, the eagles slowly started to recover. By the turn of the century the recovery picked up momentum and today the eagles are increasing in numbers with about 8% annually. National numbers are slowly getting closer to the estimated level they had before the large decline. Present national population is about 400 pairs, which means that Forsmark holds one percent of the national total. Globally, the white-tailed eagle is still very much threatened and the world population is ‘only’ about 7,000 pairs, whereof hence about 6% are found in Sweden /Artdatabanken 2005/ (written by MG).

### Osprey *Pandion haliaetus* Fiskgjuse (EU Annex 1)

The ospreys in Forsmark showed another good year in 2005. The number of pairs was unchanged and breeding success was only slightly lower than in 2004. Eight pairs started breeding and six of these produced large young, in total nine (2+2+2+1+1+1). These figures can be compared to eight attempts, seven successful ones and 11 produced large young in 2004.

In the years 2003–2005 a total of 25 large young have been fledged in Forsmark, giving an overall average local breeding output of 1.14 young/pair. This is well within the limits for calculated values of what is needed for keeping the population stable (0.80–1.25 young/pair and year /Ryttman 1994/.

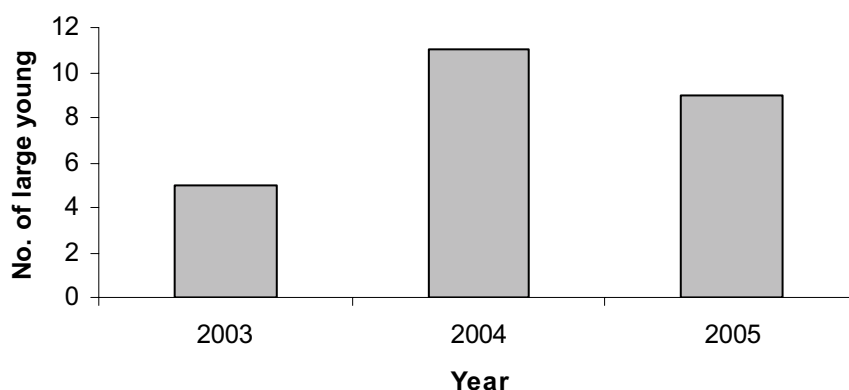
As in earlier years no pairs bred within the candidate area in 2005, but some pairs are found just outside of this. Breeding success of the pairs with nests relatively close to the candidate area was as good as, or actually even better (1.3 vs 1.0 large young/pair), for the pairs with nests further away from the more intensive parts of the site investigations.



**Figure 5-3.** Number of nesting attempts (territorial pairs) of Ospreys in Forsmark 2002–2005. 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.



### Osprey breeding output



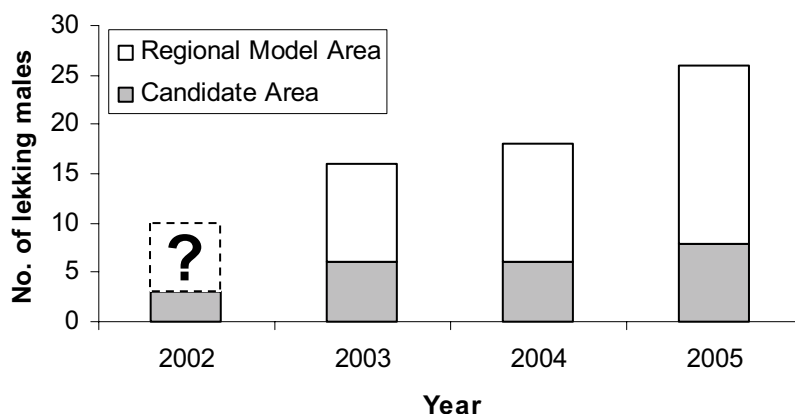
**Figure 5-4.** Number of large young of Ospreys produced in Forsmark 2003–2005. Number of large young per breeding attempt was 0.83 in 2003, 1.38 in 2004 and 1.12 in 2005.

