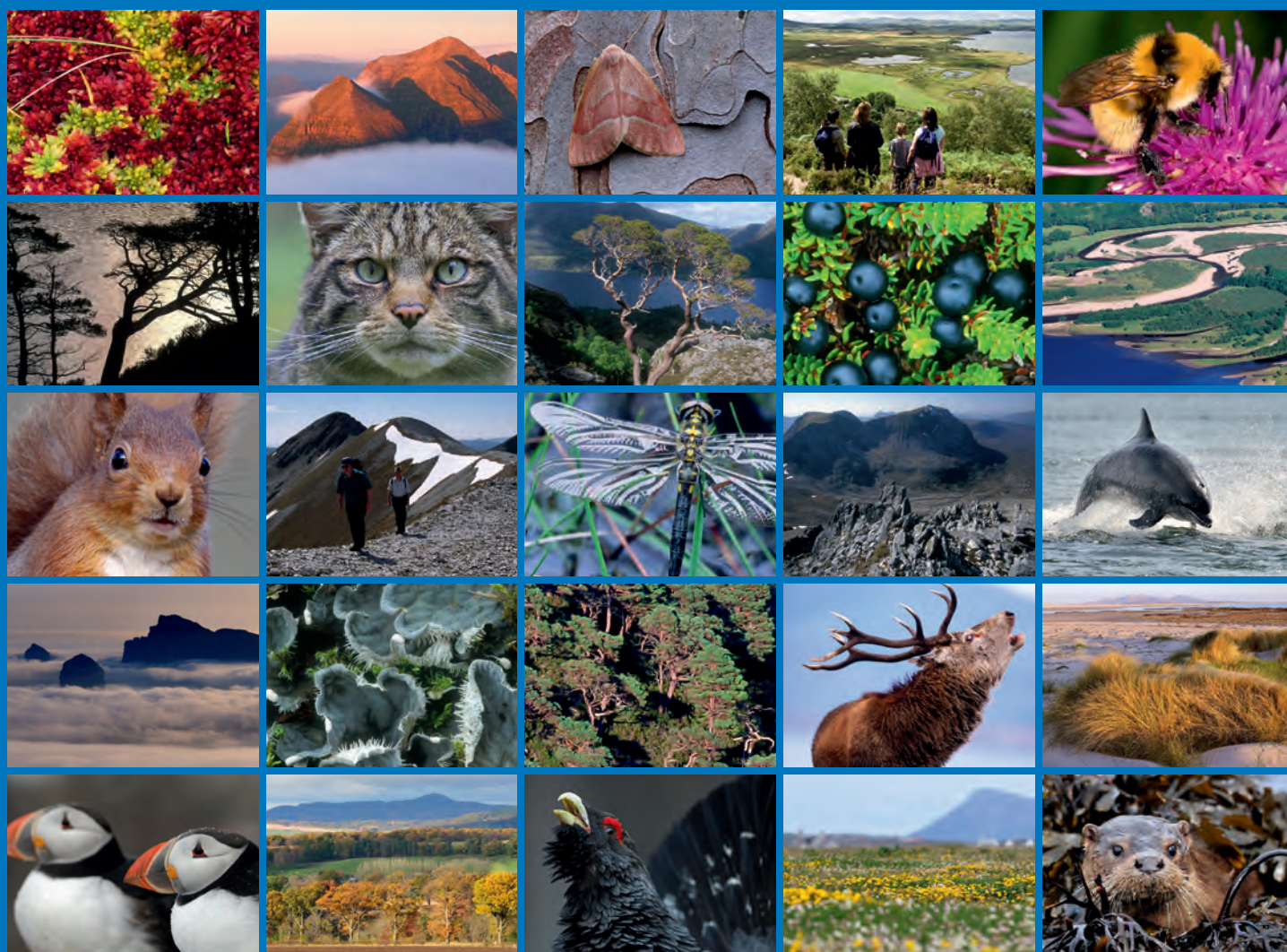


# Survey of the feeding areas, roosts and flight activity of qualifying species of the Caithness Lochs Special Protection Area





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# COMMISSIONED REPORT

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**Commissioned Report No. 523**

## **Survey of the feeding areas, roosts and flight activity of qualifying species of the Caithness Lochs Special Protection Area**

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## COMMISSIONED REPORT

# Summary

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## **Survey of the feeding areas, roosts and flight activity of qualifying species of the Caithness Lochs Special Protection Area**

**Commissioned Report No. 523** (*iBids and Project no.10912*)

**Contractor: Northern Ecological Services**

**Year of publication: 2012**

### **Background**

Caithness has recently seen a large increase in applications for small-medium scale wind energy developments. The agricultural landscape in North Caithness is heavily used for foraging by geese and swans from the Caithness Lochs SPA. The current and anticipated numbers of small scale turbine applications has the potential to present increasing risks to these species from collision, disturbance and displacement.

Current knowledge of the distribution of foraging SPA species is both dated and limited, and the impacts of these proposals (single and cumulative) on birds is not clear. Potential impacts over a wide area need to be assessed because the SPA species are very mobile, moving between roost sites (designated as SPAs) and favoured feeding grounds (which are not designated). The current data set is over 10 years old so that a new extensive survey was considered to be necessary.

### **Main findings**

- The survey described the feeding distribution, feeding habitats, roosting numbers and flight activity of three qualifying species of the Caithness Lochs SPA; Greenland white-fronted goose, greylag goose and whooper swan. The pink-footed goose was also included since it was found in large numbers in the same area as the qualifying species.
- Greylag geese, pink-footed geese and whooper swans were widely distributed over the survey area, which included all suitable habitat within 25 km of the SPA lochs. Greenland white-fronted geese were found only around Broubster Leans and Loch Calder in the west of the area and around the Loch of Mey in the north.
- The distribution of flights observed during the survey was broadly similar to the feeding distribution.
- The commonest feeding habitat was improved grassland, with stubble used frequently in autumn.
- The numbers of geese and swans using the SPA lochs, their departure directions and flight heights were tabulated in three height bands; 0 – 20m; 20 – 150m; and over 150m. Most birds flew at 20 – 150m (collision risk height).

<b>Table of Contents</b>		<b>Page</b>
<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
	1.1.1 The qualifying species	1
<b>2</b>	<b>AIMS AND APPROACH</b>	<b>2</b>
	2.1 Objectives	2
	2.2 Approach	2
<b>3</b>	<b>THE SURVEY AREA</b>	<b>3</b>
<b>4</b>	<b>METHODOLOGY</b>	<b>4</b>
	4.1 Initial site visit	4
	4.2 Roost observations	4
	4.3 Transects of the feeding area	5
	4.4 Survey schedule	5
	4.5 Data capture and analysis	5
	4.6 Health and safety	6
<b>5</b>	<b>RESULTS</b>	<b>7</b>
	5.1 Feeding distribution	7
	5.1.1 Greenland white-fronted goose	7
	5.1.2 Greylag goose	7
	5.1.3 Pink-footed goose	7
	5.1.4 Whooper swan	7
	5.1.5 All species combined	7
	5.2 Habitats and crop types	8
	5.2.1 Greenland white-fronted goose	8
	5.2.2 Greylag goose	8
	5.2.3 Pink-footed goose	9
	5.2.4 Whooper swan	9
	5.3 Distribution of flight activity	9
	5.4 Roosts	10
	5.4.1 Broubster Leans	10
	5.4.2 Loch Calder	10
	5.4.3 Loch Heilen	11
	5.4.4 Loch of Mey	12
	5.4.5 Loch Scarmclate	12
	5.4.6 Loch Watten	13
	5.4.7 Loch of Wester	14
	5.4.8 All roosts combined	14
	5.5 Flight height	15
	5.5.1 Flights in the foraging areas	15
	5.5.2 Departures from roosts	15
	5.6 Total numbers of geese and swans counted on transects and at roosts	16
	5.7 Other target species	17
<b>6</b>	<b>DISCUSSION</b>	<b>19</b>
<b>7</b>	<b>CONCLUSIONS</b>	<b>21</b>
<b>8</b>	<b>REFERENCES</b>	<b>22</b>

