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Forsmark site investigation

Bird monitoring in Forsmark 2002–2004

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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 a summary of the changes found in the breeding bird fauna in Forsmark between 2002 and 2004. The aim is to evaluate any possible effects from the ongoing SKB site investigations on breeding bird numbers in the area, in a few cases also including effects on breeding output. The report covers the complete breeding bird fauna, although special attention is given to species included in the Swedish Red List and/or the EU Birds Directive Annex 1. The breeding birds in general were monitored yearly by line transects and point counts within the Candidate Area. Listed species were monitored within the whole Regional Model Area by checking known territories and/or by visits to species specific suitable habitats. Results given in this report do only cover short time effects. For a proper evaluation of any long time effects or impacts, a much longer monitoring period is needed.

Bird numbers generally decreased within the Candidate Area between 2003 and 2004. No such decrease was found at a much larger regional reference level (the whole eastern Svealand). The reason for decline in numbers could be disturbance from the site investigations, but other factors are also likely to be involved. Only continued monitoring can pinpoint the possible causes behind the found decline. 2004 was a good year for most listed species in Forsmark. The majority of all listed species do not show any indications of being affected negatively by the site investigations. There are however differences between species, and previously registered indications were supported by the results found in 2004. The Black-throated Divers showed a very low breeding output (as in earlier years), although the numbers of breeding pairs remain stable. Breeding output of White-tailed Eagles was still lower than in surrounding reference areas (as in 2002–2003), although breeding output for the eagles is tending to improve over the three site investigation years. The Capercaillies tend to avoid areas where the most intensive parts of the site investigations are conducted, and where most people are moving around, with a clear change in area use during 2002–2004.

In summary the present analysis show the following results regarding possible effects from the site investigations on the breeding bird fauna.

- Bird numbers decreased generally from 2003 to 2004, but the causes behind the decline remains to be shown.
- There were no general, large scale effects from the site investigations on species listed in the Swedish Red List and/or in the EU Birds Directive Annex 1, neither in the Candidate Area nor in the Regional Model Area.
- Some listed species seem to be very tolerant and do not show any signs at all of being disturbed.
- A few listed species seem to be affected negatively by the site investigations.

The mitigation efforts made for the last mentioned group of birds (i.e. White-tailed Eagles) seem to have been at least partly successful so far. Breeding success of eagles increased in 2004 compared to 2002–2003. Hence it is important that these efforts continue in future years as well. Similar efforts in order to improve the situation for Black-throated Divers are desirable. The present results emphasise the importance of continued monitoring if causes behind changes in the bird fauna in relation to the site investigations should be found.

Sammanfattning

Denna rapport sammanfattar inventeringarna av fågelfaunan under perioden 2002 till 2004 i Forsmark. 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 den totala fågelfaunan, dvs inkluderande även talrika arter, men särskild uppmärksamhet ägnas åt ett urval av de arter som är upptagna i den Svenska Rödlistan och/eller i EU:s Fågelskyddsdirektiv Annex 1. Under de tre åren har den allmänna fågelfaunan följts genom linje- och punkttaxeringar inom *Kandidatområdet*. Till skillnad från åren 2002 och 2003 har inga revirkarteringar genomförts för detaljerade studier i borrhålets omedelbara närhet under 2004. Listade arter har följts upp i hela det *Regionala modellområdet* genom att besöka tidigare kända revir och/eller genom eftersök i lämpliga biotoper för aktuella arter. De resultat som presenteras i denna rapport ska ses som indikationer på eventuell korttidspåverkan på fågelfaunan. Vad som händer i ett längre tidsperspektiv är ännu för tidigt att uttala sig om. En utvärdering av eventuella långtidseffekter kräver en betydligt längre undersökningsperiod.

För den allmänna fågelfaunan noterades en nedgång i det lokala beståndet inom *Kandidatområdet* från 2003 till 2004. Detta samtidigt som någon motsvarande minskning inte kunde hittas i regionen (östra Svealand) i stort. Detta skulle kunna antyda en eventuell lokal påverkan från platsundersökningarna i negativ riktning, men skulle samtidigt kunna förklaras av en mängd andra faktorer. Det funna mönstret är hur som helst av intresse och värt en fortsatt uppföljning för att klargöra vilka faktorer som kan ligga bakom den noterade minskningen.

För de listade arter som följts upp närmare var 2004 ett bra år för flertalet. Den övervägande majoriteten av dessa arter uppvisar inte några tecken på förändringar i vare sig populationsstorlek eller häckningsframgång i Forsmark. Precis som tidigare noterats finns det dock skillnader mellan arter, och det mönster som påpekats i tidigare rapporter upprepades i princip under 2004. Storlommarna uppvisade en fortsatt låg häckningsframgång även om antalet par håller sig på en konstant nivå. Samma sak gällde för havsörnarna där häckningsframgången i Forsmark under de tre åren som platsundersökningarna pågått varit lägre än i omkringliggande områden (och jämfört med resultaten i Forsmark innan platsundersökningarna påbörjades). På den positiva sidan för havsörnarnas del ska sägas att häckningsframgången i Forsmark tenderar att öka från bottenåret 2002 (platsundersökningarnas första år) och framåt. Tjäderna förefaller undvika de områden där flest människor rör sig och en tydlig förändring av den geografiska fördelningen inom området kan ses under perioden 2002–2004.

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

- Fågelfaunan i stort uppvisade en minskning från 2003 till 2004, men inga alltför stora slutsatser ska än så länge dras från dessa resultat.
- Ingen generell, storskalig påverkan har skett på listade arter vare sig inom *Kandidatområdet* eller inom det *Regionala modellområdet*.
- Vissa listade arter förefaller vara mycket toleranta och visar inga tecken på att störas.
- Andra listade arter uppvisar tecken på att påverkas negativt.

Det förefaller som om de åtgärder som vidtagits för att motverka åtminstone en del av de negativa effekterna för sistnämnda grupp (t ex när det gäller havsörn) har ett visst resultat (bättre häckningsframgång 2004 jämfört med 2003). Därför är det av vikt att dessa åtgärder fortsätter på samma vis även framöver. Möjligen skulle man kunna diskutera vissa enkla åtgärder för att om möjligt förbättra förutsättningarna även för exempelvis storlommarna.

Annars belyser årets undersökningar vikten av fortsatta uppföljningar för att kunna säkerställa eventuell påverkan på fågelfaunan.

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1 Introduction

This document reports the data gathered within the monitoring part of the bird surveys, one of the activities within the site investigations in Forsmark, during 2004. The bird surveys started in 2002 and continued in 2003, allowing comparisons between the earlier years and 2004. The aim of this report is to evaluate the effects of the ongoing site investigations on the breeding bird fauna in the area. The surveys were made according to activity plan AP PF 400-03-104 (SKB internal document). The project has been conducted by the Department of Animal Ecology, Lund University. This document is a summary of changes in the overall breeding bird fauna in the candidate area between 2002 and 2004. For a number of selected listed species (according to the Swedish Red List and/or the EU Birds Directive) 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 such as species listed in the Swedish Red List /Gårdenfors, 2000/ and European Unions Birds directive 79/409/EEG: Annex 1, (www.environ.se) /cf Green, 2003, 2004/. 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.

The monitoring part of the bird surveys aims at tracking changes in overall bird numbers (densities) in the areas in close contact with the most disturbing parts of the site investigations (drilling sites) as well as in the candidate area at large. To be able to disentangle changes caused by other factors than the site investigations, the results from Forsmark are compared with results gathered on a national and regional basis (collected through the national monitoring programme of the Swedish Environmental Protection Agency, <http://www.biol.lu.se/zooekologi/birdmonitoring>), or through special projects for some listed species. In this report, data regarding the overall breeding bird fauna in the candidate area are compared with data from the above mentioned programme for the whole eastern Svealand (mainly the county of Uppland). In some cases general national trends up until 2003 are mentioned as well /Lindström and Svensson, 2004/ and compared with the Forsmark data. For certain listed species (Swedish Red List and the EU:s Birds Directive) the monitoring aims at following the population development in the entire 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 only concern short-time effects from the site investigations. The long-time effects will not be possible to analyse for several years yet. Hence, the results presented here should be taken as indications of possible effects more than as firm conclusions about long-time effects.

The monitoring programme is carried out at different levels, both geographically and regarding which birds that are monitored. More details about these levels are presented in /Green, 2003/ and in the activity plan (AP PF 400-03-104).

Regional model area. (area of possible large-scale effects). In Forsmark the land area of the regional model area is about 60 km². This area is shown by a thick broken line in Figure 2-1. Within this area a number of selected species listed in the Swedish Red List and/or the EU:s Birds Directive are monitored (from 2004 onwards, but during 2002 and 2003 all listed species as well as non-listed raptors and owls were monitored).

The aim of the surveys is to find out the yearly number of breeding pairs within the area, and for a few species also to establish the breeding success of these.

Candidate area. This level involves a smaller area covering all the potential drilling sites, and is the core area of the site investigations. The size of the area in Forsmark is about 10 km². The candidate area is shown with a thick unbroken line in Figure 2-1. The candidate area is surveyed more in detail compared to the regional model area. The aim here is to monitor changes in breeding bird numbers not only for listed species but for the complete bird fauna. The candidate area is surveyed by a combination of line transects and point counts. The area is surveyed twice each season (early and late in the breeding season).

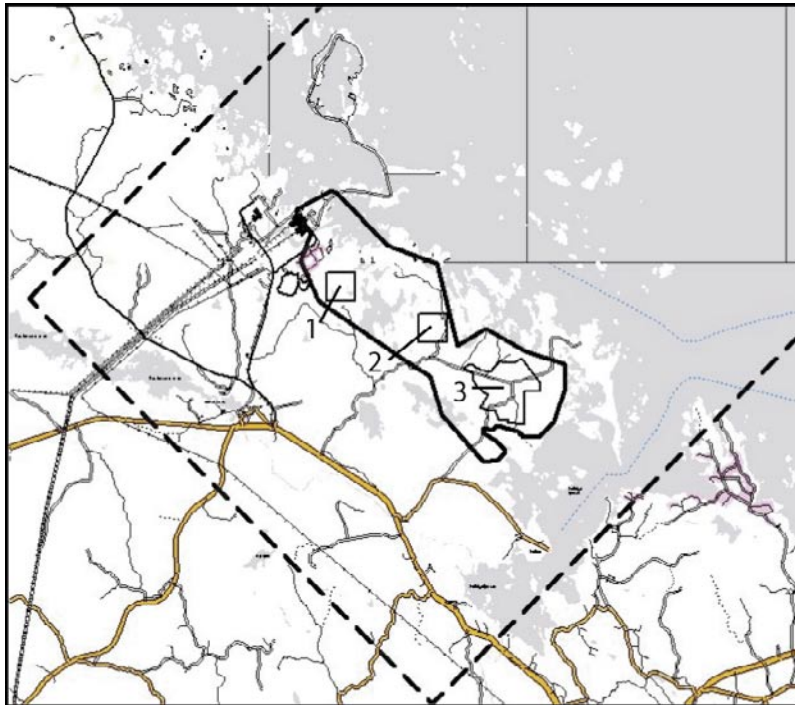


Figure 2-1. Map of the survey area in Forsmark. The regional model area is shown with a thick broken line, the candidate with a thick unbroken line. The map also illustrates the territory mapping areas used in 2002–2003, but not in 2004 (1, 2, 3).

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 400-03-104. More information about the methods can be found at: www.biol.lu.se/zooekologi/birdmonitoring/metoder.htm, as well as in /Svensson, 1975/ and /SNV, 1978/.

An overview of the methods used for monitoring the breeding bird fauna is presented below. To cover the bird fauna in general, incorporating also the more common bird species, a combination of line transects and point counts is used. The method is more or less directly taken from the manual for standardised breeding bird counts used by the Swedish Environmental Protection Board in their National Monitoring Program since 1996. By using the identical methods as in these surveys we get the possibility of making direct comparisons with the data gathered at national and regional level (at a larger scale than the surveys presented here). Special surveys of listed species are also made.