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

The tendencies for a positive population trend /cf Green 2005/ was further emphasised in 2005. Number of lekking males recorded during spring increased from 18 in 2004 to 26 in 2005. Numbers increased both in the candidate area (a 33% increase) and in the regional model area outside of the candidate area (a 50% increase). The pattern seems to be general on a larger regional scale as well (own observations, Peter Hunger pers comm). Numbers of black grouse are known to follow cyclical patterns with periods of relatively low numbers alternating with periods of higher numbers. Apparently we are now in one of these “higher number periods” again, after a “low period” in the late nineties and early 2000s.

Breeding success has not been monitored in 2005. There are no signs of any impact from the ongoing site investigations. On the contrary lekking males are found in close proximity to ongoing human activities within the candidate area.

### Black Grouse (Orre)



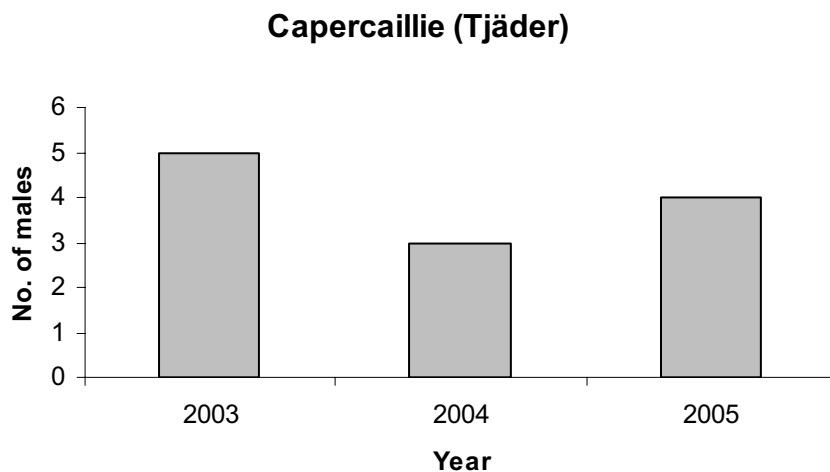
**Figure 5-5.** The recorded number of lekking Black grouse males in Forsmark 2002–2005. Shaded parts show the number within the candidate area. Exact number of lekking males in 2002 is not known. A well based estimate is shown.

### **Capercaillie *Tetrao urogallus* Tjäder (EU Annex 1)**

The lekking ground in the central area, outside but relatively close to the candidate area, was the only monitored site this year. Numbers of males here have been fluctuating between three and five the last years, and in 2005 four males were recorded. No capercaillies were registered within the candidate area in 2005.

Monitoring in other home ranges of capercaillies is desirable to evaluate the situation within the whole regional model area. The first years of bird surveys in Forsmark during the site investigation period indicated that this is one of the few species where there might be a negative effect of the site investigations. Whether this really is the case or not still remains to be shown. The data from earlier years did however indicate a change in utilisation of the area with birds avoiding parts with increased human presence that they used before the site investigations started. Probably, late winter surveys would be the best way of studying true numbers of birds within the area. The distribution of birds /see Green 2005/ would also need further attention. At present we can only conclude that numbers at the central lek has remained fairly stable over the last three years.

Generally it seems as capercaillie numbers have been increasing at a larger regional scale (outside the regional model area), in a similar way as black grouse numbers (own observations, Peter Hunger pers comm).



**Figure 5-6.** The recorded number of capercaillie males in 'the central area' at Forsmark 2003–2005 (see text).

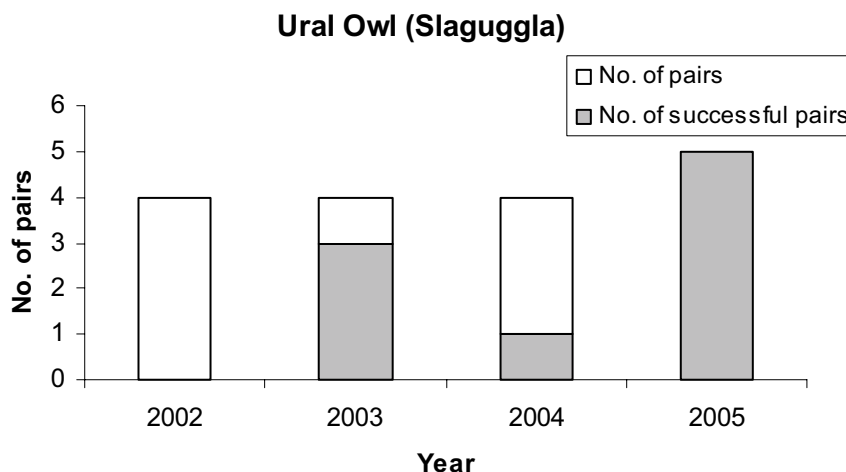
### Hazelhen *Bonasia bonasia* Järpe (EU Annex 1)