## **List of Figures**

---

*Figure 3.1. The Caithness Lochs survey area, showing the SPA lochs, the survey area boundary, areas which could not be surveyed and the vantage points used in roost observations.*

*Figure 3.2. The road network in the Caithness Lochs survey area.*

*Figure 5.1. The distribution of sites used by Greenland white-fronted geese in the Caithness Lochs survey area in 2011/12*

*Figure 5.2. The distribution of sites used by greylag geese in the Caithness Lochs survey area in 2011/12*

*Figure 5.3. The distribution of sites used by pink-footed geese in the Caithness Lochs survey area in 2011/12*

*Figure 5.4. The distribution of sites used by whooper swans in the Caithness Lochs survey area in 2011/12*

*Figure 5.5. The distribution of sites used by geese and whooper swans in the Caithness Lochs survey area in 2011/12*

*Figure 5.6. Flights by geese and swans in the Caithness Lochs survey area during transect surveys in 2011/12*

## **List of Tables**

---

*Table 5.1. The habitats and crop types on which Greenland white-fronted geese were recorded in the Caithness Lochs survey area in 2011/12*

*Table 5.2. The habitats and crop types on which greylag geese were recorded in the Caithness Lochs survey area in 2011/12*

*Table 5.3. The habitats and crop types on which pink-footed geese were recorded in the Caithness Lochs survey area in 2011/12*

*Table 5.4. The habitats and crop types on which whooper swans were recorded in the Caithness Lochs survey area in 2011/12*

*Table 5.5. The numbers of geese and swans recorded roosting at Broubster Leans in 2011/12*

*Table 5.6. The departure directions of geese and swans from Broubster Leans in 2011/12*

*Table 5.7. The numbers of geese and swans recorded roosting at Loch Calder in 2011/12*

*Table 5.8. The departure directions of geese and swans from Loch Calder in 2011/12*

*Table 5.9. The numbers of geese and swans recorded roosting at Loch Heilen in 2011/12*

*Table 5.10. The departure directions of geese and swans from Loch Heilen in 2011/12*

*Table 5.11. The numbers of geese and swans recorded roosting at Loch of Mey in 2011/12*

*Table 5.12. The departure directions of geese and swans from Loch of Mey in 2011/12*

### **List of Tables, Continued**

*Table 5.13. The numbers of geese and swans recorded roosting at Loch Scarmclate in 2011/12*

*Table 5.14. The departure directions of geese and swans from Loch Scarmclate in 2011/12*

*Table 5.15. The numbers of geese and swans recorded roosting at Loch Watten in 2011/12*

*Table 5.16. The departure directions of geese and swans from Loch Watten in 2011/12*

*Table 5.17. The numbers of geese and swans recorded roosting at Loch of Wester in 2011/12*

*Table 5.18. The departure directions of geese and swans from Loch of Wester in 2011/12*

*Table 5.19. The numbers of geese and swans recorded roosting at the Caithness SPA lochs (combined) in 2011/12*

*Table 5.20. The flight height of goose and swan flocks recorded in the Caithness Lochs survey area in 2011/12*

*Table 5.21. The flight height of goose and swan flocks departing from Caithness Lochs roosts in 2011/12*

*Table 5.22. The total numbers of geese and swans recorded in the Caithness Lochs survey area and at the SPA roosts in 2011/12*

*Table 5.23. Other target species recorded during the Caithness Lochs transect surveys*



## 1 INTRODUCTION

The background to the work, as outlined by SNH, is that Caithness has recently seen a large increase in applications for small-medium scale wind energy developments. The agricultural landscape in North Caithness is heavily used for foraging by geese and swans from the Caithness Lochs SPA. The current and anticipated numbers of small scale turbine applications has the potential to present increasing risks to these species from collision, disturbance and displacement. In addition, forestry proposals driven by government afforestation targets are likely to encourage considerable land-take within these areas, which may cause cumulative loss of foraging habitat.

SNH are required to be able to assess proposals which have connectivity to the SPA, in relation to *Natura* legislation. Current knowledge of the distribution of foraging SPA species is both dated and limited, and the impacts of these proposals (single and cumulative) on birds is not clear. The current data set is over 10 years old and details the broad abundance and distribution of migratory geese and whooper swans across Caithness. Potential impacts over a wide area need to be assessed because the SPA species are very mobile, moving between roost sites (designated as SPAs) and favoured feeding grounds (which are not designated). For these reasons, a new extensive survey was considered to be necessary.

### 1.1.1 *The qualifying species*

The qualifying bird species of the Caithness Lochs SPA are the Greenland white-fronted goose *Anser albifrons flavirostris*, the greylag goose *Anser anser* and the whooper swan *Cygnus cygnus*. The number of each species in the SPA Citation is based on the mean of winter peak counts made between 1993/94 and 1997/98. More recent five-year mean counts were taken from SNH's Site Condition Monitoring of the SPA.

#### Greenland white-fronted goose

SPA Citation; 440 birds, representing 3% of the GB wintering population and 1% of the Greenland population. The five-year mean number in 2005/6 to 2009/10 was 326. Numbers appear to have remained at around the same level, with two main flocks of approximately equal size: the western population roosting at Loch Thormaid / Loch Saorach and Broubster Leans area; the eastern flock at Loch of Mey but also on the moss at Phillip's Mains.

#### Greylag goose

SPA Citation; 7,190 birds, representing 7% of the GB wintering population and 7% of the Iceland population. The five-year mean number in 1996/97 to 2000/01 was 8,730. Recent numbers have varied between years, from 2,792 in November 2002 to 12,129 in November 2008, representing from 3.8% to 12.3% of GB wintering population (data from the Wildfowl and Wetlands Trust National Grey Goose Census). The numbers from recent years exclude an estimated 1,000 resident breeding birds (counted in August 2009), which are thought to remain to spend the winter in the area (Forrester *et al.* 2007).

#### Whooper swan

SPA Citation; 240 birds, representing 4% of the GB wintering population and 1% of the Iceland population. The five-year mean number in 1996/97 to 2000/01 was 232. Forrester *et al.* (2007) report that most birds were found to roost on Loch of Wester (158 birds) and Loch Heilen (60 birds).

## **2 AIMS AND APPROACH**

### **2.1 Objectives**

The purpose of the work, as specified by SNH, was to determine the following:

- i) The location of known feeding areas of each of the qualifying interests of the Caithness Lochs Special Protection Area (SPA) throughout the core wintering period (October to April inclusive);
- ii) What the SPA qualifying species are feeding on;
- iii) The key flight lines (including flight heights) between the Caithness Lochs roost sites and feeding areas.

### **2.2 Approach**

The proposed methodology to answer the above questions was of three types;

- i) Observation of roost sites at dawn, to count the number of birds present and to plot the flight lines from the roost;
- ii) Systematic road transects of the whole potential foraging area, to determine the feeding distribution of each qualifying species, to describe the food sources being used and to plot flight lines of birds moving between feeding sites;
- iii) Measurement of flight height by each species at different distances from roost sites.