4.1 Line transects and point counts

The aim of the line transects and point counts is to get a good overview of the breeding bird fauna in the area in a way that can yield comparisons between years (population development) and that can be compared with other areas. The surveys are based on the Swedish Grid (RT-90). The line transects are made along the north-south axes of this grid, with grid lines being 1 km apart. To get a more detailed coverage of the candidate area, an additional transect in between the RT-90 lines is added so that the area is gone through along north-south directed lines being 500 m apart. Point counts are made at every full km, the corners of the km-squares of the Swedish Grid. Point counts along the extra lines (in between the RT-90 lines) are moved to the midpoint of the km square (according to the grid) to get a better geographic coverage of the area (Figure 4-1).

Each line transect, and the point counts along these, within the candidate area are made twice each season, one early round and one late round respectively. Along the lines all birds seen and heard are counted while the observer is walking at slow speed, stopping, listening and looking around when needed. The observer registers bird species, number of individuals and the local time. To allow rapid data gathering in the field, all common species are summed (by the observer in the field) per five minutes period. The registration of time is important for linking the bird observations to the GPS-registered route and hence for positioning all bird observations correctly (see below). Observations of listed species are registered individually with data on time and position (from GPS) directly in the field.

During the point counts all birds heard and seen are counted during five minutes (disregarding what has been recorded along the line transects). The start and stop time of each counting period as well as the position from where the count is made is recorded. The count is, if possible, conducted from the pre-determined location. If the pre-determined location can not be reached, counting from a location not deviating more than 250 m from the pre-determined one is allowed.

During line transects and point counts a GPS is used for registration of the route. The GPS log positions data automatically every five minutes, and after each days field work the logged positions (all with data on time as well) are down-loaded and stored as a conventional text file in PC-format.

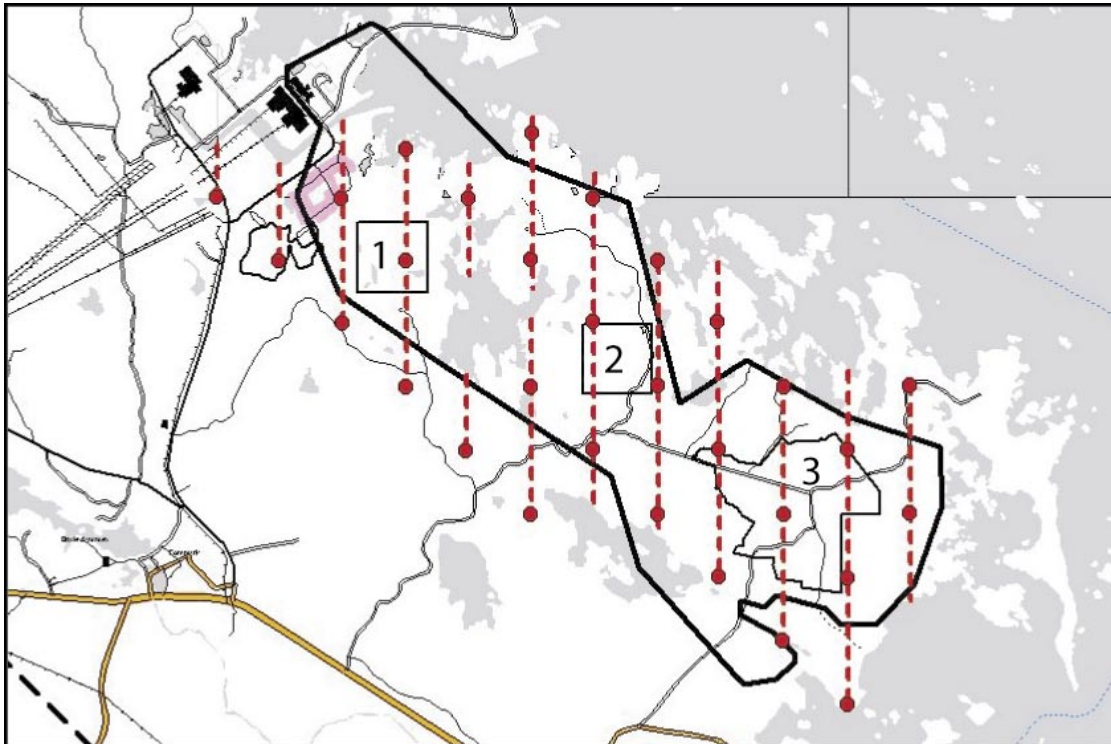


Figure 4-1. Map of the candidate area in Forsmark showing line transects (broken, red, north-south directed lines) and positions for point counts (red dots) in 2002–2004. The territory mapping areas used in 2002–2003 but not in 2004 (1, 2, 3) are shown as well.

Line transects and point counts do not give direct measures of absolute bird densities within an area. The bird density measures yielded by the line transects and point counts in Forsmark are however directly comparable to the ones collected through the Swedish Environmental Protection Boards' National Monitoring Program (<http://www.biol.lu.se/zooekologi/birdmonitoring>) as the methods used are identical.

4.2 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 /Green, 2003 and 2004/. Starting from 2004, a selection of these species are monitored on a yearly basis. The species in question are shown in Table 4-1. Selection of monitoring species were made according to a set of different criteria. A species was included for further monitoring if: 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); iii) Forsmark holds high densities of the species.

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

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

These species were monitored in 2004 by visiting known nesting places/territories used in 2002–2003, combined by visits to habitats suspected to possibly hold the species in question. Visits to nest sites/territories/good 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 were made for some species, i.e. black-throated diver, white-tailed eagle, honey buzzard, 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.

4.3 Execution

The monitoring field work in 2004 was carried out during the period 2004-03-22 to 2004-08-05. The field work was performed by Sören Svensson (line transects, point counts, listed species), Johanna Grönroos (listed species) and Martin Green (line transects, point counts, listed species). Additional information on listed species were given by Peter Hunger and Alf Sevastik. 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.

4.4 Data handling

In the field (line transects, point counts, listed species) all registered birds were recorded in notebooks with data on species, number of individuals and time together with additional data on bird behaviour and circumstances where such data were relevant. During line transects, common (numerous) species were summed already in the field in five minute periods while more scarce, and especially listed species were recorded with individual data for each observation. At the same time, position and time were automatically registered by GPS every fifth minute. Observations of listed species were registered with the exact position individually taken directly from the GPS in the field. After each day of field work, the bird and time data were transferred to pre-made protocols. The logged position and time data were down-loaded from the GPS to text files in PC-format with the programme Waypoint1803. Bird and time data were then entered into Excel-files from protocols, where after the files were cross-checked against the field notes by the project leader. After this, the bird and time data were linked to the position/time data whereby each observation

were given a geographic position. The time resolution (five minutes for common species) provides a geographical resolution of about 100–150 m for these. Positions for listed species 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.

4.5 Analyses and interpretations

The results gathered in 2004 during line transects and point counts are compared with results gathered in an identical way in 2002–2003, with the aim of evaluating possible changes in bird numbers in the candidate area at large. With both methods, statistical testing is at present non-sensical at the species level as only three data points (2002, 2003, 2004) exist. For any meaningful statistical analysis on the species level we need data from at least five years to evaluate trends in the local population size. For the breeding bird community as a whole, however, the numbers of breeding birds (as estimated by line transect and point count data) are tested to look for differences between 2002, 2003 and 2004. As the data do not conform to normal distributions, non-parametric tests are used. All statistical testing was made in the software SPSS for Windows version 10.0 (SPSS Inc).

The following statistical comparisons were made:

- a) Number of recorded bird individuals per km and species during line transects in the candidate area during 2002 vs 2003 and 2003 vs 2004.
- b) Number of recorded bird individuals per point and species during point counts in the candidate area during 2002 vs 2003 and 2003 vs 2004.

Any general decrease or increase in the bird fauna would turn up as statistical differences using this approach. The tests do in reality check whether the number of decreasing and increasing species are significantly different from each other. If the total bird community should decrease, one would expect that more species are decreasing than increasing etc. The normal, undisturbed level would be that similar numbers of increasing and decreasing species are found (i.e. no significant differences).

Statistical tests of the data gathered at the regional level (eastern Svealand, data from the national environmental monitoring programme) were analysed in the same way as the Forsmark data.

Changes in numbers of territories and/or individuals at species level for listed species 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 the same as stated above for analyses at the species level of common species. With a time series of only three years, any such test is non-sensical.

4.6 Nonconformities

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

5 Results

English and Swedish names of the birds are used throughout the results part. Latin names are given the first time a species is mentioned. A complete list of English, Latin and Swedish names for all bird species breeding in Sweden is given in Appendix 1.

5.1 Line transects

Within the candidate area a total of 45.0 km (22.5+22.5 km during the first and second round respectively) of line transects were made in 2004. Corresponding figures for 2002 and 2003 were 42.6 km (22.3+20.3 km) and 46.5 km (23.4+23.1 km) respectively. The two rounds of line transects were conducted May 4–6 and June 4–18 in 2004. In the two earlier years the line transects were made April 25–June 7 and June 19–28 in 2002 and April 29–May 15 and June 9–15 in 2003. During the line transects in 2004 a total of 2,692 birds of 83 species were registered. Both the number of birds and the number of species were lower in 2004 compared to 2002 and 2003. In the earlier years, 3,326 birds of 86 species were recorded in 2002 and 3,541 birds of 96 species were recorded in 2003. In total, 111 species were registered during the line transects within the candidate area in these three years combined. The results from the line transects within the candidate area are shown in full detail in Appendix 2.

The figures above translate into remarkably similar bird densities in the first two years, 78.1 birds/km in 2002 and 76.2 birds/km in 2003, but with a much lower density in 2004, 59.8 birds/km. The decrease in overall density from 2003 to 2004 is 22% and the density is 16% below the average for the three years combined. If the analysis is restricted to only include ‘land birds’ (excluding all birds primarily associated with water habitats such as divers, grebes, cormorants, swans, geese, ducks, gulls and terns) the overall densities for the three years were 56.2 birds/km in 2002, 62.6 birds/km in 2003 and 49.6 birds/km in 2004. The density for ‘land birds’ in 2004 was then 21% below the density in the preceding year and 16% below the average for the three years taken together. The rationale for doing the distinction between ‘land birds’ and ‘water birds’ here is that the results for waterbirds show a very large variation between years when looking at individual species. Hence, the results for land birds are probably more robust than the ones for water birds.

There was no statistical difference in the number of birds/km between the two earlier years, 2002 and 2003, when comparing the number of recorded individuals/km per species (Wilcoxon signed ranks test, $Z = 1.21$, $p = 0.22$, $N = 110$, white-tailed eagle *Haliaeetus albicilla* (havsörn) was excluded from the comparison as this species was not counted during the line transects in 2002 due to a misunderstanding, Z and p -values differ slightly from results shown in /Green, 2004/ as more species are now entered into the test). Z is the test value computed by the test, a high absolute value of Z means that there is a large difference between the two tested data sets; p is the probability level, a low value of p indicates that there is a high probability that the two data sets differ (and a low probability that they are similar). Following international conventions on statistics, the level used to say that the two data sets differ significantly from each other is set at 0.05. The lower the value of p , the more the two data sets differ. N is the total number of species entered into the comparison. Recorded individuals/km per species recorded in 2004 were significantly lower than the ones recorded in 2003 (Wilcoxon signed ranks test, $Z = 3.71$, $p = 0.0002$, $N = 111$). In other words, there was no significant difference in the number of increasing

and decreasing species between 2002 and 2003. Higher densities were registered in 2003 (compared to 2002) for 59 species and lower densities were registered for 47 species. There was however a significant difference in the number of increasing and decreasing species between 2003 and 2004. Between 2003 and 2004, 38 species increased and 67 decreased in density.

The results shown above remain the same also if only 'land birds' are entered into the comparison (statistical details not shown, being very similar to the ones for the total number of species). Furthermore, the results are virtually unchanged even if only the 45 most numerous land species, i.e. the ones for which the results are most likely to be robust and least likely to be influenced by stochastic sampling errors, are included in the analysis (statistical details not shown, see above). Speaking in general terms, the results from the line transects indicate that there was a significant decrease in the overall bird community in Forsmark in 2004 compared to the earlier survey years.