No hazelhen monitoring was conducted in 2005, as this would have been too time- and money-consuming. Still, some kind of monitoring is desirable as this species might be sensitive to disturbances from the site investigations /Green 2004, 2005/. Any future monitoring of hazelhens should preferably be made in winter (the birds stay year around in their territories) and during snow conditions. During such circumstances it is easy to detect the tracks of hazelhens and a fair estimate of the overall occurrence can be obtained by relatively easy means. Hazelhens are tightly connected to specific habitats and by visiting these and looking for tracks, monitoring is possible. More time-consuming, but also possible, is to use another method later in spring. This method uses the fact that hazelhens males respond to the calls of other males. By walking slowly through suspected territories and imitating the calls with a hunting whistle, at points situated 100–150 m apart, a very accurate estimate of presence or absence can be obtained.

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

After an extremely stable situation with same four territories being occupied during 2002–2004 a new, fifth territory was established in 2005. Birds were registered occasionally in this territory also in 2004, but the presence of a territory (stationary presence) could not be confirmed until 2005. As earlier, only one of the territories is situated completely within the regional model area. The others are situated along the borders with parts both inside and outside the regional model area. No territory is found within the candidate area, although hunting birds are occasionally observed there.

Breeding success was the best recorded during the four study years. All five pairs were successful and nine large young were fledged (3+2+2+1+1), giving an average of 1.80 fledged young/occupied territory. Overall average breeding output during 2002–2005 was 0.82 fledged young/occupied territory and year. There does not seem to be any impact from the site investigations on the ural owls in the area. However, records from the pre-site investigation period (before 2002) indicate established territories also within the candidate area, something that has not been the case during the last four years.



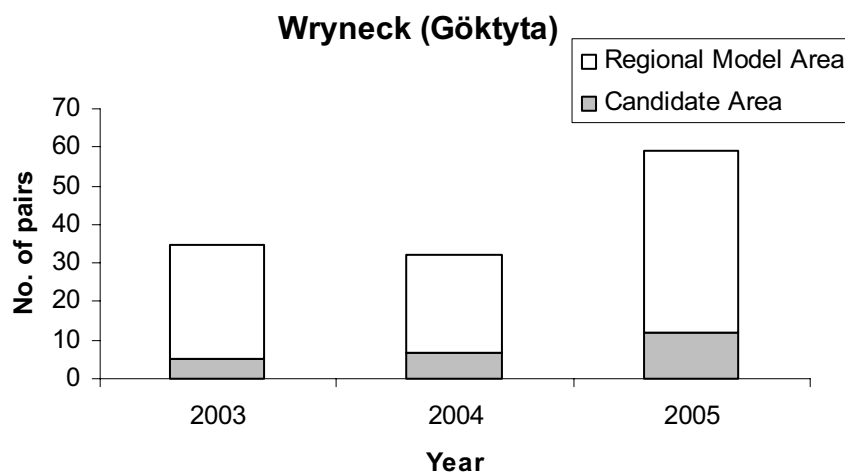
**Figure 5-7.** Number of territorial pairs of ural owl within the regional model area in Forsmark 2002–2005. Shown is also the number of successful pairs (shaded).

### Wryneck *Jynx torquilla* Göktyta (Sw Red List)

For wryneck, 2005 was an exceptional year with very high numbers recorded. Overall there was almost a doubling of the number of recorded pairs compared to earlier years. Earlier estimates of total population size in the regional model area was 40–50 pairs /Green 2005/, but this year no less than 59 occupied territories were registered! Numbers increased both within the candidate area (from seven to twelve, a 71% increase) and in the regional model area outside of the candidate area (from 25 to 47, an 88% increase). Obviously, there are no tendencies of any impact from the site investigations on local population size.