### 3 THE SURVEY AREA

The Caithness Lochs SPA comprises one mire (Broubster Leans) and six lochs; Calder, Heilen, Mey, Scarmclate, Watten and Wester (Figure 3.1). A recent review for SNH by Patterson (2011) has shown that most pink-footed geese *Anser brachyrhynchus* in Grampian forage within 20 km of their roost and that flight activity beyond this range is at “background” level, mainly through geese moving around the region and between roost sites (Giroux 1991; Giroux and Patterson 1995). A range of 20 km is also generally considered to be the maximum distance at which connectivity to a goose SPA can be assumed. Consequently, the proposed survey area was delimited by a 25 km radius around the west, south-west and south of the Caithness Lochs and by the sea coast to the north and east. Much of this very large area is made up of habitats such as forest and dry upland heath, which are unsuitable for goose and swan foraging. These habitats are concentrated in a large part of the west and south-west of the area, and on Dunnet Head and in the north-east of the area. The remaining agricultural lowland where the geese and swans were expected to forage has a total area of approximately 700 km<sup>2</sup> (Figure 3.1).

The initial choice of the area in which the survey of foraging distribution would be carried out was informed by the results of previous surveys (Laybourne 1997; Laybourne & Fox 1988) and by consultation with local ornithologists, Stan Laybourne and Julian Smith, who have studied geese in the area for many years. However, since the birds’ foraging distribution may well have altered in recent years in response to land use and other changes, it is important that a systematic and unbiased survey of the whole area is carried out.

## **4 METHODOLOGY**

### **4.1 Initial site visit**

A visit to the survey area was made by David Lambie and Ian Patterson on 19 – 21 September 2011, to consult Stan Laybourne and Julian Smith, to inspect potential vantage points, to check the visibility of foraging areas from the road network, and to discuss methodology.

### **4.2 Roost observations**

The roost sites were observed at dawn from vantage points (Figure 3.1) that gave unobstructed views of the outgoing flights, but which were far enough away to avoid any influence of the observer on the flight paths of the birds. The vantage points were selected on advice from Stan Laybourne and Julian Smith, based on their experience of the most likely flight lines from each roost. During the initial site visit, each of the vantage points was visited to check visibility and to familiarise the surveyors with the site and access to the vantage point.

A suitable vantage point was located at each of the roost sites (Figure 3.1). All of the vantage points were on public roads, so there were no access problems. Their grid references are:

Broubster Leans; ND 028 610

Loch Calder (north); ND 076 615

Loch Calder (south); ND 083 600

Loch Heilen; ND 262 695

Loch of Mey; ND 275 725, on A836

Loch Scarmclate; ND 200 593, on track at Scarmclate

Loch Watten; ND 232 552, on A882, opposite Wester Watten

Loch of Wester; ND 331 588, on old bridge

The observations started at least 45 min before sunrise, before the time when the birds were expected to start departing (from observations at roosts in Aberdeenshire) and ended when all of the geese and swans had departed. The birds of each species were counted as they flew out and their flight lines were plotted on large scale maps. After the birds' departure, the main flight lines were followed up, to check whether birds had flown into areas not covered by the road transects (below).

Flight heights were measured by laser rangefinder/clinometer for those flocks which flew close enough to the observer (within 400m; I.J. Patterson, personal observations). The flight heights of more distant flocks were estimated in relation to features such as trees and pylons and by reference to flight heights measured by rangefinder. The estimated heights were divided into four bands; up to 20m (the lower limit collision risk zone); 20 – 50m; 50 – 100m; 100 – 150m and above 150m (the upper limit of the collision risk zone). In practice, few flocks flew close enough to the surveyors for the rangefinder to be used, so most flight heights were estimated.

Dusk observations were not carried out, since experience at roosts in Aberdeenshire suggests that counts may underestimate the total number of birds present if arrivals continue after dark and that flight lines will be difficult to plot accurately in deteriorating light conditions.

The dates of the roost observations and details of the weather reported by the surveyors are shown in Appendix 1.

### **4.3 Transects of the feeding area**

Surveys of the birds' foraging distribution followed the procedure used successfully by Keller *et al.* (1997) in the area around the Loch of Strathbeg, Aberdeenshire. The surveyors drove along all of the available roads in the area (apart from any which duplicated the coverage from other roads), including minor roads and tracks (Figure 3.2), stopping at intervals (especially on vantage points) to scan the area for flocks of geese and swans. The starting point of the route was varied between surveys, to prevent any systematic bias in relation to the time of day when each part of the area was visited. Any small flocks seen in flight were watched, since they were likely to join larger flocks foraging in fields, some of which may not have been seen easily from the road transect route. This methodology gave an unbiased description of the birds' foraging distribution, but was augmented by observations of flight lines, which could reveal the use of foraging areas that were outside the transect area. Any such observations were followed up and, if necessary, additional areas were added to the transect route.

Some areas, especially in the north-east of the survey area, were far from any roads and could not be surveyed (Figure 3.1). In addition, some small pockets of land were not visible from the transect route, but these were considered to be distributed fairly evenly throughout the survey area, so that they would not have biased the survey results.

Transects were usually started in the morning and continued throughout the day. The dates of the transect surveys and details of the weather reported by the surveyors are shown in Appendix 1.

All geese and swans detected on the transects were counted, their locations recorded as grid references and the crop type of the field recorded as an indication of the food being consumed. The data, which were entered on *pro-forma* recording sheets, included as a minimum; date, time, grid reference, crop type, species code, number of birds, and predominant activity (feeding or resting). A separate record was kept of the weather on each survey day.

The flight paths of all geese and swans seen flying within the survey area were plotted on maps and flight heights were measured or estimated as described above. Particular attention was paid to the plotting of flight lines in the late afternoon and early evening, as geese and swans began to move towards their roost sites. The data, which were written on the map alongside the flight line, included as a minimum; date, time, species code, number of birds and flight height.

In addition to the qualifying species of the SPA, all other target species, such as pink-footed geese and raptors, seen in the survey area were recorded.

### **4.4 Survey schedule**

The field survey started in the second half of October, after the first geese and swans had arrived in the area, and ended in mid April, by which time most of the birds had departed. Surveys were carried out at monthly intervals, giving a total of seven surveys over the whole period.

### **4.5 Data capture and analysis**

The road transect data were analysed to produce maps of the foraging distribution of each of the three qualifying species in different seasons of the wintering period. The grid references were converted to GIS coordinates and the locations of flocks were plotted in ArcGIS 9.

Different dot colours were used to represent the three seasons of the wintering period: autumn (October and November); winter (December to February); and spring (March and April). The GIS shapefiles supplied with this report will allow the individual fields used by the birds to be pinpointed and can also be used to summarise the foraging distributions by contouring.

The flight line data were digitised in ArcGIS 9 and collated to provide similar maps, which showed the amount of flight activity by each species in different parts of the survey area. Different colours were used to distinguish the different species.

The roost counts of geese and swans were collated and tabulated, to provide data on the number of each species roosting at each roost site. It was found to be impractical to plot the flight lines of flocks departing from roosts, since in most cases there were large numbers of separate departures, many taking different flight paths, some circling the roost before leaving. Plotting of these flight lines gave a very cluttered picture, so the data were summarised to show the distribution of final departure directions over eight compass points.

Records of bird species other than the SPA qualifying species were also collated.

Copies of the raw transect data and digitised flight line maps were sent each month to the SNH Nominated Officer.

#### **4.6 Health and safety**

All field work was carried out in accordance with NES health and safety procedures. In particular, care was taken to establish safe access routes to vantage points, especially as these were visited in poor light conditions at dawn. Particular care was also taken when driving on road transects and the surveyors stopped only where it was safe to do so, e.g. in field gateways or on wide verges.

## 5 RESULTS

### 5.1 Feeding distribution

The locations where geese and whooper swans were found during the transect surveys are shown in Figures 5.1 to 5.5 by coloured dots, which distinguish observations made in the different parts of the season; autumn (October and November); winter (December to February); and spring (March and April). Because of the very wide variation in flock sizes (from a few birds to several thousands), it was not found to be practicable to indicate flock size by different dot sizes; large dots obscured too much of the location and small dots were difficult to see.