An analysis of the data from the whole region of eastern Svealand (mainly Uppland) did not show the same pattern as in Forsmark. There was no statistical difference between 2002 and 2003 ($Z = 0.94$, $p = 0.35$, $N = 121$) and a significant increase between 2003 and 2004 ($Z = 2.45$, $p = 0.014$, $N = 121$), when looking at all species registered during the line transects in this area. In general words, the number of birds/km and species in the whole region was higher in 2004 compared to both 2003 (and 2002). Making the same comparisons for only 'land birds' and for only the most common species gave the same results (statistical details not shown), although the increase from 2003 to 2004 was not fully significant in the last mentioned case (the most common species, $Z = 1.76$, $p = 0.078$, $N = 65$). Hence the results on the large regional level seems rather robust. The overall bird community of eastern Svealand remained stable or increased during the period 2002–2004 according to the line transect data.

Making the same analysis as above for the 23 listed species registered within the candidate area during the line transects in the three years combined did not reveal any significant differences between the years (statistical details not shown). This analysis is however quite weak (statistically speaking) as most species are registered in very low numbers and hence sampling errors (problems with disentangling the question of whether a species is really absent or if it is present but not recorded) are likely to have a relatively large impact on the outcome.

Among the listed birds, it is worth noting that two of the species absent in 2003 but recorded in 2002, were now registered again within the candidate area. These were hazelhen *Bonasia bonasia* (järpe) and three-toed woodpecker *Picoides tridactylus* (tretåig hackspett). The hazelhens were now found in one of the least disturbed parts of the candidate area, and it is possible that they occurred there also in 2003 without being detected. Occurrence of three-toed woodpeckers probably varies largely between years and the presence this year could very well be the result of an influx of birds from other areas. One 'new' listed species was registered during the line transects in 2004, not registered during 2002–2003: the red-breasted flycatcher *Ficedula parva* (mindre flugsnappare). This is a long distance migrant probably occurring in the area in low densities in all years. It has very secretive habits and a very short period of territory announcing (singing) which makes it difficult to survey and easy to overlook. Otherwise most listed species were recorded in similar numbers in 2004 as in earlier years during the line transects (see Appendix 2).

5.2 Point counts

64 point counts were made in the candidate area in 2004. Corresponding figures from 2002 and 2003 were 58 and 64 respectively. The point counts were conducted simultaneously with the line transects in all years (for dates see above). During the point counts, 1,300 birds of 72 species were registered in 2004. In the earlier years, 906 birds of 70 species were registered in 2002 and 1,404 birds of 81 species in 2003. In total, 96 bird-species were registered during the point counts in the three years taken together. The results from the point counts within the candidate area are shown in full detail in Appendix 3.

The figures above translate into overall bird densities of 20.3 birds/point in 2004 which should be compared with 15.6 birds/point in 2002 and 21.9 birds/point in 2003. Restricting the analysis to 'land birds', as above for line transects (excluding all 'water birds'), gave densities of 9.5 'land birds'/point in 2004 compared to 9.9 'land birds'/point in 2002 and 12.6 'land birds'/point in 2003. Densities of 'land birds' in 2004 were hence similar to the ones in 2002, but 24% lower than the ones in 2003 and 10% lower than the average for the three years combined.

Looking at all species together, there was a tendency that more species increased in numbers between 2002 and 2003, than the other way around, although the difference was not fully significant (Wilcoxon signed ranks test, $Z = 1.93$, $p = 0.053$, $N = 95$, white-tailed eagle (havsörn) was excluded from the comparison as this species was not counted during the point counts in 2002). 54 species increased in number of birds/point while 37 decreased. Between 2003 and 2004 there was a significant difference in the same direction as indicated by the line transects. Results were similar if looking at 'land birds' only. In this case there was a significant increase between 2002 and 2003 (Wilcoxon signed ranks test, $Z = 2.18$, $p = 0.029$, $N = 74$) and a significant decrease between 2003 and 2004 (Wilcoxon signed ranks test, $Z = 3.39$, $p = 0.001$, $N = 75$).

The results were very much the same if looking at the 27 most numerous 'land birds' only (statistical results not shown). In general terms, the point counts indicate a small increase in overall bird numbers between 2002 and 2003 followed by a larger decrease between 2003 and 2004.

Regional point count data from the entire eastern Svealand showed no significant differences in numbers of birds/km and species between the years (Z between 0.26 and 1.26, all $p > 0.20$, $N = 102$) when looking at all species together. The results were the same when looking at only 'land birds' or only the most common species. In general terms, the bird community of eastern Svealand remained stable during 2002–2004, according to the point counts.

Regarding the listed species, very little information is gathered during the point counts and no large differences were registered between 2003 and 2004. One comment can be made though. Of the listed, possibly breeding species, two disappeared from 2003 to 2004: corncrake (kornknarr) and wood lark (trädlärka). Both these occur in very low numbers in Forsmark in general and were not present in the candidate area in 2002 either.

5.3 Listed species

The following section provides a summary of the population development during the last three years for some of the species listed as endangered, threatened or vulnerable according to the Swedish Red List (Gärdenfors, 2000), and/or species listed in the European Union's 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 white-tailed eagle is written by Björn Helander.

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

Three pairs in lakes, two pairs in Kallrigafjärden and one pair at the coast north of the Forsmark power plant were present in 2004. No young were observed and the breeding output of divers in Forsmark continues to be low. After the report for last year was written, it turned out that in addition to the five pairs reported, there was a pair breeding in Fiskarfjärden in 2003 as well, and this pair produced one large young! This is the first successful breeding in Forsmark during the years of the site investigations!

During the years of the site investigations the number of pairs have been more or less constant. With only one produced young in three years, the breeding output must be regarded as extremely low. It has been calculated that black-throated divers need to produce 0.37–0.47 young/pair and year to keep the population size constant in the long run /Nilsson, 1977/. In Forsmark the figure for the last three years is 0.06 young/pair and year. If the low breeding success continues, the population will eventually decrease, unless there is an immigration of birds from other areas with higher reproductive output.

As divers are long-lived birds who can live for up to 25 years /Nilsson, 1977/, changes in population size will lag behind. Even if breeding success is very low for many years in a row, one do not expect to detect any major changes in population size until much later, as long as adult survival remains unchanged. Another possibility is that divers in most years produce very few young, but in the few good years still produce enough young for keeping the population level constant. Arguing against the latter hypothesis is the finding that black-throated divers in Svealand at large produced 0.3–0.8 young/pair and year during the period 1994–2001 /Eriksson et al. 2002/, not showing such a large variation in breeding output as expected under a scenario as described above. The conclusion is however that there is a need for long time series when monitoring long-lived birds like divers, if one should be able to register population changes.

No data are available from earlier years on breeding success in Forsmark for comparison, but according to local knowledge breeding success has been ‘low’ for many years. What ‘low’ means in this case is however unclear. It is well known that divers may suffer high breeding losses due to human activities during critical periods of the breeding cycle. Whether human activities (i.e. the activities within the site investigations) is the reason behind the low reproductive output in Forsmark is so far unknown.

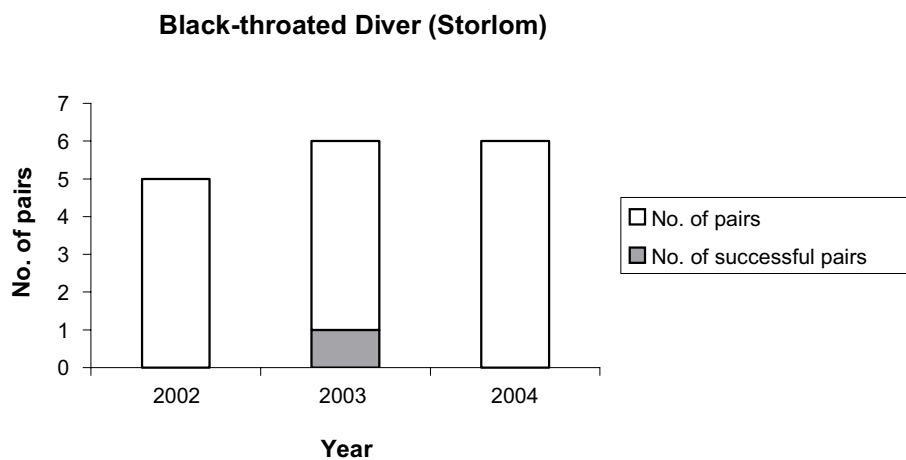


Figure 5-1. Number of territorial pairs of Black-throated divers in Forsmark 2002–2004. Shading shows the number of successful pairs.

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

The Honey Buzzard had a good year in Forsmark in 2004. The number of territorial pairs increased from four to six. Four of these were confined within the regional model area and one was found within the candidate area. The sixth territory had parts within the regional model area and parts being outside of this. At least two of the pairs produced young, 2+2 juveniles (= 0.67 young/pair). Both these are nesting within the regional model area. No young were recorded in 2003. Adding the seemingly complete failure in breeding attempts in 2003 to the figure gives a local breeding output of 0.40 young/pair and year for Forsmark 2003–2004.

Breeding success is generally low in this species with marked variations between years. Reproductive output in southern Uppland 1986–1991 was 0.60 young/pair and year /Tjernberg and Ryttman, 1994/ and calculations show that between 0.34–0.67 young/pair and year is needed to keep population size constant /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/.

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.

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

The breeding success for white-tailed eagles in the Forsmark area and in two neighbouring reference areas in 2004, 2003, 2002 and 1998–2001 is summarised below. Like in 2002 and 2003, breeding success within the regional model area at Forsmark was lower than in previous years in the same area, as well as in the neighbouring reference areas. At one nest site that failed, boot footprints close to the nest-tree showed that the site had been visited earlier this season. This inevitably must have caused flushing of the adult from the nest and may have caused the breeding failure. Another nest that failed this year had been refurbished by the eagles during late winter but was abandoned already in early April, for unknown reasons. One successful nest in the area showed evidence of probably repeated visits during June (footprints, all moulted eagle feathers missing and apparently collected). The marked decline in breeding success of white-tailed eagles from 2002 when intense activities commenced in the investigation area indicates disturbance as the main cause during these years. As indicated in previous reports though, it will take longer to evaluate the magnitude of an impact from the activities in Forsmark on the breeding success of the eagles.

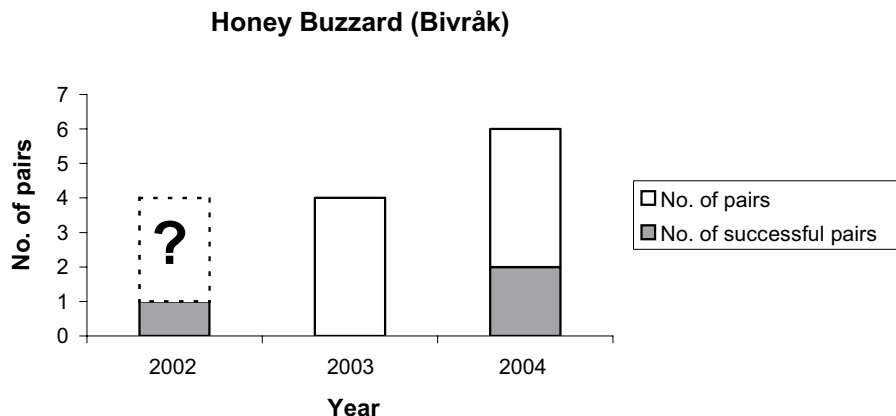


Figure 5-2. Number of territorial pairs of Honey Buzzards within the regional model area in Forsmark 2002–2004. Shading shows number of successful pairs. The exact number of territorial pairs in 2002 is not known, a well based estimate is shown.