Interestingly, exactly the same pattern was registered in the Simpevarp study area in 2005, and at a large scale it seems as if wryneck numbers in 2005 were much higher than in the years just before. The reason behind this increase remains unknown, but it may have been a very good breeding season in 2004, combined with beneficial conditions both during migration and wintering (the wrynecks spend the winter in tropical Africa) resulting in the unexpected increase between 2004 and 2005.

The wryneck is classified as ‘Near-Threatened’ (missgynnad) in the Swedish Red List /Gärdenfors 2005/. The number of wrynecks in Sweden decreased with over 50% between 1975 and 2004, but the numbers have remained fairly stable during the last decade /Lindström and Svensson 2005/. The reason behind the large decline is probably loss of suitable habitats as a large proportion of small-scale farms in largely forested areas were abandoned in the mid 1900s. National population size is estimated to be 5,500–15,000 pairs /Artdatabanken 2005/. Should the lower number in the interval be closest to reality, Forsmark holds about 1% of the national population.



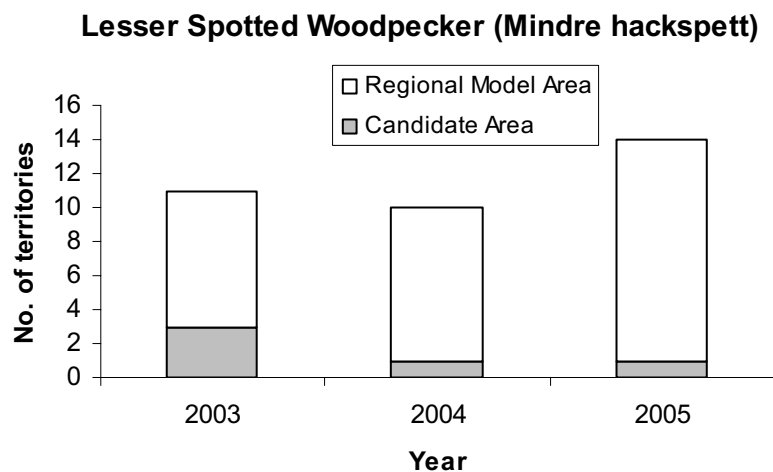
**Figure 5-8.** Number of occupied wryneck territories in well monitored parts of Forsmark in 2003–2005. Shading shows the number of occupied territories within the candidate area.

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

Numbers of occupied lesser spotted woodpecker-territories increased slightly from 2004 to 2005. In areas checked equally well in both years, ten territories were registered in 2004 and 14 in 2005. In total, 15 occupied territories were recorded within the regional model area in 2005, which is the highest total during the site investigation period 2002–2005. As in earlier years there were a few more occupied territories just outside the regional model area as well.

Numbers within the candidate area remained at the low level recorded in the year before. The same pattern is shown in the Simpevarp area. General numbers are increasing but numbers in the candidate area are decreasing or staying at a lower level than during the first years of the site investigations. The exact reason for these patterns is unclear but it can not be ruled out that this is an effect of the site investigations.

The lesser-spotted woodpecker is classified as ‘Near-Threatened’ (missgynnad) in the Swedish Red List. National numbers decreased with about 50% between 1975 and 1990, but are thought to have remained fairly stable during the last decade. The lesser-spotted woodpecker has been negatively affected by the loss of dead wood due to modern forestry and also by the conversion of mixed and deciduous forests to monoculture conifer forests. National population size is estimated to about 3,000 pairs /Artdatabanken 2005/.