#### 5.1.1 *Greenland white-fronted goose*

White-fronted geese were found in only two parts of the survey area; in the west, near Broubster and Calder and in the north, around Mey (Figure 5.1). In the west area, the birds were found mainly to the north-west of the lochs, with two records to the south-east in autumn and winter. In the north area, the geese were found mainly to the south-east of the Loch of Mey.

#### 5.1.2 *Greylag goose*

Greylag geese were widely distributed throughout the survey area (Figure 5.2), with concentrations in the west, around Broubster and Calder; in the central part of the area between Heilen, Wester, Watten and Scarmclate; and along the east part of the north coast. Some flocks were found in the coastal strip south of Wick. Greylag geese were absent from an area around Thurso, from an area south of Scarmclate and from the higher ground in the north-east of the survey area (Figure 5.2).

#### 5.1.3 *Pink-footed goose*

Pink-footed geese were distributed widely in the south-west part of the survey area and in a band in the north, extending from Mey through Heilen to Wester (Figure 5.3). As with greylag geese, a few flocks were found in the coastal strip south of Wick. The species was less often recorded in a band between Thurso and Wick and was not found on the higher ground in the north-east of the survey area, or in an area south of Scarmclate (Figure 5.3).

#### 5.1.4 *Whooper swan*

Whooper swans were recorded mainly in a zone extending from Wick through Scarmclate to the coast north of Broubster and in a band from Mey through Heilen to Wester (Figure 5.4). The swans were absent from an area around Thurso, from an area south of Scarmclate, from the higher ground in the north-east of the survey area and from the coastal strip south of Wick (Figure 5.4).

#### 5.1.5 *All species combined*

When the records of all four species are combined (Figure 5.5), there was clearly a concentration of flocks in the north-west of the survey area, north of Broubster and Calder; in an area in the south-west (south of Calder); in a band from Scarmclate, through Watten to Wick; and in a band from Mey through Heilen to Wester. There was also a concentration between Castletown and Scarmclate and another on the north-east coast. The latter was composed entirely of greylag geese.

## 5.2 Habitats and crop types

To detect seasonal changes in the habitats and crop types being used by the birds, the wintering period was divided into three seasons: autumn (October and November); winter (December to February); and spring (March and April). For two of the species, there were few records in one or more seasons, so data were combined.

### 5.2.1 Greenland white-fronted goose

Since only 13 flocks of white-fronted geese were recorded during the transect surveys, it was not possible to analyse the use of different feeding habitats separately for the three parts of the wintering period, so all records have been combined. Most flocks and geese were found on improved grassland and on stubble fields (Table 5.1), with fewer birds on unimproved grassland and other habitats, which were mainly loch margins.

*Table 5.1. The habitats and crop types on which Greenland white-fronted geese were recorded in the Caithness Lochs survey area in 2011/12. The values are percentages of the totals in the last line*

Habitat	Flocks	Geese
Bog	0.0	0.0
Improved grassland	53.8	59.4
Stubble	30.8	28.3
Unimproved grassland	7.7	0.7
Winter cereal	0.0	0.0
Other	7.7	11.7
Number of flocks/birds	13	768

### 5.2.2 Greylag goose

In autumn, most flocks of greylag geese were found on stubble, although the mean flock size there was smaller than on improved grassland, so that similar numbers of geese fed on the two crop types (Table 5.2). A lower percentage of flocks and geese were recorded on stubble in winter and by spring, all of the greylag geese seen in the transect surveys were on grassland, mostly improved grassland.

*Table 5.2. The habitats and crop types on which greylag geese were recorded in the Caithness Lochs survey area in 2011/12. The values are percentages of the totals in the last line*

Habitat	Autumn		Winter		Spring	
	Flocks	Birds	Flocks	Birds	Flocks	Birds
Bog	3.4	1.0	0.0	0.0	0.0	0.0
Improved grassland	17.2	48.6	66.7	58.5	90.0	69.9
Stubble	65.5	46.8	30.3	40.5	0.0	0.0
Unimproved grassland	6.9	1.4	1.5	0.2	10.0	30.1
Winter cereal	0.0	0.0	1.5	0.8	0.0	0.0
Other	6.9	2.2	0.0	0.0	0.0	0.0
Number of flocks/birds	29	12,437	66	10,166	30	3,571

### 5.2.3 Pink-footed goose

Very few pink-footed geese were recorded in the autumn surveys, so the data have been combined with those from winter. In autumn and winter, most birds were found on improved grassland, with around a quarter on stubble and some on unimproved grassland (Table 5.3). In spring, all of the pink-footed geese were found on grassland, mainly improved grassland.

*Table 5.3. The habitats and crop types on which pink-footed geese were recorded in the Caithness Lochs survey area in 2011/12. The values are percentages of the totals in the last line*

Habitat	Autumn/winter		Spring	
	Flocks	Birds	Flocks	Birds
Bog	0.0	0.0	0.0	0.0
Improved grassland	63.2	55.6	86.2	85.4
Stubble	21.1	28.4	0.0	0.0
Unimproved grassland	10.5	15.0	13.8	14.6
Winter cereal	0.0	0.0	0.0	0.0
Other	5.3	1.0	0.0	0.0
Number of flocks/birds	19	10,357	29	20,719

### 5.2.4 Whooper swan

In autumn, the majority of whooper swans recorded on the transect surveys were found on stubble fields, with most of the remainder feeding on lochs (Table 5.4; "Other"). In winter, most of the swans were found in bogs and on improved grassland, while in spring the great majority of the birds were recorded on the latter.

*Table 5.4. The habitats and crop types on which whooper swans were recorded in the Caithness Lochs survey area in 2011/12. The values are percentages of the totals in the last line*

Habitat	Autumn		Winter		Spring	
	Flocks	Birds	Flocks	Birds	Flocks	Birds
Bog	0.0	0.0	30.8	33.3	0.0	0.0
Improved grassland	0.0	0.0	30.8	44.4	90.0	97.1
Stubble	64.3	77.1	23.1	12.0	0.0	0.0
Unimproved grassland	3.6	0.1	0.0	0.0	0.0	0.0
Winter cereal	0.0	0.0	0.0	0.0	0.0	0.0
Other	32.1	20.6	15.4	10.3	10.0	2.9
Number of flocks/birds	28	1,356	13	234	10	279

## 5.3 Distribution of flight activity

Rather few flights by geese and swans were observed during the road transects: 15 by greylag geese; eight by pink-footed geese; eight by unidentified geese; and four by whooper swans; a total of 35 flights (Figure 5.6). Details of the flights are shown in Appendix 2.

The distribution of flights followed fairly closely the birds' feeding distribution (section 5.1, above), the main exception being in the north-west part of the area, where there were fewer flights relative to the number of foraging flocks recorded in the transect survey.



## 5.4 Roosts

### 5.4.1 Broubster Leans

Broubster was used by all four species, although not all of them in every month (Table 5.5). Pink-footed geese were recorded only in April.

Table 5.5. The numbers of geese and swans recorded roosting at Broubster Leans in 2011/12

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	254	0	45	0	0	299
November	0	0	0	26	50	76
December	120	0	73	0	0	193
January	122	0	0	28	6	156
February	0	0	0	0	0	0
March	No count, due to fog					
April	6	800	0	0	0	806

In addition to the birds roosting on Broubster itself, others were seen flying over the area from the west, probably from Loch Saorach or Loch Thormaid. These were: Greenland white-fronted geese; 45 on 18/10/2011, 100 on 29/11/2011 and six on 11/01/2012; greylag geese; 254 on 18/10/2011 and 810 on 29/11/2011. Only those birds which flew eastwards over Broubster would have been detected by the surveyors and others may well have departed in other directions.