Table 5-1. Percent successfully breeding pairs of white-tailed eagles in 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	2004	2003	2002	1998–2001	N
Forsmark	50	33	25	85	24
Reference S	100	80	100	79	35
Reference N	86	67	83	72	37

Osprey *Pandion haliaetus* Fiskgjuse (EU Annex 1)

The Ospreys had a very good year in 2004, the best one since the site investigations started. Eight breeding attempts were recorded and seven of these were successful! The seven successful nests together produced 11 fledged young (3+2+2+1+1+1+1). No pairs bred within the candidate area, and no breeding attempts have been registered there during the study period 2002–2004.

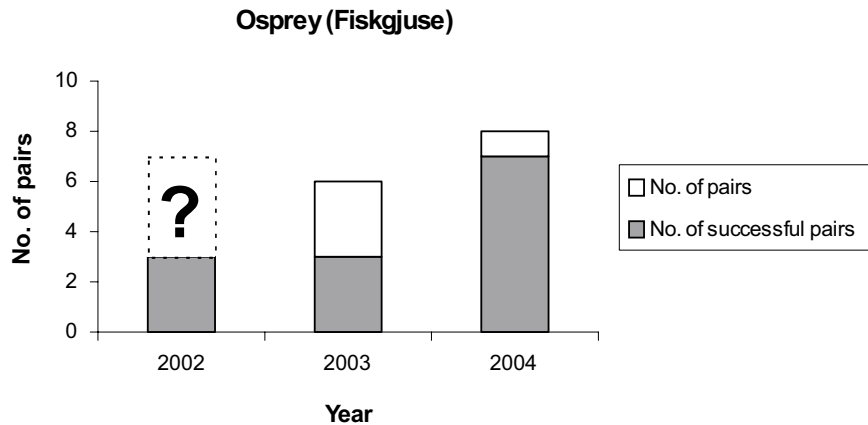


Figure 5-3. Number of nesting attempts (territorial pairs) of Ospreys in Forsmark 2002–2004. Number of successful nests (shaded parts) are shown as well. The exact number of territorial pairs in 2002 is not known, a well based estimate is shown



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

The reproductive output in Forsmark, 1.14 young/pair and year 2003–2004, is 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/).

So far there are no direct signs of that the site investigations affect the ospreys in any way. Even though no pair has been recorded breeding within the candidate area in 2002–2004, there are at least three pairs breeding relatively close to this. These pairs must have experienced a much higher level of human activity in their neighbourhoods compared to before the site investigations started, but still breeding success is high! All these three pairs produced young in 2004, in total five large young! The absence of ospreys within the candidate area probably have other reasons than disturbances from the site investigations.

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

The black grouse was not among the selected species for monitoring in 2004, but since a general interest for the ‘forest hens’ has been expressed from SKB locally, and since the species may be included in future monitoring, it is never the less included here. Data about lekking males is also easily collected and was indeed collected also in 2004. The species was not covered well in 2002, partly because of a late start of the bird surveys and partly for other reasons, but the general impression was that more birds were present in 2003 compared to 2002, especially within the candidate area. Well covered in 2003–2004 and the impression of a positive trend in the area from 2002 to 2003 was substantiated in 2004 with an even higher number of lekking males in this year.

Breeding success has not been monitored but hens with young were seen in 2002 and 2004. So far no signs of any impact from the ongoing site investigations have been seen. Overall numbers in the area seem to be increasing and numbers within the candidate area were stable between 2003 and 2004. Local population size of this species is probably much more sensitive to changes in predator- and hunting pressures than to possible disturbances from the site investigations.

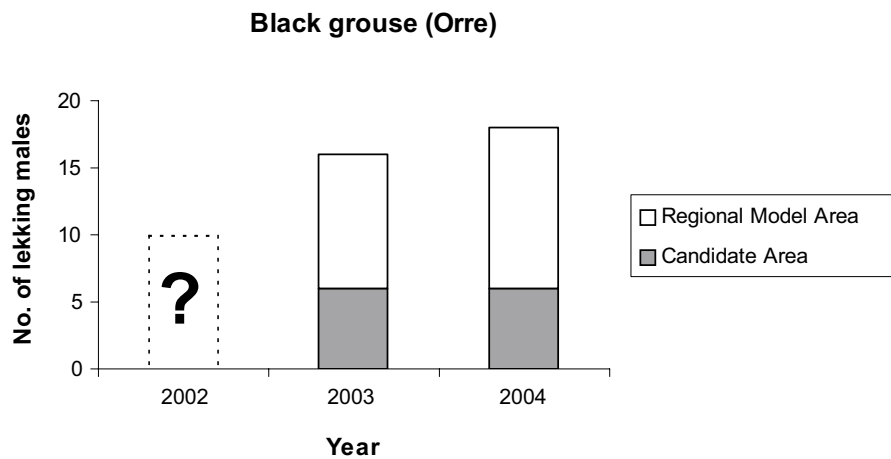


Figure 5-5. The recorded number of lekking Black grouse males in Forsmark 2002–2004. Shaded parts show the number within the candidate area. Exact number of lekking males in 2002 is not known. A well based estimate is shown.

Capercaillie *Tetrao urogallus* Tjäder (EU Annex 1)

As for the black grouse, the capercaillie was not included among the species for detailed monitoring in 2004. Never the less, data were collected from the ‘central area’ (close by the candidate area) in 2004. For the same reasons as for Black grouse, a few words about the capercaillie are presented here. As mentioned in /Green, 2004/, the capercaillie has been recorded in three parts of the regional model area. Most birds have been seen in what can be called the ‘central area’. These parts do also contain a lekking ground. At this, there were at least five males in 2003. In 2004 the number had dropped to three. Furthermore, it seems like the area used by Capercaillies has changed during the three years of site investigations. In 2002 parts of the candidate area were included within the ‘home ranges’ of capercaillies, observations of both males and females were made. Breeding was also confirmed by the finding of a hen with small young. Since then, no capercaillies have been recorded within the candidate area. The birds were still found in the vicinity in both 2003 and 2004, but seem to avoid the areas where most people are moving around, at least during the breeding season.

The capercaillie is thus one of the few species where there might be a negative effect of the site investigations. Whether this really is the case or not remains to be shown. The data do however indicate both a drop in numbers and a change in utilisation of the area with birds avoiding parts with increased human presence that they used before the site investigations started.

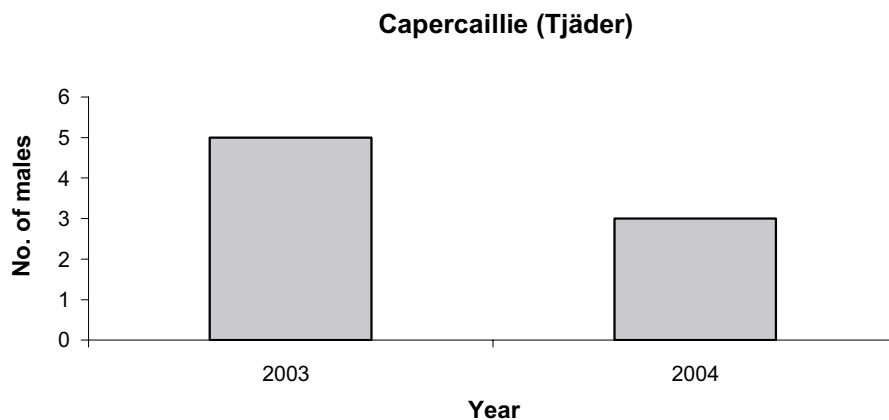


Figure 5-6. The recorded number of capercaillie males in ‘the central area’ Forsmark 2003–2004 (see text).

Hazelhen *Bonasia bonasia* Järpe (EU Annex 1)

The third ‘forest hen’ is included here to get the full picture of this group of birds in Forsmark. No monitoring has been made of hazelhens and the data collected in 2002–2004 do not allow any analysis of population development. It takes a lot of effort to monitor hazelhens as they are very secretive, especially during the breeding season. Birds may well be present but not detected if only single / few visits are made to their territories. In the years 2002–2003 very few hazelhens were registered in Forsmark and no good picture of their occurrence was obtained. Lucky circumstances with a sudden spell of snow in early spring 2004 however changed this. During snow conditions 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 relatively tightly connected to specific habitats and by visiting these and looking for tracks, monitoring is possible. Any future monitoring of hazelhens should hence preferably be made in winter (the birds stay year around in their territories) and during snow conditions.

Overall, 20 occupied territories of hazelhens were found within the regional model area in 2004, three of these within the candidate area. The species seems to occur more or less where ever there is enough suitable habitat. Since not all places with suitable habitat could be controlled in 2004, it is likely that the local population is around 30 pairs, making the hazelhen the most numerous ‘forest hen’ in Forsmark.

In 2002, there was an occupied territory close to the future drilling site at Jungfruholm. These birds were not there in 2003, when the drilling site was active. In fact, no hazelhens at all were registered within the candidate area in 2003 and it was concluded that this species might be sensitive to disturbances from the site investigations /Green, 2004/. In 2004, birds were re-discovered within the candidate area at three sites. Still none of the sites were close to drilling sites or areas with a high levels of human activities and it is likely that the conclusion from last year still holds. It seems however as if hazelhens only move away a short distance from the most disturbed parts and re-settle relatively close to the old territories as long as there are suitable habitats for them. It is strongly suspected that the territory close to the Jungfruholm drilling site has moved about 500 m to its new location in more undisturbed parts of the candidate area.

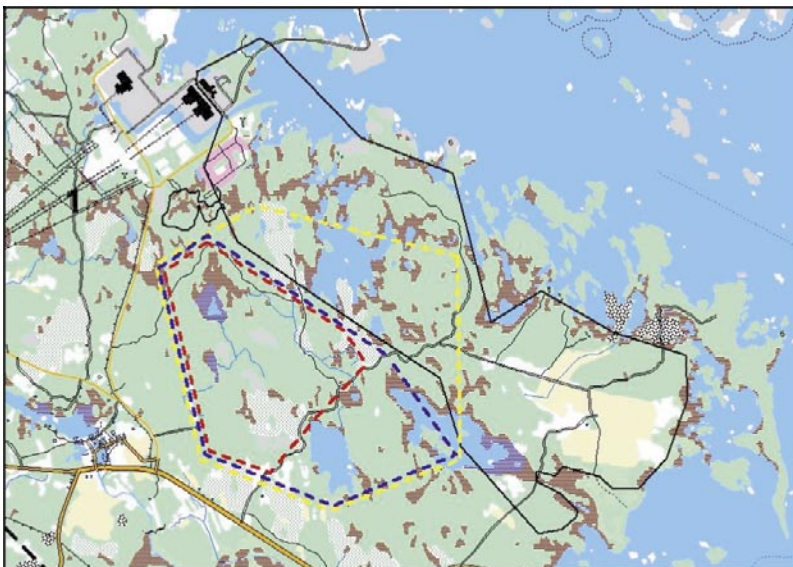


Figure 5-7. The ‘central area’ for capercaillies Forsmark 2002 (yellow broken line), 2003 (blue broken line) and 2004 (red broken line). Within each of the shown areas, all observations and tracks of capercaillies were made in resp. year. Capercaillies outside of the ‘central area’ are not shown.

Ural owl *Strix uralensis* Slaguggla (Sw. Red List; EU Annex 1)

The same four territories that have been occupied in the last two years were occupied also in 2004. Only one of the territories is situated completely within the regional model area. The three others are situated along the borders with parts both inside and outside the regional model area. Breeding success was low with only one produced young in 2004, with certainty due to very low numbers of rodents in the area.

Additional birds were registered at three other localities during the season. Whether these were 'new' birds trying to establish new territories or just the old territorial birds moving around to new sites due to the low food density remains to be shown. The number of pairs has been stable during three years and no impact from the site investigation has been recorded.

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

A nationally declining species where Forsmark holds high numbers and where the local trend do not seem to follow the national one. Total population size in the regional model area is estimated to be 40–50 pairs. Numbers remained fairly stable from 2003 to 2004. In localities checked in both years there was a small overall decrease from 35 to 32 occupied territories (a 9% decrease), but such a small difference is well within the error margins of the method used. Within the more well studied candidate area the number of occupied territories increased from five to seven, perhaps further emphasising that there were no major changes in population size between the years and no apparent impact from the site investigations on the local population.