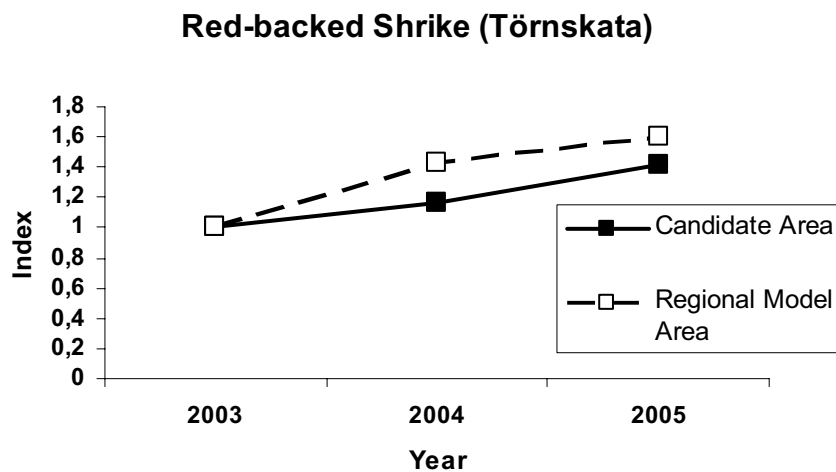
**Figure 5-9.** Number of occupied territories of Lesser spotted woodpeckers in areas monitored in all three years 2003–2005 in Forsmark. Shading shows numbers of occupied territories in the candidate area.

### Red-backed shrike *Lanius collurio* Törnškata (Sw Red List; EU Annex 1)

2005 was a very good year for this species as well (cf wryneck above). In total 60 occupied territories were recorded, the same number as the previous estimate of the whole population in the area. The total estimate is hence adjusted to at least 80 pairs, as some areas probably holding shrikes were not covered in the 2005 survey. Numbers increased at an almost equal rate in both the candidate area and in the regional model area. There are no indications of any negative impact from the site investigations on the local shrike population.

The population development of red-backed shrikes in Forsmark is shown below in Figure 5-10. As areas covered during the site investigation period have differed between the years, at least outside the candidate area, the development is shown as an index instead of absolute numbers. Here I have used a chain index where the percent change between areas checked equally well in years following each other are compared. Index for 2003 (the first year with decent coverage of the species) is set to one. The figure should be read as there has been a 41% increase in red-backed shrike numbers within the candidate area between 2003 and 2005, and an 60% increase in the regional model area outside the candidate area, i.e. a very similar population development over the whole Forsmark area.

As for the wryneck, the reason behind the increase is essentially unknown. In the case of the shrikes, there do not seem to be any large-scale pattern similar to the one recorded in Forsmark. Numbers in Simpevarp decreased slightly between 2004 and 2005 and at the national level numbers were stable between these years (Åke Lindström, pers comm). The factors mentioned as possible reasons behind the high numbers of wrynecks may never the less be the same for the shrikes in Forsmark, but the lack of a general large-scale pattern indicates local factors as well.



**Figure 5-10.** Population development of red-backed shrikes in Forsmark 2003–2005 shown as a chain index. Index for year 2003 is set to 1. See text for further explanations.

A large proportion of the shrikes in Forsmark are found in clear-cuts (42% of all territories 2002–2005) and under electrical power wires (35% of all territories). Both these habitats may have been exceptionally favourable for shrikes in 2005. The area of clear-cuts increased after cutting actions in the previous winter (in the regional model area) making larger areas available to shrikes. Areas under power wires may have been in the ‘best state’ for shrikes in 2005. These areas are managed every eight years in order to keep vegetation low, giving a succession favouring species like shrikes a few years after management actions. The latest management actions under power wires in Forsmark were made in 2004, perhaps making the habitat ideal in 2005. Within the candidate area it is likely that the increased grazing of cattle around Storskäret, with larger areas being suitable for shrikes during later years is the reason behind the increasing numbers.

The red-backed shrike is classified as ‘Near-Threatened’ (Missgynnad) in the Swedish Red List /Gärdenfors 2005/. National numbers have decreased with over 50% during the last 30 years /Lindström and Svensson 2005/ and numbers in a well-studied, predominantly farmland area outside Uppsala decreased from 120 to 60 pairs during 1998–2003 /Artdatabanken 2005/. The reason for the decrease at a general level is thought to be due to habitat loss, as many semi-natural grazing pastures have disappeared during later decades. National population size of red-backed shrikes is estimated to be about 23,000 pairs /Artdatabanken 2005/.

Table 5-2 presents a summary of general population changes of the monitored species in Forsmark between 2004 and 2005.