Most flocks departed from the roost in a northward direction, ranging from north-east to north-west (Table 5.6).

Table 5.6. The departure directions of flocks of geese and swans from Broubster Leans in 2011/12. The species codes on this and subsequent tables are: GJ – greylag goose; NW – Greenland white-fronted goose; PG – pink-footed goose; WS – whooper swan

Species	Number in each direction								Total
	N	NE	E	SE	S	SW	W	NW	
GJ	3	2						3	8
NW			1				1		2
PG	1							2	3
WS		3							3
All	4	5	1				1	5	16
%	25.0	31.3	6.3				6.3	31.3	

### 5.4.2 Loch Calder

Loch Calder was used by greylag geese, pink-footed geese and whooper swans, but no Greenland white-fronted geese were recorded there (Table 5.7). Pink-footed geese were found only in March and April.

Table 5.7. The numbers of geese and swans recorded roosting at Loch Calder in 2011/12

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	287	0	0	62	0	349
November	3	0	0	7	0	10
December	128	0	0	7	0	135
January	466	0	0	0	0	466
February	55	0	0	18	0	73
March	494	3	0	0	16	513
April	1,626	769	0	0	0	2,395

Most flocks leaving the roost flew north, north-east, or east (Table 5.8).

Table 5.8. The departure directions of flocks of geese and swans from Loch Calder in 2011/12

Species	Number in each direction								Total
	N	NE	E	SE	S	SW	W	NW	
GJ	15	31	19	3		1	1	3	73
PG	6	7	1						14
WS		1	7	2					10
All	21	39	27	5		1	1	3	97
%	21.6	40.2	27.8	5.2		1.0	1.0	3.1	

#### 5.4.3 Loch Heilen

Loch Heilen was used for roosting by greylag geese and whooper swans, but no pink-footed or Greenland white-fronted geese were recorded roosting there (Table 5.9).

Table 5.9. The numbers of geese and swans recorded roosting at Loch Heilen in 2011/12

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	154	0	0	147	0	301
November	621	0	0	106	0	727
December	45	0	0	20	0	65
January	250	0	0	33	0	283
February	95	0	0	0	0	95
March	0	0	0	124	0	124
April	0	0	0	0	275	275

Greylag geese and whooper swans left Loch Heilen in a wide range of directions (apart from north-west), but mainly north-east and south east (Table 5.10).

Table 5.10. The departure directions of flocks of geese and swans from Loch Heilen in 2011/12

Species	Number in each direction								Total
	N	NE	E	SE	S	SW	W	NW	
GJ	1	6		1	1	2	1		12
WS	2	7	6	11	1	1	3		31
All	3	13	6	12	2	3	4		43
%	7.0	30.2	14.0	27.9	4.7	7.0	9.3	0.0	

#### 5.4.4 Loch of Mey

All four species were recorded roosting at Loch of Mey, although greylag geese and pink-footed geese were found only in February, March and April (Table 5.11).

Table 5.11. The numbers of geese and swans recorded roosting at Loch of Mey in 2011/12

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	0	0	90	90	0	180
November	0	0	0	8	0	8
December	0	0	179	0	0	179
January	0	0	3	0	0	3
February	260	320	90	22	60	752
March	80	4,700	100	0	50	4,930
April	0	2,200	0	9	720	2,929

More than half of the birds leaving the Loch of Mey flew south-eastwards, with most of the remainder flying to the south-west (Table 5.12).

Table 5.12. The departure directions of flocks of geese and swans from Loch of Mey in 2011/12

Species	Number in each direction								Total
	N	NE	E	SE	S	SW	W	NW	
GJ						4			4
NW				7	2	1			10
PG				3	1	3			7
WS				6		3			9
All				16	3	11			30
%				53.3	10.0	36.7			

#### 5.4.5 Loch Scarmclate

Loch Scarmclate was also used for roosting by all four species, although Greenland white-fronted geese were recorded only in January (Table 5.13). Greylag geese were found in every month, with an unusually large number in November. Pink-footed geese occurred in large numbers in March and April.

Table 5.13. The numbers of geese and swans recorded roosting at Loch Scarmclate in 2011/12

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	89	0	0	54	0	143
November	1,782	10	0	108	0	1,900
December	406	0	0	0	0	406
January	162	464	12	0	0	638
February	109	85	0	0	20	214
March	300	2,700	0	0	0	3,000
April	19	6,300	0	32	0	6,351

The birds leaving Loch Scarmclate flew in a variety of directions (apart from westwards), but mainly east and south-east (Table 5.14).

Table 5.14. The departure directions of flocks of geese and swans from Loch Scarmclate in 2011/12

Species	Number in each direction								Total
	N	NE	E	SE	S	SW	W	NW	
GJ	1	3	6	11	1	1		1	24
PG	1	3	5	1				2	12
WS	3	2	2	2	3	1			13
All	5	8	13	14	4	2		3	49
%	10.2	16.3	26.5	28.6	8.2	4.1		6.1	

#### 5.4.6 Loch Watten

Loch Watten was used for roosting by greylag geese and small numbers of whooper swans, but no Greenland white-fronted geese or pink-footed geese were recorded there (Table 5.15). Greylag geese were found in large numbers in October, November and March.

Table 5.15. The numbers of geese and swans recorded roosting at Loch Watten in 2011/12

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	1,955	0	0	10	0	1,965
November	1,396	0	0	15	0	1,411
December	972	0	0	0	285	1,257
January	13	0	0	4	0	17
February	579	0	0	0	156	735
March	4,000	0	0	0	0	4,000
April	20	0	0	0	0	20

Greylag geese left Loch Watten in all directions, but more flew to the south-east and south than in any other direction (Table 5.16). The small number of whooper swan flocks flew north-east, east and south-east.

Table 5.16. The departure directions of flocks of geese and swans from Loch Watten in 2011/12

Species	Number in each direction								Total
	N	NE	E	SE	S	SW	W	NW	
GJ	4	2	3	7	10	6	6	7	45
WS		2	1	1					4
All	4	4	4	8	10	6	6	7	49
%	8.2	8.2	8.2	16.3	20.4	12.2	12.2	14.3	

#### 5.4.7 Loch of Wester

Loch of Wester was used for roosting by greylag geese, pink-footed geese and whooper swans, but no Greenland white-fronted geese were recorded there (Table 5.17). Pink-footed geese occurred in their highest numbers in April.

Table 5.17. The numbers of geese and swans recorded roosting at Loch of Wester in 2011/12

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	0	0	0	0	0	0
November	270	50	0	262	0	582
December	260	0	0	0	0	260
January	75	0	0	0	0	75
February	0	4	0	76	0	80
March	465	370	0	161	20	1,016
April	0	1,500	0	0	0	1,500

Just under half of the geese and swans leaving Loch Wester did so in a southerly direction, with most of the remainder flying westwards (Table 5.18).

Table 5.18. The departure directions of flocks of geese and swans from Loch of Wester in 2011/12

Species	Number in each direction								Total
	N	NE	E	SE	S	SW	W	NW	
GJ					3		2	3	8
PG		3			5				8
WS					11	2	9	2	24
All		3			19	2	11	5	40
%		7.5			47.5	5.0	27.5	12.5	

#### 5.4.8 All roosts combined

Greenland white-fronted geese were recorded roosting in the SPA lochs in all months except November and April, with the highest number (252) in December (Table 5.19). Over 1,000 greylag geese were recorded in every month, with the peak (5,339) in March. Numbers of pink-footed geese began to build up in January and February and increased greatly in

March, with a peak of 11,569 in April. Whooper swans were found in every month, in fluctuating numbers, with a peak of 532 in November (Table 5.19).