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

The early surveys for woodpeckers in 2004 resulted in the detection of three 'new' territories in the southern part of the regional model area. As these parts were not as intensively surveyed in the earlier years (2002–2003), these territories may have been occupied also in these years without being detected. Otherwise there were no major changes in numbers between the years. Total population size within the regional model area is estimated to be about 13 pairs. In addition to these, there are three more territories just outside the borders of the regional model area, probably with parts extending into this. Of the eleven known territories occupied in 2003, eight were occupied also in 2004, two were vacant and the birds from one territory probably moved about a km south. In addition, there was a new territory discovered in 2004, not occupied in 2003.

In conclusion, there were no major changes in local population size and no immediate negative impact from the site investigations. However, it might be worth noting that the only pair having a territory in close association with the active parts of the site investigations in 2003, probably moved away (but still stayed within the candidate area) in 2004.

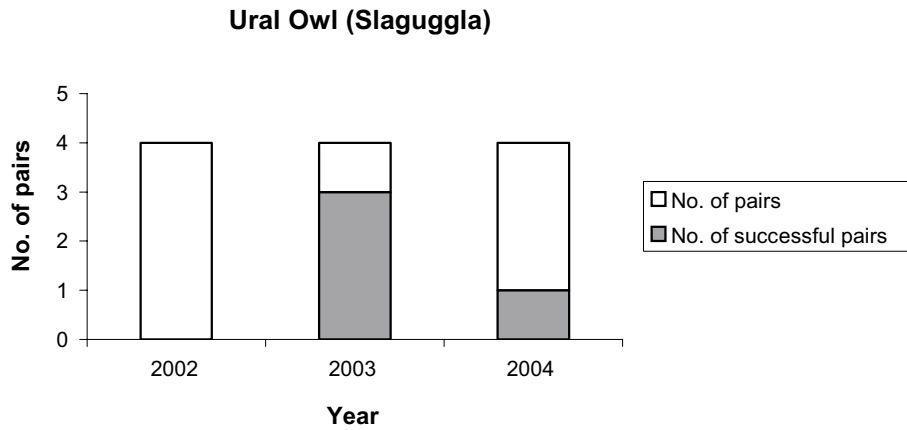


Figure 5-8. Number of territorial pairs of Ural owl within the regional model area in Forsmark 2002–2004. Shown is also the number of successful pairs (shaded).

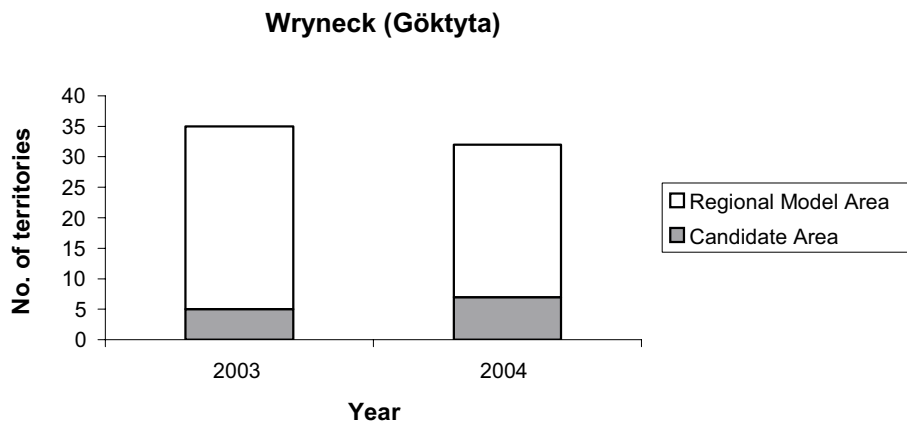


Figure 5-9. Number of occupied Wryneck territories in well monitored parts of Forsmark in 2003–2004. Shading shows the number of occupied territories within the candidate area.

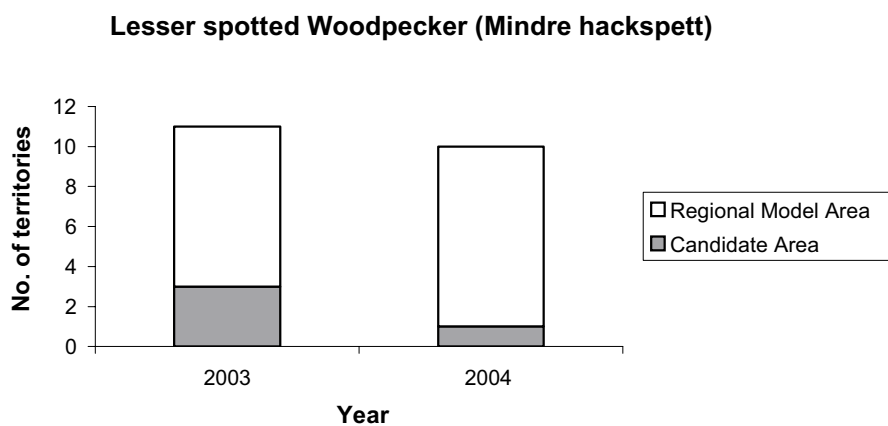


Figure 5-10. Number of occupied territories of Lesser spotted woodpeckers in areas monitored in both 2003 and 2004 in Forsmark. Shading shows number of occupied territories in the candidate area.

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

As for several other listed species mentioned above, also the red-backed shrike had a good year in Forsmark in 2004. In parts checked carefully in both 2003 and 2004 the number of occupied territories increased from 20 to 27 (a 35% increase). Total population size for the whole regional model area is estimated as being at least 60 pairs. Looking at the candidate area only, the corresponding figures were six territories in 2003 and seven in 2004. In other words, there are no signs what so ever of any impact from the site investigations on local population size so far. Even though breeding success was not monitored in any detail, the reproductive output seemed to be high in 2004. At least 20 broods were recorded during surveys for other species in the later parts of the summer.

Table 5-2. General population changes of selected listed species in Forsmark between 2002/2003 and 2004. 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 2004 in general terms is shown for divers, raptors and owls.

Species	Regional model area	Candidate area	Whole area	Breeding output 2004
Black-throated Diver	0	0	0	Very poor
Honey Buzzard	+	0	+	Decent
White-tailed Eagle			0	Decent
Osprey	+		+	Good
Black grouse	+	0	+	
Capercaillie	–	–	–	
Ural owl	0	0	0	Poor
Wryneck	–	+	0	
Lesser Spotted Woodpecker	0	(–)	0	
Red-backed shrike	+	(+)	+	

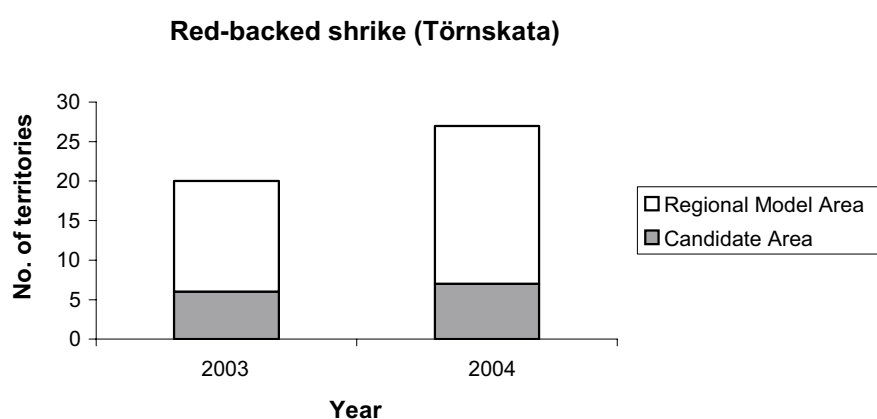


Figure 5-11. The number of occupied territories of Red-backed shrikes in well monitored parts of Forsmark 2003–2004. Shading shows number of occupied territories within the candidate area.

6 Discussion

This report is the second trying to evaluate any effects from the ongoing site investigations on the breeding bird fauna in Forsmark. The results gathered during the first two years (2002–2003) of the site investigations were reported in /Green, 2004/.

Many of the indications of likely effects reported in the first report were confirmed by adding an extra year (2004) of surveys to the data set, but there were some differences too. It should still be remembered that the results gathered so far can only give indications of short time effects. The study period is so far too short to say anything about long time effects.

The general bird fauna in the candidate area did not show any signs of changes in overall numbers of breeding birds between 2002 and 2003. Between 2003 and 2004 however, the results of the bird surveys indicate a general decrease in bird numbers within the candidate area. This decrease was not paralleled by any similar pattern in the region of eastern Svealand at large. Hence, there may have been local effects in Forsmark causing the decrease. One should not draw any larger conclusions from this result though. There are still a lot of unknowns involved that could have affected the results. Likely or possible reasons for the registered difference (decline) between 2003 and 2004 are as follows:

- The local bird community did actually decrease between the years and this may or may not be an effect of the site investigations.
- Differences between observers conducting the surveys.
- Differences in exact timing of the surveys and the relation between when the surveys were made and the local breeding cycle of birds between years (depending on at what stage of the breeding cycle the birds are, they are more or less active and hence more or less easy to detect).
- Meteorological factors during the surveys. Weather strongly affects the activity and detectability of birds.

The methods used in Forsmark build on the assumption that many of the factors listed above will cancel each other as long as the study period is long enough (differences between observers, timing, weather etc). The methods are hence suited for time series studies. They can of course be used also for comparing only single years with each other, but the interpretation of results will be much weaker in those cases. The only way to disentangle the possible causes of the recorded decline in bird numbers in Forsmark is to continue the monitoring programme for as long as the site investigations continue.

Turning to the listed species selected for monitoring, results from 2004 were very much in line with results from 2002–2003 /Green, 2004/. No effects from the site investigations were recorded for the majority of species, and the species where any effects were suspected were more or less the same as in earlier years.

Breeding success of black-throated divers continue to be low and no young were seen in 2004. Whether this has anything to do with the site investigations or not is uncertain. It could however be noted that breeding success in Forsmark 2002–2004 has been much lower than in Svealand at large 1994–2001 /Eriksson et al. 2002/; no data are available from exactly the same time period unfortunately). Since divers are known to be sensitive to human disturbance during certain periods of the breeding cycle, it could be suspected that

at least when talking about the pairs breeding in lakes in Forsmark, the increase in human activity following upon the site investigations may play a role in the recorded pattern.

Also the white-tailed eagles continue to show a lower breeding output in Forsmark during the site investigations compared to the years before these and to reference areas surrounding Forsmark. Breeding success was however better in 2004 compared to 2002–2003, perhaps as a result of the mitigating efforts taken to leave the eagles undisturbed. Still, the areas around at least two nests showed signs of human disturbances during the breeding season 2004, and in at least one case this may have been the reason behind the breeding failure in this nest. These specific disturbances were however not connected to the site investigations at all (as far as we know) and it seems as the efforts made within the site investigations to increase breeding success of the eagles are successful. It should also be noted that despite still showing a low breeding success, the output of eagles in Forsmark has been improving from the bottom year in 2002 to 2004.

The capercaillie was not among the selected species for monitoring in 2004, but data collected indicate that these birds may have avoided the candidate area in later years. Hence it may be of interest to include the capercaillie in future monitoring. Also the hazelhen may be a candidate for future monitoring, as there are signs of reactions to the increased human presence in the candidate area also for this species.

On the positive side, the breeding season of 2004 showed very good results for a couple of listed species such as honey buzzard and osprey. Both species seem to be unaffected by the site investigations as long as no direct disturbances are made at nest sites.

If SKB is interested in finding out the effects of the site investigations on the breeding bird fauna in Forsmark (in any direction!), monitoring must continue for a longer time period than reported on here. Every year of data collection adds 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 both selected listed species and the bird fauna at large should continue for as long as the site investigations continue.

7 References

Eriksson M O G, Hake M, Lindberg P, 2002. Projekt Lom 2001. I: SOF 2002, Fågelåret 2001, Stockholm, pp 47–52.

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.