**Table 5-2. General population changes of selected listed species in Forsmark between 2004 and 2005. 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 2005 in general terms is shown for divers, raptors and owls.**

Species	Regional model area	Candidate area	Whole area	Breeding output 2005
Black-throated Diver	0	0	0	Poor
Honey Buzzard	+	0	+	Decent
White-tailed Eagle			0	Good
Osprey	0		0	Good
Black grouse	+	+	+	
Capercaillie	?	0/+	?	
Ural owl	+	0	+	Good
Wryneck	++	++	++	
Lesser Spotted Woodpecker	+	0	+	
Red-backed shrike	++	++	++	

## 6 Discussion

This publication is the third annual report investigating possible effects from the ongoing site investigations on the breeding bird fauna in Forsmark. Earlier results can be found in /Green 2003, 2004, 2005/. Several of the tendencies noted in earlier years were corroborated even more during last year's monitoring. Generally, species showing a high tolerance to the increased human presence in the area in earlier years continue to do so, and species showing tendencies for being negatively affected by the site investigations in 2005 are the same that showed such tendencies before.

As has been repeated several times by now, black-throated divers continue to show a very low breeding output in the area. This has led us to suspect that there may be other factors than disturbance from the site investigations in play here as well. It may be possible that most of the divers present in Forsmark are actually not breeding there, but instead use this for foraging while they have their nests outside the study area. An increased effort to find nests would be one solution for disentangling this question. If the birds really are trying to breed, but keep on to be very unsuccessful, activities within the site investigations may be one (but certainly not the only) reason behind the large proportion of breeding failures in lakes in the area. If so, breeding success may be increased by making mitigation efforts during critical periods.

Similarly, it would be of interest to increase the monitoring effort for capercaillies. This species shows tendencies for avoiding parts of the candidate area where the most intensive site investigation activities have taken place. As the human presence now is decreasing again in these parts, it would be interesting to study if the birds increase their home ranges accordingly, back to the 'pre-site investigation' distribution. The same reasoning applies to the hazelhen, a species that could not be monitored in 2005, due to lack of resources.

Generally, most of the results from the continued bird monitoring are positive and the majority of listed species do not show any tendencies for being affected at all by the site investigations. Several of these species have on the contrary showed a positive population development in the area during the last three-four years.

The breeding success of white-tailed eagles is perhaps the single most positive result from 2005. After a really low breeding output in Forsmark 2002 and 2003, compared to the years before in Forsmark and to reference areas surrounding Forsmark, success was better in 2004 and back at the 'pre-site investigation' level in 2005. This pattern may have two possible explanations, and probably both act together. First of all, mitigation measures have been implemented during later years in order to avoid disturbance of the eagles during critical periods of the breeding cycle. It seems as if these measures have been successful. At the same time, one can not rule out that the eagles in some way have adjusted to the higher general level of human activities in the area and hence show better breeding results now than a few years back when the site investigations started. It is in any case important that the mitigation efforts are maintained also in coming years.

Finding out the effects of the site investigations on the breeding bird fauna in Forsmark (in any direction!), requires continued monitoring for a longer time period than reported on here. Every year of data collection add further insight and statistical power to the analyses and interpretations that are possible to make. Making comparisons between single years will always be the weakest tool to evaluate effects, and by using such an approach there is



always the risk of not being able to disentangle possible causes and consequences at all. It is therefore suggested that monitoring of the selected listed species should continue, and for some species rather increase in intensity, for as long as the site investigations continue.

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## 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 2002–2005. Since the Swedish Red List was updated in 2005, a few species being red-listed before, but not after, 2005 are included as well. These species are shown within parenthesis. Otherwise the listing follows the updated version of the Red List /Gärdenfors 2005/. Species added to the Red list in 2005, not included before 2005 are marked with an asterisk (\*).**