*Table 5.19. The numbers of geese and swans recorded roosting at the Caithness SPA lochs (combined) in 2011/12*

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	2,739	0	135	363	0	3,237
November	4,072	60	0	532	50	4,714
December	1,931	0	252	27	285	2,495
January	1,088	464	15	65	6	1,638
February	1,098	409	90	116	236	1,949
March	5,339	7,773	100	285	86	13,583
April	1,671	11,569	0	41	995	14,276

## 5.5 Flight height

### 5.5.1 Flights in the foraging areas

Almost all of the greylag geese seen in flight during the road transect survey were flying above 100m (Table 5.20), with the majority in the collision risk zone (20 – 150m). Around one third were flying at over 150m, suggesting that they were on long-distance flights, rather than on local foraging flights.

No flights by Greenland white-fronted geese were seen during the road transect surveys.

All of the pink-footed geese recorded flying in the area were below 100m, with over 80% of the birds in the collision risk zone (Table 5.20).

All of the whooper swans were recorded below 50m, with almost one third of the birds flying below collision risk height (below 20m).

*Table 5.20. The flight height of goose and swan flocks recorded in the Caithness Lochs survey area in 2011/12*

Species		Percentage in each height band (m)					Total
		0–20	21–50	51–100	101–150	Over 150	
Greylag	Flocks	6.7	6.7	33.3	33.3	20.0	15
	Birds	0.7	1.5	27.7	36.2	33.9	1,576
Pinkfoot	Flocks	25.0	37.5	37.5			8
	Birds	17.1	41.8	41.1			6,594
Whooper	Flocks	50.0	50.0				4
	Birds	30.8	69.2				39

### 5.5.2 Departures from roosts

All of the geese and swans seen departing from roosts were flying at heights below 100m (Table 5.21). The majority of greylag and pink-footed geese flew at 21- 50m, but some were still below 20m and thus were below collision risk height when they passed from view. All of the Greenland white-fronted geese and whooper swans were flying below 50m when they

passed out of sight of the surveyors. The majority of the white-fronted geese were flying at 21 – 50m, while most whooper swans flew at heights below 20m and thus below the collision risk zone.

*Table 5.21. The flight height of goose and swan flocks departing from Caithness Lochs roosts in 2011/12. No birds were recorded flying at over 100m*

Species		Percentage in each height band (m)			Total
		0–20	21–50	51–100	
Greylag	Flocks	21.7	68.1	10.2	166
	Birds	16.6	65.6	17.8	11,408
Pinkfoot	Flocks	13.6	77.3	9.1	44
	Birds	10.4	75.0	14.6	19,811
Whitefront	Flocks	25.0	75.0		12
	Birds	13.1	86.9		535
Whooper	Flocks	76.6	23.4		94
	Birds	76.1	23.9		1,272

## **5.6 Total numbers of geese and swans counted on transects and at roosts**

Although neither the road transect data nor the roost counts can be considered as censuses of the total number of geese and swans in the survey area (see section 6), a comparison of the results of the two methods was considered to be useful in giving an indication of the proportion of birds recorded in the survey area that were roosting on the Caithness SPA lochs.

The total number of birds counted on the transects over the whole wintering period was higher than the number counted at the roosts in the case of all four species (Table 5.22, last three lines). In greylag and pink-footed geese, the total counted on the transects was around 50% higher than at the roosts, while for Greenland white-fronted geese and whooper swans, the transect total was around 30% higher. Greenland white-fronted geese and greylag geese had higher counts on the transects than at the roosts in four months out of seven. Whooper swans had higher numbers on transects in five months and pink-footed geese had higher numbers on the transects in all seven months.



Table 5.22. The total numbers of geese and swans recorded on transects in the Caithness Lochs survey area and at the SPA roosts in 2011/12

Month	Survey	Greylag	Pinkfoot	Whitefront	Whooper	Total
October	Roost	2,739	0	135	363	3,237
	Transect	9,450	42	117	761	10,370
November	Roost	4,072	60	0	532	4,664
	Transect	2,987	105	95	595	3,782
December	Roost	1,931	0	252	27	2,210
	Transect	4,548	0	100	0	4,648
January	Roost	1,088	464	15	65	1,632
	Transect	2,234	4,900	0	111	7,245
February	Roost	1,098	409	90	116	1,713
	Transect	3,384	5,311	199	123	9,017
March	Roost	5,339	7,773	100	285	13,497
	Transect	2,415	9,246	182	166	12,009
April	Roost	1,671	11,569	0	41	13,281
	Transect	1,156	11,723	75	113	13,067
Total	Roost	17,938	20,275	592	1,429	
	Transect	26,174	31,327	768	1,869	
	Percentage	45.9	54.5	29.7	30.8	

### 5.7 Flight directions from roosts in relation to feeding locations

Although it was not possible to track flocks leaving the roost all the way to their feeding areas (unless these were close to the roost site), there was in general a good correspondence between roost flight directions (section 5.4) and concentrations of feeding locations (Figure 5.5). Most birds flew north or north-east from Broubster and Calder, north-east and south-east from Heilen, south-west and south-east from Mey, east and south-east from Scarmclate, south and south-east from Watten and south and west from Wester (section 5.4). All of these flight directions would have taken the birds into areas where several feeding locations were identified. However, the feeding locations near the survey area boundary to the south-west of Scarmclate (Figure 5.5) and those on the extreme north-east coast did not have significant flight departures in their direction from any of the SPA lochs.

### 5.8 Other target species

In the course of the road transect surveys, four other target species were recorded (Table 5.23): one record of a merlin in October; four records of hen harriers in October and

November; one record of a flock of golden plover in November and four records of European white-fronted geese in February 2011.

*Table 5.23. Other target species recorded during the Caithness Lochs transect surveys. The species codes are: EW – European white-fronted goose; GP – golden plover; HH – hen harrier; ML – merlin. The sex and age categories are: M – male; F – female; J – juvenile. The crop category IG refers to improved grassland*

Date	Time	Grid	Crop	Species	Sex/age	Number	Activity
17/10/2011	1214	ND 155 343		ML	F	1	Hunting
17/10/2011	1249	ND 335 425		HH	J	1	Hunting
18/10/2011		ND 040 590		HH	M & F	2	Hunting
19/10/2011	1055	ND 207 644		HH	J	1	
19/11/2011	1325	ND 291 578		HH	F	1	Hunting
20/11/2011	1329	ND 369 724	IG	GP		600	Feeding
11/02/2012	1550	ND 352 616	IG	EW		30	Feeding
12/02/2012	1135	ND 329 597	IG	EW		15	Feeding
22/02/2012	1345	ND 205 634	IG	EW		105	Feeding

In addition to the records in Table 23, at least one European white-fronted goose and at least 20 tundra bean geese were detected among greylag geese, during the roost observations at Loch Scarmclate on 29 November 2011.

## 6 DISCUSSION

The background to the survey, as defined by SNH in the Statement of Requirements, was the need "...to assess the risks of small and medium scale wind energy development and afforestation proposals on the qualifying interests of the Caithness Lochs Special Protection Area". It is appropriate to discuss to what extent the survey has contributed to this assessment.

A first step in assessing risk is to map the areas where the qualifying species occur at highest density, where risk will be greatest. However, it is also important to plot areas where the birds are found infrequently, where risk will be minimal and where development would have least impact. Since the survey was a systematic one, with equal coverage of all parts of the survey area, it has produced an unbiased description of the birds' feeding distribution and has defined the parts of the area with the highest densities, shown in Figure 5.5. The survey has also identified areas where no geese or whooper swans were recorded. These areas include; the north-west of the survey area, around Reay; an area south-east of Thurso; an area south-west of Loch Scarmclate; and a large area in the north-east. For most of these areas, it is not clear why they were not used by the birds, since the habitats are broadly similar to those in the areas which were used. An exception is the north-east area, with a large proportion of forest and upland heath, habitats which are not used by geese and swans. A large proportion of this area was far from roads and could not be surveyed. However, no geese or swans were recorded in those parts of the interior of the area which were visible from roads.