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

Lindström Å, Svensson S, 2004. Övervakning av fåglarnas populationsutveckling. Rapport, Ekologiska inst., Lunds Universitet och Naturvårdsverket, Lund.

Nilsson S G, 1977. Adult survival of Black-throated Diver *Gavia arctica*. *Ornis Scandinavica* 8: 193–195.

Ryttman H, 1994. Överlevnadsberäkningar och försök att skatta populationsutvecklingen hos fiskgjuse *Pandion haliaetus*, ormvråk *Buteo buteo* och sparvhök *Accipiter nisus* i Sverige. *Ornis Svecica* 4: 159–172.

SNV, 1978. BIN. Biologiska Inventeringsnormer – Fåglar. Statens Naturvårdsverk RR 1978:1.

Svensson S, 1975.Handledning för Svenska Häckfågeltaxeringen med beskrivningar av revirkarteringsmetoden och punkttaxeringsmetoden. Zoologiska inst., Lunds universitet, Lund.

Tjernberg M, Ryttman H, 1994. Bivråkens överlevnad och beståndsutveckling i Sverige. *Ornis Svecica* 4: 133–139.

<http://www.biol.lu.se/zooekologi/birdmonitoring>.

<http://www.viron.se>

List of all bird species in Sweden

Table A-1. List of all bird species breeding in Sweden with Latin, Swedish and English names.

Latin-Genus	Latin-species	Swedish	English
<i>Clangula</i>	<i>hyemalis</i>	Alfågel	Long-tailed Duck
<i>Riparia</i>	<i>riparia</i>	Backsvala	Sand Martin
<i>Aythya</i>	<i>marila</i>	Bergand	Scaup
<i>Fringilla</i>	<i>montifringilla</i>	Bergfink	Brambling
<i>Bubo</i>	<i>bubo</i>	Berguv	Eagle Owl
<i>Pernis</i>	<i>apivorus</i>	Bivränk	Honey Buzzard
<i>Turdus</i>	<i>pilaris</i>	Björktrast	Fieldfare
<i>Circus</i>	<i>cyaneus</i>	Blå kärrhök	Hen Harrier
<i>Parus</i>	<i>caeruleus</i>	Blåmes	Blue Tit
<i>Anas</i>	<i>penelope</i>	Bläsand	Wigeon
<i>Fringilla</i>	<i>coelebs</i>	Bofink	Chaffinch
<i>Aythya</i>	<i>ferina</i>	Brunand	Pochard
<i>Circus</i>	<i>aeruginosus</i>	Brun kärrhök	Marsh Harrier
<i>Saxicola</i>	<i>rubetra</i>	Buskskvätta	Whinchat
<i>Acrocephalus</i>	<i>dumetorum</i>	Busksångare	Blyth's Reed Warbler
<i>Pyrrhula</i>	<i>pyrrhula</i>	Domherre	Bullfinch
<i>Actitis</i>	<i>hypoleucos</i>	Drillsnäppa	Common Sandpiper
<i>Turdus</i>	<i>viscivorus</i>	Dubbeltrast	Mistle Thrush
<i>Accipiter</i>	<i>gentilis</i>	Duvhök	Goshawk
<i>Larus</i>	<i>minutus</i>	Dvärgmås	Little Gull
<i>Somateria</i>	<i>mollissima</i>	Ejder	Ejder
<i>Gallinago</i>	<i>gallinago</i>	Enkelbeckasin	Common Snipe
<i>Parus</i>	<i>palustris</i>	Entita	Marsh Tit
<i>Phasianus</i>	<i>colchicus</i>	Fasan	Pheasant
<i>Pandion</i>	<i>haliaetus</i>	Fiskgjuse	Osprey
<i>Larus</i>	<i>canus</i>	Fiskmås	Common Gull
<i>Sterna</i>	<i>hirundo</i>	Fisktärna	Common Tern
<i>Locustella</i>	<i>fluviatilis</i>	Flodsångare	River Warbler
<i>Motacilla</i>	<i>cinerea</i>	Forsärsla	Grey Wagtail
<i>Milvus</i>	<i>milvus</i>	Glada	Red Kite
<i>Tadorna</i>	<i>tadorna</i>	Gravand	Shelduck
<i>Phylloscopus</i>	<i>collybita</i>	Gransångare	Chiffchaff
<i>Muscicapa</i>	<i>striata</i>	Grå flugsnappare	Spotted Flycatcher
<i>Anser</i>	<i>anser</i>	Grågås	Greylag Goose
<i>Carduelis</i>	<i>flammea</i>	Gråsiska	Redpoll
<i>Passer</i>	<i>domesticus</i>	Gråsparv	House Sparrow
<i>Picus</i>	<i>canus</i>	Gråspett	Grey-headed Woodpecker
<i>Larus</i>	<i>argentatus</i>	Gråtrut	Herring Gull
<i>Anas</i>	<i>platyrhynchos</i>	Gräsand	Mallard
<i>Locustella</i>	<i>naevia</i>	Gräshoppsångare	Grashopper Warbler

Latin-Genus	Latin-species	Swedish	English
<i>Tringa</i>	<i>glareola</i>	Grönbena	Wood Sandpiper
<i>Carduelis</i>	<i>chloris</i>	Grönfink	Greenfinch
<i>Picus</i>	<i>viridis</i>	Gröngöling	Green Woodpecker
<i>Carduelis</i>	<i>spinus</i>	Grönsiska	Siskin
<i>Phylloscopus</i>	<i>sibilatrix</i>	Grönsångare	Wood Warbler
<i>Emberiza</i>	<i>citrinella</i>	Gulsparv	Yellowhammer
<i>Motacilla</i>	<i>flava</i>	Gulärta	Yellow Wagtail
<i>Troglodytes</i>	<i>troglodytes</i>	Gärdsmyg	Wren
<i>Cuculus</i>	<i>canorus</i>	Gök	Cuckoo
<i>Jynx</i>	<i>torquilla</i>	Göktyta	Wryneck
<i>Larus</i>	<i>marinus</i>	Havstrut	Great Black-backed Gull
<i>Haliaeetus</i>	<i>albicilla</i>	Havsörn	White-tailed Eagle
<i>Asio</i>	<i>otus</i>	Hornuggla	Long-eared Owl
<i>Delichon</i>	<i>urbica</i>	Hussvala	House Martin
<i>Ardea</i>	<i>cinerea</i>	Häger	Grey Heron
<i>Carduelis</i>	<i>cannabina</i>	Hämpling	Linnet
<i>Hippolais</i>	<i>icterina</i>	Härmsångare	Icterine Warbler
<i>Sylvia</i>	<i>nisoria</i>	Höksångare	Barred Warbler
<i>Bonasia</i>	<i>bonasia</i>	Järpe	Hazel Grouse
<i>Prunella</i>	<i>modularis</i>	Järnsparv	Dunnock
<i>Corvus</i>	<i>monedula</i>	Kaja	Jackdaw
<i>Branta</i>	<i>canadensis</i>	Kanadagås	Canada Goose
<i>Strix</i>	<i>aluco</i>	Kattuggla	Tawny Owl
<i>Sterna</i>	<i>sandvicensis</i>	Kentsk tärna	Sandwich Tern
<i>Bucephala</i>	<i>clangula</i>	Knipa	Goldeneye
<i>Cygnus</i>	<i>olor</i>	Knölsvan	Mute Swan
<i>Turdus</i>	<i>merula</i>	Koltrast	Blackbird
<i>Crex</i>	<i>crex</i>	Kornknarr	Corncrake
<i>Corvus</i>	<i>corax</i>	Korp	Raven
<i>Anas</i>	<i>crecca</i>	Kricka	Teal
<i>Corvus</i>	<i>corone cornix</i>	Kråka	Hooded Crow
<i>Alcedo</i>	<i>atthis</i>	Kungsfiskare	Kingfisher
<i>Regulus</i>	<i>regulus</i>	Kungsfågel	Goldcrest
<i>Aquila</i>	<i>chrysaetos</i>	Kungsörn	Golden Eagle
<i>Acrocephalus</i>	<i>palustris</i>	Kärrsångare	Marsh Warbler
<i>Stercorarius</i>	<i>parasiticus</i>	Labb	Arctic Skua
<i>Hirundo</i>	<i>rustica</i>	Ladusvala	Swallow
<i>Strix</i>	<i>nebulosa</i>	Lappuggla	Great Grey Owl
<i>Phylloscopus</i>	<i>trochiloides</i>	Lundsångare	Greenish Warbler
<i>Falco</i>	<i>subbuteo</i>	Lärfalk	Hobby
<i>Phylloscopus</i>	<i>trochilus</i>	Lövsångare	Willow Warbler
<i>Dendrocopos</i>	<i>medius</i>	Mellanspett	Middle Spotted Woodpecker
<i>Ficedula</i>	<i>parva</i>	Mindre flugsnappare	Red-breasted Flycatcher
<i>Dendrocopos</i>	<i>minor</i>	Mindre hackspett	Lesser Spotted Woodpecker
<i>Loxia</i>	<i>curvirostra</i>	Mindre korsnäbb	Crossbill
<i>Charadrius</i>	<i>dubius</i>	Mindre strandpipare	Little Ringed Plover
<i>Scolopax</i>	<i>rusticola</i>	Morkulla	Woodcock

Latin-Genus	Latin-species	Swedish	English
<i>Caprimulgus</i>	<i>europaeus</i>	Nattskärria	Nightjar
<i>Luscinia</i>	<i>luscinia</i>	Näktergal	Thrush Nightingale
<i>Nucifraga</i>	<i>caryocatactes</i>	Nötkråka	Nutcracker
<i>Garrulus</i>	<i>glandarius</i>	Nötskrika	Jay
<i>Sitta</i>	<i>europaea</i>	Nötväcka	Nuthatch
<i>Buteo</i>	<i>buteo</i>	Ormvråk	Buzzard
<i>Tetrao</i>	<i>tetrix</i>	Orre	Black Grouse
<i>Emberiza</i>	<i>hortulana</i>	Ortolansparv	Ortolan Bunting
<i>Passer</i>	<i>montanus</i>	Pilfink	Tree Sparrow
<i>Aegolius</i>	<i>funereus</i>	Pärluggla	Tengmalm's Owl
<i>Perdix</i>	<i>perdix</i>	Rapphöna	Partridge
<i>Columba</i>	<i>palumbus</i>	Ringduva	Woodpigeon
<i>Carpodacus</i>	<i>erythrinus</i>	Rosenfink	Rosefinch
<i>Arenaria</i>	<i>interpres</i>	Roskarl	Turnstone
<i>Tringa</i>	<i>totanus</i>	Rödbena	Redshank
<i>Erithacus</i>	<i>rubecula</i>	Rödhake	Robin
<i>Phoenicurus</i>	<i>phoenicurus</i>	Rödstart	Redstart
<i>Turdus</i>	<i>iliacus</i>	Rödvingetrast	Redwing
<i>Botaurus</i>	<i>stellaris</i>	Rördrom	Bittern
<i>Gallinula</i>	<i>chloropus</i>	Rörhöna	Moorhen
<i>Acrocephalus</i>	<i>scirpaceus</i>	Rörsångare	Reed Warbler
<i>Larus</i>	<i>fuscus</i>	Silltrut	Lesser Black-backed Gull
<i>Sterna</i>	<i>paradisaea</i>	Silvertärna	Arctic Tern
<i>Pica</i>	<i>pica</i>	Skata	Magpie
<i>Anas</i>	<i>clypeata</i>	Skedand	Shoveler
<i>Columba</i>	<i>oenas</i>	Skogsduva	Stock Dove
<i>Tringa</i>	<i>ochropus</i>	Skogssnäppa	Green Sandpiper
<i>Panurus</i>	<i>biarmicus</i>	Skägges	Bearded Tit
<i>Larus</i>	<i>ridibundus</i>	Skrattmås	Black-headed Gull
<i>Sterna</i>	<i>caspia</i>	Skräntärna	Carpian Tern
<i>Podiceps</i>	<i>cristatus</i>	Skäggdopping	Great Crested Grebe
<i>Anthus</i>	<i>petrosus</i>	Skärpiplärka	Rock Pipit
<i>Strix</i>	<i>uralensis</i>	Slaguggla	Ural Owl
<i>Tachybaptus</i>	<i>ruficollis</i>	Smådopping	Little Grebe
<i>Mergus</i>	<i>serrator</i>	Småskrake	Red-breasted Merganser
<i>Porzana</i>	<i>porzana</i>	Småfläckig sumphöna	Spotted Crane
<i>Sterna</i>	<i>albifrons</i>	Småtärna	Little Tern
<i>Anas</i>	<i>strepera</i>	Snatterand	Gadwall
<i>Fulica</i>	<i>atra</i>	Sothöna	Coot
<i>Accipiter</i>	<i>nisus</i>	Sparvhök	Sparrow Hawk
<i>Glaucidium</i>	<i>passerinum</i>	Sparvuggla	Pygmy Owl
<i>Anser</i>	<i>brachyrhynchus</i>	Spetsbergsgås	Pink-footed Goose
<i>Dryocopus</i>	<i>martius</i>	Spillkråka	Black Woodpecker
<i>Sturnus</i>	<i>vulgaris</i>	Stare	Starling
<i>Carduelis</i>	<i>carduelis</i>	Steglits	Goldfinch
<i>Coccothraustes</i>	<i>coccothraustes</i>	Stenknäck	Hawfinch
<i>Oenanthe</i>	<i>oenanthe</i>	Stenskvätta	Wheatear