English name	Swedish name	Latin name	Listing	Estimated population size (pairs/territories) in Forsmark (regional model area)
Whooper Swan	Sångsvan	<i>Cygnus cygnus</i>	EU	5
(Gadwall)	(Snatterand)	( <i>Anas strepera</i> )	(SRL)	4
Shoveler	Skedand	<i>Anas clypeata</i>	SRL	6
Pochard	Brunand	<i>Aythya ferina</i>	SRL	1
Velvet Scoter	Svärta	<i>Melanitta fusca</i>	SRL	7
Hazelhen	Järpe	<i>Bonasia bonasia</i>	EU	30
Black Grouse	Orre	<i>Tetrao tetrix</i>	EU	26
Capercaillie	Tjäder	<i>Tetrao urogallus</i>	EU	5
Quail	Vaktel	<i>Coturnix coturnix</i>	SRL	1
Black-throated Diver	Storlom	<i>Gavia arctica</i>	EU	5–7
Slavonian Grebe	Svarthakedopping	<i>Podiceps auritus</i>	SRL, EU	0–1
Bittern	Rördrom	<i>Botaurus stellaris</i>	SRL, EU	3–4
Honey Buzzard	Bivräk	<i>Pernis apivorus</i>	SRL, EU	8
White-tailed Eagle	Havsörn	<i>Haliaeetus albicilla</i>	SRL, EU	4
Marsh Harrier	Brun kärrhök	<i>Circus aeruginosus</i>	EU	5
Osprey	Fiskgjuse	<i>Pandion haliaetus</i>	EU	8
Spotted Crane	Småfläckig sumphöna	<i>Porzana porzana</i>	SRL, EU	1–3
Corncrake	Kornknarr	<i>Crex crex</i>	SRL, EU	0–1
Crane	Trana	<i>Grus grus</i>	EU	20
Curlew*	Storspov*	<i>Numenius arquata*</i>	SRL	3
Turnstone	Roskarl	<i>Arenaria interpres</i>	SRL	10
Lesser Black-backed Gull	Silltrut	<i>Larus fuscus</i>	SRL	97
Common Tern	Fisktärna	<i>Sterna hirundo</i>	EU	95
Arctic Tern	Silvertärna	<i>Sterna paradisaea</i>	EU	234
(Black Guillemot)	(Tobisgrissla)	( <i>Cepphus grylle</i> )	(SRL)	50
Stock dove	Skogsduva	<i>Columba oenas</i>	SRL	10
Pygmy Owl	Sparvuggla	<i>Glaucidium passerinum</i>	EU	15
Ural Owl	Slaguggla	<i>Strix uralensis</i>	EU	5
Tengmalms Owl	Pärluggla	<i>Aegolius funereus</i>	EU	0–1
Wryneck	Göktyta	<i>Jynx torquilla</i>	SRL	60
Grey-headed Woodpecker	Gråspett	<i>Picus canus</i>	EU	0–2
Black woodpecker	Spillkråka	<i>Dryocopus martius</i>	EU	13
Lesser Spotted Woodpecker	Mindre hackspett	<i>Dendrocopus minor</i>	SRL	15
Three-toed Woodpecker	Tretåig hackspett	<i>Picoides tridactylus</i>	SRL, EU	1–2
Wood Lark	Trädlärka	<i>Lullula arborea</i>	EU	1–2
Skylark*	Sånglärka*	<i>Alauda arvensis*</i>	SRL	9
Wheatear*	Stenskvätta*	<i>Oenanthe oenanthe*</i>	SRL	6
Grashopper Warbler*	Gräshoppsångare*	<i>Locustella naevia*</i>	SRL	1–2
River Warbler	Flodsångare	<i>Locustella fluviatilis</i>	SRL	0–1
Greenish Warbler	Lundsångare	<i>Phylloscopus trochiloides</i>	SRL	0–1
Red-breasted Flycatcher	Mindre flugsnappare	<i>Ficedula parva</i>	SRL, EU	5
Marsh Tit*	Entita*	<i>Parus palustris*</i>	SRL	20
Red-backed Shrike	Törnskata	<i>Lanius collurio</i>	SRL, EU	80
Nutcracker	Nötkråka	<i>Nucifraga caryocatactes</i>	SRL	5
Linnet*	Hämpling*	<i>Carduelis cannabina*</i>	SRL	4
Scarlet Rosefinch*	Rosenfink*	<i>Carpodacus erythrinus*</i>	SRL	50
Ortolan Bunting	Ortolansparv	<i>Emberiza hortulana</i>	SRL, EU	1