An important question is whether the feeding distribution described by the survey is likely to remain stable from year to year. This is likely to be the case for feeding sites on grassland, which generally persists in the same fields for several years. There could, however, be substantial changes in autumn, when the quantity and location of attractive stubble fields may vary. To determine the extent of such potential year-to-year changes would require more than one year's survey.

Observations of goose and whooper swan flights contributed relatively little to the assessment of risk, since only 35 flights were recorded during the road transect survey (Figure 5.6). The reason for this is likely to be that during these day-time surveys, the majority of the birds were settled on feeding areas and were not moving around very much. Also, the detection of flights was limited by the fact that for safety reasons the surveyors could scan effectively for flying birds only when they had stopped driving to survey the surrounding area. Most flights were recorded in the areas where the majority of feeding flocks were found and conversely, flights were not observed in the areas which were not used for feeding.

The generally good correspondence between departure directions from the roosts (section 5.4) and the distribution of feeding locations (Figure 5.5) suggests that it would be reasonable to assume flight lines between the roosts and the identified foraging areas, for example between Broubster/Calder and the feeding area on the coast to the north. One exception to the general correspondence was a feeding area on the extreme north-east coast, which did not have flight departures in its direction from any SPA loch. It was used only by greylag geese, which may have come from Orkney or which may have roosted on the island of Stroma. A second exception, a concentration of feeding sites south-west of Scarmclate, may have been used by geese from Loch Shurrery or Loch Caluim.

Most of the geese observed during the surveys were flying at heights between 20m and 150m, where they would be at risk of collision with wind turbines, so that all of the areas where the birds were concentrated (Figure 5.5) should be regarded as risk zones. Some flocks of greylag geese were recorded flying at over 150m, suggesting that they were on

long-distance flights rather than local journeys to and from feeding areas. Some greylag flocks were seen flying into the survey area over the sea from the direction of Orkney (D. Lambie; J. Smith pers. comm.).

More information on flight frequency and flight height in different parts of the survey area could be obtained by targeted vantage point observations carried out at dawn, when geese and whooper swans would be moving from their roosts to feeding areas, and just before dusk, when the birds would be returning. The main problem with this would be coverage of the large survey area, since at a time of day with poor light, geese could be identified reliably and their flight paths plotted accurately within only a limited range of each vantage point. It might be necessary to restrict such a survey to limited priority areas, such as those where wind energy developments or forestry were considered to be most likely to occur.

The observations at roosts were generally successful in determining the number of each qualifying species using each site throughout the over-wintering period, in determining flight height and in summarising the birds' departure directions. However, the survey was less successful in plotting flight lines between the roosts and feeding areas. The birds tended to depart in a range of directions rather than in a few well-defined flight lines and the topography around the roosts meant that flocks were usually lost to view long before they reached their feeding areas. The surveyors had to remain until the last birds left the roost, by which time the earlier flocks had disappeared, limiting the opportunity to follow flight lines.

Neither the road transect data nor the roost counts can be considered as censuses of the total number of geese and swans in the survey area, since each survey was carried out over a number of different days in each month. In addition, the two types of survey were sometimes carried out in different periods of the month. Consequently, during the period covered by the counts, birds were likely to move between areas and between roosts, leading to some birds being missed and/or some being counted more than once. Consequently, it is not valid to compare the results of the two types of survey. However, a comparison of the results of the two methods was considered to be useful in perhaps giving some indication of the proportion of birds recorded in the survey area which were roosting on the Caithness SPA lochs.

In all four species, the total number of birds counted on the road transects over the whole wintering period was higher than the total number counted at the roosts (Table 5.22). This suggests strongly that in all of the species, some birds were roosting at sites other than the SPA lochs. This was most pronounced in greylag and pink-footed geese, where it appeared that about a third of the birds in the area were roosting at sites other than the SPA lochs. The difference between surveys was less in Greenland white-fronted geese and whooper swans, but even in these, around a quarter of the birds in the area were roosting away from the SPA. There are several possibilities for alternative roost sites; during the International Goose Census (IGC) in 2011, carried out on 5 November and 3 December, geese were recorded roosting on Loch Beg, Lochan Dubh, Loch More, Loch Saorach, Loch Shurrery and Loch Thormaid (K. Graham, RSPB, pers. comm.). Greenland white-fronted geese roost at Philips Mains, south-east of Mey, and geese have also been reported from Loch Caluim, south-west of Loch Shurrery (J. Smith, unpublished data).

For the reasons given above, it would not be valid to compare the total number of birds counted in the present survey with the totals counted in the IGC counts, especially as the latter were carried out at the beginning of each month whereas the roost counts in the present survey were carried out between 19 and 30 November and (apart from one) between 12 and 18 December (Appendix 2). Especially in December, severe weather later in the month led to many geese and most of the whooper swans leaving the area (Table 5.22).

## 7 CONCLUSIONS

The survey has described the feeding distribution, feeding habitats, roosting numbers and flight activity of three qualifying species of the Caithness Lochs SPA; Greenland white-fronted goose, greylag goose and whooper swan. The pink-footed goose was also included in the survey since it was found in large numbers in the same area as the qualifying species.

Greylag geese, pink-footed geese and whooper swans were widely distributed over the survey area, which included all suitable habitat within 25 km of the SPA lochs. Greenland white-fronted geese were found only around Broubster Leans and Loch Calder in the west of the area and around the Loch of Mey in the north. The maps in this report show the distribution of the birds within the area, while the GIS shapefiles supplied with the report will allow plotting to the level of individual fields in areas of particular interest. The GIS data will also allow the birds' distributions to be generalised by contouring.

Only 35 flights by geese and swans were recorded during the road transect surveys, when most of the birds would have been settled in feeding areas. The distribution of flights was broadly similar to the feeding distribution. Most flights were at collision risk height (20 – 150m), with some greylag geese flying above 150m and a large proportion of whooper swans flying below 20m.

The commonest feeding habitat was improved grassland, with stubble used frequently in autumn.

The numbers of geese and swans roosting on the SPA lochs are tabulated by roost, species and month. The birds' departure directions, classified into eight compass points, are tabulated by roost and their flight heights are tabulated by species. Most birds flew at collision risk height (20 – 150m), although many whooper swans flew lower than 20m.

A comparison of the number of birds counted at the SPA roosts and the number recorded in the feeding area showed that for all four species, the number counted in the feeding area was higher than the number counted at the roosts. The difference was greatest in greylag and pink-footed geese suggesting that especially for these two species, a significant proportion of the birds roosted at sites other than the SPA lochs.

## 8 REFERENCES

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## Appendix 1. Field survey dates and weather

The data are: observer initials; wind direction; wind force (Beaufort); cloud cover (eighths); visibility; and precipitation.