Latin-Genus	Latin-species	Swedish	English
<i>Anas</i>	<i>acuta</i>	Stjärtand	Pintail
<i>Aegithalos</i>	<i>caudatus</i>	Stjärtmes	Long-tailed Tit
<i>Gavia</i>	<i>arctica</i>	Storlom	Black-throated Diver
<i>Phalacrocorax</i>	<i>carbo</i>	Storskarv	Cormorant
<i>Mergus</i>	<i>merganser</i>	Storskrake	Goosander
<i>Numenius</i>	<i>arquata</i>	Storspov	Curlew
<i>Haematopus</i>	<i>ostralegus</i>	Strandskata	Oystercatcher
<i>Cinclus</i>	<i>cinclus</i>	Strömstare	Dipper
<i>Dendrocopos</i>	<i>major</i>	Större hackspett	Great Spotted Woodpecker
<i>Loxia</i>	<i>pytyopsittacus</i>	Större korsnäbb	Parrot Crossbill
<i>Charadrius</i>	<i>hiaticula</i>	Större strandpipare	Ringed Plover
<i>Ficedula</i>	<i>hypoleuca</i>	Svartvit flugsnappare	Pied Flycatcher
<i>Podiceps</i>	<i>auritus</i>	Svarthakedopping	Slavonian Grebe
<i>Sylvia</i>	<i>atricapilla</i>	Svarthätta	Blackcap
<i>Parus</i>	<i>ater</i>	Svartmes	Coal Tit
<i>Chlidonias</i>	<i>niger</i>	Svarttärna	Black Tern
<i>Melanitta</i>	<i>fusca</i>	Svärta	Velvet Scoter
<i>Alauda</i>	<i>arvensis</i>	Sånglärka	Skylark
<i>Motacilla</i>	<i>alba</i>	Sädesärta	White Wagtail
<i>Emberiza</i>	<i>schoeniclus</i>	Sävsparv	Reed Bunting
<i>Acrocephalus</i>	<i>schoenobaenus</i>	Sävsångare	Sedge Warbler
<i>Parus</i>	<i>major</i>	Talgoxe	Great Tit
<i>Parus</i>	<i>montanus</i>	Talltita	Willow Tit
<i>Turdus</i>	<i>philomelos</i>	Taltrast	Song Thrush
<i>Columba</i>	<i>livia</i>	Tamduva	Feral Pigeon
<i>Tetrao</i>	<i>urogallus</i>	Tjäder	Capercaillie
<i>Cephus</i>	<i>grylle</i>	Tobisgrissla	Black Guillemot
<i>Parus</i>	<i>cristatus</i>	Tofsmes	Crested Tit
<i>Vanellus</i>	<i>vanellus</i>	Tofsvipa	Lapwing
<i>Falco</i>	<i>tinnunculus</i>	Tornfalk	Kestrel
<i>Alca</i>	<i>torda</i>	Tordmule	Razorbill
<i>Apus</i>	<i>apus</i>	Tornseglare	Swift
<i>Grus</i>	<i>grus</i>	Trana	Crane
<i>Acrocephalus</i>	<i>arundinaceus</i>	Trastsångare	Great Reed Warbler
<i>Picoides</i>	<i>tridactylus</i>	Tretåig hackspett	Three-toed Woodpecker
<i>Certhia</i>	<i>familiaris</i>	Trädkrypare	Treecreeper
<i>Lullula</i>	<i>arborea</i>	Trådlärka	Wood Lark
<i>Anthus</i>	<i>trivialis</i>	Trädpiplärka	Tree Pipit
<i>Sylvia</i>	<i>borin</i>	Trädgårdssångare	Garden Warbler
<i>Streptopelia</i>	<i>decaocto</i>	Turkduva	Collared Dove
<i>Streptopelia</i>	<i>turtur</i>	Turturduva	Turtle Dove
<i>Lanius</i>	<i>collurio</i>	Törnskata	Red-backed Shrike
<i>Sylvia</i>	<i>communis</i>	Törnsångare	Whitethroat
<i>Coturnix</i>	<i>coturnix</i>	Vaktel	Quail
<i>Lanius</i>	<i>excubitor</i>	Varfågel	Great Grey Shrike
<i>Rallus</i>	<i>aquaticus</i>	Vattenrall	Water Rail
<i>Aythya</i>	<i>fuligula</i>	Vigg	Tufted Duck

Latin-Genus	Latin-species	Swedish	English
<i>Carduelis</i>	<i>flavrostris</i>	Vinterhämpling	Twite
<i>Dendrocopos</i>	<i>leucotos</i>	Vitryggig hackspett	White-backed Woodpecker
<i>Anas</i>	<i>querquedula</i>	Årta	Garganey
<i>Circus</i>	<i>pygargus</i>	Ängshök	Montagu's Harrier
<i>Anthus</i>	<i>pratensis</i>	Ängsplärka	Meadow Pipit
<i>Sylvia</i>	<i>curruca</i>	Ärtsångare	Lesser Whitethroat

Appendix 2

Total number of birds registered during the line transects

Table A-2. Total number of birds registered during the line transects in the candidate area in Forsmark 2002–2004. English and Swedish names are shown. Listed species in bold text. Densities (no of birds/km) are shown for all years. Due to a misunderstanding, white-tailed eagles were not counted during the line transects in 2002.

Species	No of birds 2002	No of birds 2003	No of birds 2004	No of birds/ km 2002	No of birds/ km 2003	No of birds/ km 2004
Cormorant, Storskarv	500	0	1	11.74	0.00	0.02
Chaffinch, Bofink	484	617	444	11.36	13.27	9.87
Willow warbler, Lövsångare	482	401	460	11.31	8.62	10.22
Siskin, Grönsiska	152	84	74	3.57	1.81	1.64
Robin, Rödhake	151	188	206	3.54	4.04	4.58
Greylag goose, Grågås	113	137	116	2.65	2.95	2.58
Blackbird, Koltrast	105	105	87	2.46	2.26	1.93
Song thrush, Taltrast	77	178	98	1.81	3.83	2.18
Yellowhammer, Gulsparr	67	70	37	1.57	1.51	0.82
Common gull, Fiskmås	58	190	198	1.36	4.09	4.40
Jackdaw, Kaja	55	153	35	1.29	3.29	0.78
Mute swan, Knölsvan	54	23	5	1.27	0.49	0.11
Great tit, Talgoxe	54	62	58	1.27	1.33	1.29
Garden warbler, Trädgårds-sångare	45	60	35	1.06	1.29	0.78
Wood pigeon, Ringduva	43	49	67	1.01	1.05	1.49
Black-headed gull, Skratmås	41	19	20	0.96	0.41	0.44
Canada goose, Kanadagås	39	2	0	0.92	0.04	0.00
Pied flycatcher, Svartvit Flug-snappare	39	31	35	0.92	0.67	0.78
Tree pipit, Trädpiplärka	37	26	37	0.87	0.56	0.82
Goldeneye, Knipa	36	90	19	0.85	1.94	0.42
Wren, Gärdsmyg	33	33	24	0.77	0.71	0.53
Redwing, Rödvingetrast	32	91	32	0.75	1.96	0.71
Goosander, Storskrake	32	25	23	0.75	0.54	0.51
Duncock, Järnsparv	30	39	30	0.70	0.84	0.67
Hooded crow, Kråka	30	37	18	0.70	0.80	0.40
Reed bunting, Sävsparv	30	26	25	0.70	0.56	0.56
House martin, Hussvala	26	2	0	0.61	0.04	0.00
Blackcap, Svarthätta	24	41	30	0.56	0.88	0.67
Blue tit, Blåmes	23	12	9	0.54	0.26	0.20
Wood warbler, Grönsångare	23	14	10	0.54	0.30	0.22
Goldcrest, Kungsfågel	23	97	56	0.54	2.09	1.24
Lesser whitethroat, Ärtsångare	21	18	18	0.49	0.39	0.40
Skylark, Sånglärka	20	25	14	0.47	0.54	0.31
Sedge warbler, Sävsångare	19	11	3	0.45	0.24	0.07
Swift, Tornseglare	19	2	0	0.45	0.04	0.00
White wagtail, Sädessärila	18	14	9	0.42	0.30	0.20
Starling, Stare	18	20	20	0.42	0.43	0.44

Species	No of birds 2002	No of birds 2003	No of birds 2004	No of birds/ km 2002	No of birds/ km 2003	No of birds/ km 2004
Whinchat, Buskskvätta	17	1	2	0.40	0.02	0.04
Chiffchaff, Gransångare	15	10	14	0.35	0.22	0.31
Lapwing, Tofsvipa	15	10	12	0.35	0.22	0.27
Crested tit, Tofsmes	14	17	9	0.33	0.37	0.20
Grey heron, Häger	13	7	1	0.31	0.15	0.02
Whooper swan, Sångsvan	13	30	35	0.31	0.65	0.78
Treecreeper, Trädkrypare	12	26	22	0.28	0.56	0.49
Greenfinch, Grönfink	10	19	21	0.23	0.41	0.47
Coal tit, Svartmes	10	31	12	0.23	0.67	0.27
Whitethroat, Törnsångare	10	17	8	0.23	0.37	0.18
Common snipe, Enkelbeckasin	9	16	32	0.21	0.34	0.71
Tufted duck, Vigg	9	64	4	0.21	1.38	0.09
Green sandpiper, Skogssnäppa	8	7	14	0.19	0.15	0.31
Mallard, Gräsand	7	19	14	0.16	0.41	0.31
Nuthatch, Nötväcka	7	2	4	0.16	0.04	0.09
Rosefinch, Rosenfink	7	14	6	0.16	0.30	0.13
Herring gull, Gråtrut	6	4	0	0.14	0.09	0.00
Greater black-backed gull, Havstrut	6	6	1	0.14	0.13	0.02
Raven, Korp	6	7	0	0.14	0.15	0.00
Fieldfare, Björkrast	5	6	9	0.12	0.13	0.20
Marsh tit, Entita	5	1	1	0.12	0.02	0.02
Swallow, Ladusvala	5	2	0	0.12	0.04	0.00
Redshank, Rödbena	5	3	2	0.12	0.06	0.04
Redstart, Rödstart	5	0	1	0.12	0.00	0.02
Willow tit, Talltita	5	13	13	0.12	0.28	0.29
Cuckoo, Gök	4	8	8	0.09	0.17	0.18
Arctic tern, Silvertärna	4	5	12	0.09	0.11	0.27
Common sandpiper, Drillsnäppa	3	3	2	0.07	0.06	0.04
Osprey, Fiskgjuse	3	2	0	0.07	0.04	0.00
Spotted flycatcher, Grå Flugsnappare	3	19	6	0.07	0.41	0.13
Icterine warbler, Härmsångare	3	8	3	0.07	0.17	0.07
Lesser spotted woodpecker, Mindre Hackspett	3	2	1	0.07	0.04	0.02
Oystercatcher, Strandskata	3	0	0	0.07	0.00	0.00
Bullfinch, Domherre	2	9	1	0.05	0.19	0.02
Hazelhen, Järpe	2	0	2	0.05	0.00	0.04
Woodcock, Morkulla	2	2	0	0.05	0.04	0.00
Red-breasted merganser, Småskrake	2	0	0	0.05	0.00	0.00
Black woodpecker, Spillkråka	2	4	1	0.05	0.09	0.02
Black-throated diver, Stormalom	2	1	2	0.05	0.02	0.04
Feral pigeon, Tamduva	2	0	0	0.05	0.00	0.00
Meadow pipit, Ängsplucka	1	0	0	0.02	0.00	0.00

Species	No of birds 2002	No of birds 2003	No of birds 2004	No of birds/ km 2002	No of birds/ km 2003	No of birds/ km 2004
Greenish warbler, Lund sångare	1	0	0	0.02	0.00	0.00
Jay, Nötskrika	1	4	0	0.02	0.09	0.00
Wheatear, Stenskvätta	1	3	1	0.02	0.06	0.02
Great spotted woodpecker, Större Hackspett	1	7	2	0.02	0.15	0.04
Curlew, Storspov	1	1	0	0.02	0.02	0.00
Kestrel, Tornfalk	1	0	0	0.02	0.00	0.00
Crane, Trana	1	4	5	0.02	0.09	0.11
Three-toed woodpecker, Tretåig Hackspett	1	0	1	0.02	0.00	0.02
Mistle thrush, Dubbeltrast	0	3	3	0.00	0.06	0.07
Common tern, Fisktärna	0	5	2	0.00	0.11	0.04
Wryneck, Göktyta	0	2	3	0.00	0.04	0.07
White-tailed eagle, Havsörn	Not counted	6	4	Not counted	0.13	0.09
Corncrake, Kornknarr	0	1	0	0.00	0.02	0.00
Teal, Kricka	0	2	0	0.00	0.04	0.00
Crossbill, Mindre korsnäbb	0	9	0	0.00	0.19	0.00
Thrush nightingale, Näktergal	0	1	0	0.00	0.02	0.00
Nutcracker, Nötkråka	0	1	0	0.00	0.02	0.00
Buzzard, Ormvråk	0	2	0	0.00	0.04	0.00
Black grouse, Orre	0	2	7	0.00	0.04	0.16
Ortolan bunting, Ortolan- sparv	0	1	0	0.00	0.02	0.00
Bittern, Rördrom	0	1	0	0.00	0.02	0.00
Reed warbler, Rørsångare	0	22	26	0.00	0.47	0.58
Caspian tern, Skräntärna	0	5	2	0.00	0.11	0.04
Hawfinch, Stenknäck	0	4	0	0.00	0.09	0.00
Long-tailed tit, Stjärtmes	0	9	0	0.00	0.19	0.00
Parrot crossbill, Större kors- näbb	0	57	0	0.00	1.23	0.00
Red-backed shrike, Törn- skata	0	1	1	0.00	0.02	0.02
Wood lark, Trädlärka	0	1	0	0.00	0.02	0.00
Green woodpecker, Gröngö- ling	0	0	2	0.00	0.00	0.04
Crested grebe, Skäggdopping	0	0	2	0.00	0.00	0.04
Hobby, Lärkfalk	0	0	1	0.00	0.00	0.02
Red-breasted flycatcher, Mindre flugsnappare	0	0	1	0.00	0.00	0.02
Sparrowhawk, Sparvhök	0	0	1	0.00	0.00	0.02
Total	3,326	3,541	2,692	78.08	76.15	59.82

Total number of birds registered during the point counts

Table A-3. Total number of birds registered during the point counts in the candidate area in Forsmark 2002–2004. Listed species in bold text. English and Swedish bird names are shown. Densities (no of birds/point) are shown for all years. Due to a misunderstanding, white-tailed eagles (havsörn) were not counted during the point counts in 2002.

Species	No of birds 2002	No of birds 2003	No of birds 2004	No of birds/ point 2002	No of birds/ point 2003	No of birds/ point 2004
Willow warbler, Lövsångare	111	96	116	1.91	1.50	1.81
Chaffinch, Bofink	92	150	111	1.59	2.34	1.73
Greylag goose, Grågås	86	75	83	1.48	1.17	1.30
Canada goose, Kanadagås	60	28	3	1.03	0.44	0.05
Siskin, Grönsiska	41	26	17	0.71	0.41	0.27
Robin, Rödhake	37	42	34	0.64	0.66	0.53
Great crested grebe, Skägg dopping	31	2	8	0.53	0.03	0.13
Mute swan, Knölsvan	29	11	54	0.50	0.17	0.84
Blackbird, Koltrast	27	41	21	0.47	0.64	0.33
Black-headed gull, Skrattnås	25	25	22	0.43	0.39	0.34
Common gull, Fiskmå	24	27	426	0.41	0.42	6.66
Song thrush, Taltrast	22	66	37	0.38	1.03	0.58
Yellowhammer, Gulsparv	21	32	21	0.36	0.50	0.33
Arctic tern, Silvertärna	21	23	18	0.36	0.36	0.28
Goldeneye, Knipa	18	86	13	0.31	1.34	0.20
Wood pigeon, Ringduva	17	21	28	0.29	0.33	0.44
Skylark, Sånglärka	14	9	4	0.24	0.14	0.06
Great tit, Talgoxe	14	18	19	0.24	0.28	0.30
Hooded crow, Kråka	13	18	7	0.22	0.28	0.11
Whooper swan, Sångsvan	12	19	20	0.21	0.30	0.31
Pied flycatcher, Svartvit flug- snappare	12	10	11	0.21	0.16	0.17
Wood warbler, Grönsångare	10	4	3	0.17	0.06	0.05
Reed bunting, Sävsparv	10	8	7	0.17	0.13	0.11
Red-breasted merganser, Småskrake	9	0	0	0.16	0.00	0.00
Blackcap, Svarthätta	9	12	11	0.16	0.19	0.17
Garden warbler, Trädgårds sångare	9	15	6	0.16	0.23	0.09
Wren, Gärdsmyg	8	11	7	0.14	0.17	0.11
Jackdaw, Kaja	8	1	4	0.14	0.02	0.06
Goosander, Storskrake	7	208	8	0.12	3.25	0.13
Crested tit, Tofsmes	7	6	3	0.12	0.09	0.05
Common tern, Fishtëarna	6	2	0	0.10	0.03	0.00
Tree pipit, Trädpiplärka	6	7	5	0.10	0.11	0.08
Lesser whitethroat, Ärtsångare	5	6	9	0.09	0.09	0.14

Species	No of birds 2002	No of birds 2003	No of birds 2004	No of birds/ point 2002	No of birds/ point 2003	No of birds/ point 2004
Common snipe, Enkelbeckasin	5	3	10	0.09	0.05	0.16
Chiffchaff, Gransångare	5	6	5	0.09	0.09	0.08
Greenfinch, Grönfink	5	10	10	0.09	0.16	0.16
Whitethroat, Törnsångare	5	6	3	0.09	0.09	0.05
Grey heron, Häger	4	2	6	0.07	0.03	0.09
Lapwing, Tofsvipa	4	2	3	0.07	0.03	0.05
Winchat, Buskskvätta	3	0	1	0.05	0.00	0.02
Common sandpiper, Drillsnäppa	3	3	1	0.05	0.05	0.02
Osprey, Fiskgjuse	3	0	0	0.05	0.00	0.00
Goldcrest, Kungsfågel	3	15	16	0.05	0.23	0.25
Swallow, Ladusvala	3	0	0	0.05	0.00	0.00
Redshank, Rödbena	3	2	1	0.05	0.03	0.02
Redwing, Rödvingetrast	3	20	7	0.05	0.31	0.11
Fieldfare, Björktrast	2	3	1	0.03	0.05	0.02
Bullfinch, Domherre	2	0	0	0.03	0.00	0.00
Mallard, Gräsand	2	7	6	0.03	0.11	0.09
Great black-backed gull, Havstrut	2	2	2	0.03	0.03	0.03
House martin, Hussvala	2	2	0	0.03	0.03	0.00
Duncock, Järnsparv	2	12	7	0.03	0.19	0.11
Raven, Korp	2	2	2	0.03	0.03	0.03
Redstart, Rödstart	2	0	0	0.03	0.00	0.00
Rosefinch, Rosenfink	2	12	2	0.03	0.19	0.03
White wagtail, Sädesärta	2	5	3	0.03	0.08	0.05
Starling, Stare	2	12	0	0.03	0.19	0.00
Goldfinch, Steglits	2	0	0	0.03	0.00	0.00
Crane, Trana	2	0	7	0.03	0.00	0.11
Marsh tit, Entita	1	0	0	0.02	0.00	0.00
Lesser spotted woodpecker, Mindre hackspett	1	0	1	0.02	0.00	0.02
Crossbill, Mindre korsnäbb	1	0	1	0.02	0.00	0.02
Jay, Nötskrika	1	3	0	0.02	0.05	0.00
Nuthatch, Nötväcka	1	1	1	0.02	0.02	0.02
Buzzard, Ormvråk	1	0	0	0.02	0.00	0.00
Sedge warbler, Sävsångare	1	3	2	0.02	0.05	0.03
Great spotted woodpecker, Större hackspett	1	1	2	0.02	0.02	0.03
Coal tit, Svartmes	1	13	1	0.02	0.20	0.02
Willow tit, Talltita	1	4	5	0.02	0.06	0.08
Swift, Tornseglare	1	2	0	0.02	0.03	0.00
Treecreeper, Trädkrypare	1	11	8	0.02	0.17	0.13
Blue tit, Blåmes	0	5	2	0.00	0.08	0.03
Cuckoo, Gök	0	7	4	0.00	0.11	0.06

Species	No of birds 2002	No of birds 2003	No of birds 2004	No of birds/ point 2002	No of birds/ point 2003	No of birds/ point 2004
Spotted flycatcher, Grå flugsnappare	0	2	0	0.00	0.03	0.00
Herring gull, Gråtrut	0	3	6	0.00	0.05	0.09
Icterine warbler, Härmsångare	0	2	1	0.00	0.03	0.02
White-tailed eagle, Havsörn	Not counted	2	1	Not counted	0.03	0.02
Corncrake, Kornknarr	0	2	0	0.00	0.03	0.00
Woodcock, Morkulla	0	1	0	0.00	0.02	0.00
Thrush nightingale, Näktergal	0	2	0	0.00	0.03	0.00
Black grouse, Orre	0	2	2	0.00	0.03	0.03
Ortolan bunting, Ortolan-sparv	0	2	0	0.00	0.03	0.00
Reed warbler, Rörsångare	0	3	5	0.00	0.05	0.08
Lesser black-backed gull, Silltrut	0	2	0	0.00	0.03	0.00
Shoveler, Skedand	0	1	0	0.00	0.02	0.00
Green sandpiper, Skogs-snäppa	0	4	5	0.00	0.06	0.08
Black-throated diver, Storlom	0	2	0	0.00	0.03	0.00
Parrot crossbill, Större korsnäbb	0	10	0	0.00	0.16	0.00
Ringed plover, Större strandpipare	0	2	0	0.00	0.03	0.00
Oystercatcher, Strandskata	0	1	5	0.00	0.02	0.08
Wood lark, trädlärka	0	1	0	0.00	0.02	0.00
Tufted duck, Vigg	0	71	15	0.00	1.11	0.23
Wryneck, Göktyta	0	0	1	0.00	0.00	0.02
Wheatear, Stenskvätta	0	0	1	0.00	0.00	0.02
Red-backed shrike, Törn-skata	0	0	1	0.00	0.00	0.02
Water rail, Vattenrall	0	0	1	0.00	0.00	0.02
Total	908	1,396	1,300	15.66	21.81	20.31