### Transect surveys

Date	Obs	Wind		Cloud	Visibility	Precipitation
		Direction	Force	Cover		
17/10/2011	DL	S	2	5 - 6	> 3 km	None
18/10/2011	DL	E	2 - 3	4 - 7	> 3 km	None
19/10/2011	RS	S - SW	4	6 - 8	Good	Showers
22/10/2011	JS/RS	S	3	4 - 8	> 3 km	Showers
17/11/2011	RS	S	1 - 2		Good	None
19/11/2011	DL	SW	0 - 1		> 3 km	None
20/11/2011	DL	SW	0 - 1		> 3 km	None
11/12/2011	DL	NW	2	4 - 6	> 3 km	None
12/12/2011	DL	NW	1 - 2	4 - 6	> 3 km	Showers
13/12/2011	RS	W	2 - 3		Good	Showers later
16/12/2011	RS	SW - W	1 - 2		Good	None
11/01/2012	RS	SW	2 - 3		Good	Light showers
12/01/2012	DL	NW	1 - 2	5 - 8	> 3 km	None
13/01/2012	DL	SW	1 - 2		> 3 km	Light showers
14/01/2012	DL	SW - W	1 - 2		> 3 km	None
11/02/2012	RS	SW	0 - 2	6 - 8		None
12/02/2012	DL	N	2 - 3		Good	Light showers
13/02/2012	DL	NW			Good	Light showers
22/02/2012	RS	SW	3 - 4	8		Drizzle pm
14/03/2012	DL	NW	2 - 3	7 - 8	Good	None
15/03/2012	DL	W	1	5	Good	None
17/03/2012	RS	SW	3 - 5	5		Occasional light showers
23/03/2012	RS	SW	3 - 4	2	Good	None
03/04/2012	DL	NW	1 - 2	5 - 8	Good	Light showers
05/04/2012	RS	NW	0 - 2	8	1 - 3 km	Light showers

### Roost observations

<b>Broubster Leans</b>						
Date	Obs	Wind		Cloud	Visibility	Precipitation
		Direction	Force	Cover		
18/10/2011	DL	NW	5 - 6	8	c 1 km	Sleet and hail showers
29/11/2011	RS	SW	1 - 2		Good	Rain at start
13/12/2011	RS	W	2 - 3	2	Good	
11/01/2012	RS	SW	2 - 3		Good	Light showers
13/02/2012	DL	NW - N	3 - 4	8	1 - 2 km	Drizzle
23/03/2012	RS	SW	1 - 2	8	> 500m	Drizzle, clearing
04/04/2012	DL	NW	3 - 4	8	1 - 3 km	Heavy showers



## Appendix 1. Continued

<b>Loch Calder</b>						
Date	Obs	Wind		Cloud	Visibility	Precipitation
		Direction	Force	Cover		
21/10/2011	JS/RS	SW	1 - 3	8		Rain later
30/11/2011	JS/RS	SW	3	6		None
17/12/2011	JS/RS	N	3	3 - 4		
24/01/2012	JS/RS	-	0			
28/02/2012	JS/RS	NW	3 - 4	8	2 km	None
24/03/2012	JS/RS	SE	0 - 1	4	Good	None
07/04/2012	JS/RS	S	1	8		Light showers
<b>Loch Heilen</b>						
Date	Obs	Wind		Cloud	Visibility	Precipitation
		Direction	Force	Cover		
20/10/2011	JS	S	0 - 1	8		
20/11/2011	DL	-	0	1	> 3 km	None
03/12/2011	JS	NW	6			Hail showers
13/01/2012	DL	SW	2	5 - 6	> 3 km	None
12/02/2012	RS	W	3	8		Showers
20/03/2012	RS	SSW	3 - 4	8		None
06/04/2012	RS	WSW	1	8	1 - 2 km	Light rain
<b>Loch of Mey</b>						
Date	Obs	Wind		Cloud	Visibility	Precipitation
		Direction	Force	Cover		
23/10/2011	RS	SE	3	8	> 3 km	None
28/11/2011	RS	SW	3 - 4	2	Good	
16/12/2011	RS	SW	1	0		
22/01/2012	RS		3 - 5	8	2 km	Heavy rain showers
12/02/2012	DL	NW	2	4	> 3 km	None
17/03/2012	RS	SW	3 - 4	8		None
05/04/2012	DL	NW	2	8	1 - 2 km	Light rain

## Appendix 1. Continued

<b>Loch Scarmclate</b>						
Date	Obs	Wind		Cloud	Visibility	Precipitation
		Direction	Force	Cover		
19/10/2011	DL	NW	3	6 - 8	1 - > 3 km	None
29/11/2011	JS	S	2	8	Good	Light rain
12/12/2011	DL	NW	2 - 3	4	> 3 km	None
18/01/2012	YB	SW	4 - 6	4 - 6	> 3 km	None
26/02/2012	RS	S	3 - 4	8	> 3 km	
15/03/2012	DL	W	0 - 1	6	> 3 km	None
11/04/2012	JS	N	0 - 2	6	> 3 km	Heavy showers
<b>Loch Watten</b>						
Date	Obs	Wind		Cloud	Visibility	Precipitation
		Direction	Force	Cover		
22/10/2011	J/RSS	S	3	4 - 8	> 3 km	Showers
19/11/2011	DL	E	0 - 1	6 - 8	> 3 km	None
13/12/2011	DL	W	2	4	> 3 km	None
13/01/2012	YB	SW	2	6	> 3 km	
11/02/2012	RS	SW	0 - 2	8		None
16/03/2012	DL	W	1	6		None
05/04/2012	DL	W	1	6	> 3 km	None
<b>Loch of Wester</b>						
Date	Obs	Wind		Cloud	Visibility	Precipitation
		Direction	Force	Cover		
27/10/2011	DL	SE	3 - 4	4	> 3 km	None
24/11/2011	RS	SW	3	8		Continuous rain
18/12/2011	RS	W	1 - 2		Good	
14/01/2012	DL	W	2	5	> 3 km	None
22/02/2012	RS	SW	3 - 4	8	Good	
21/03/2012	RS	SW	3 - 4	8		None
03/04/2012	DL	NW	2	7	> 3 km	None

**Appendix 2. Records of goose and swan flights observed within the Caithness Lochs survey area in 2011/12.**

The record numbers refer to the flight lines plotted in Figure 5.6. The species codes are: GJ – greylag goose; OU – unidentified goose species; PG – pink-footed goose; WS – whooper swan

Record	Date	Time	Species	Number	Height	Direction
1	17/11/2011	0915	GJ	200	200	S
2	17/11/2011	0920	GJ	250	200	S
3	17/11/2011		GJ	45	100	SW
4	19/11/2011	1020	GJ	47	100	NE
5	19/11/2011	0940	WS	3	40	SE
6	19/11/2011	0950	GJ	90	120	S
7	19/11/2011	1035	GJ	51	150	SW
8	20/11/2011	1020	PG	80	80	E
9	20/11/2011	1041	WS	7	15	SE
10	20/11/2011	1135	GJ	80	120	NE
11	16/12/2011	1150	GJ	11	20	E
12	16/12/2011	1105	GJ	15	70	NW
13	16/12/2011	1444	WS	5	10	NE
14	13/01/2012	1635	GJ	280	150	N
16	12/02/2012	1128	GJ	29	100	W
17	13/02/2011	1434	GJ	84	170	NW
18	22/02/2012	0907	OU	150	80	SW
19	22/02/2012	0909	OU	100	80	SW
20	22/02/2012	0927	PG	130	20	S
21	22/02/2012	0930	OU	30	90	N
22	22/02/2012	0945	OU	48	90	NE
23	22/02/2012	1028	OU	22	100	N
24	22/02/2012	1033	GJ	24	50	N
25	22/02/2012	1145	OU	50	40	SW
26	14/03/2012	1730	GJ	300	60	E
27	15/03/2012	1133	OU	20	100	N
28	17/03/2012	0835	WS	24	35	NW
29	17/03/2012	0859	PG	1,000	20	SW
30	17/03/2012	1005	PG	750	35	SE
31	17/03/2012	1007	PG	2,000	30	S
32	17/03/2012	1218	OU	500	30	SW
33	23/03/2012	1119	PG	128		NE
34	03/04/2012	1325	PG	2,500	100	S
35	03/04/2012	1530	GJ	70	150	NE
36	05/04/2012	1145	PG	6	50	NW

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