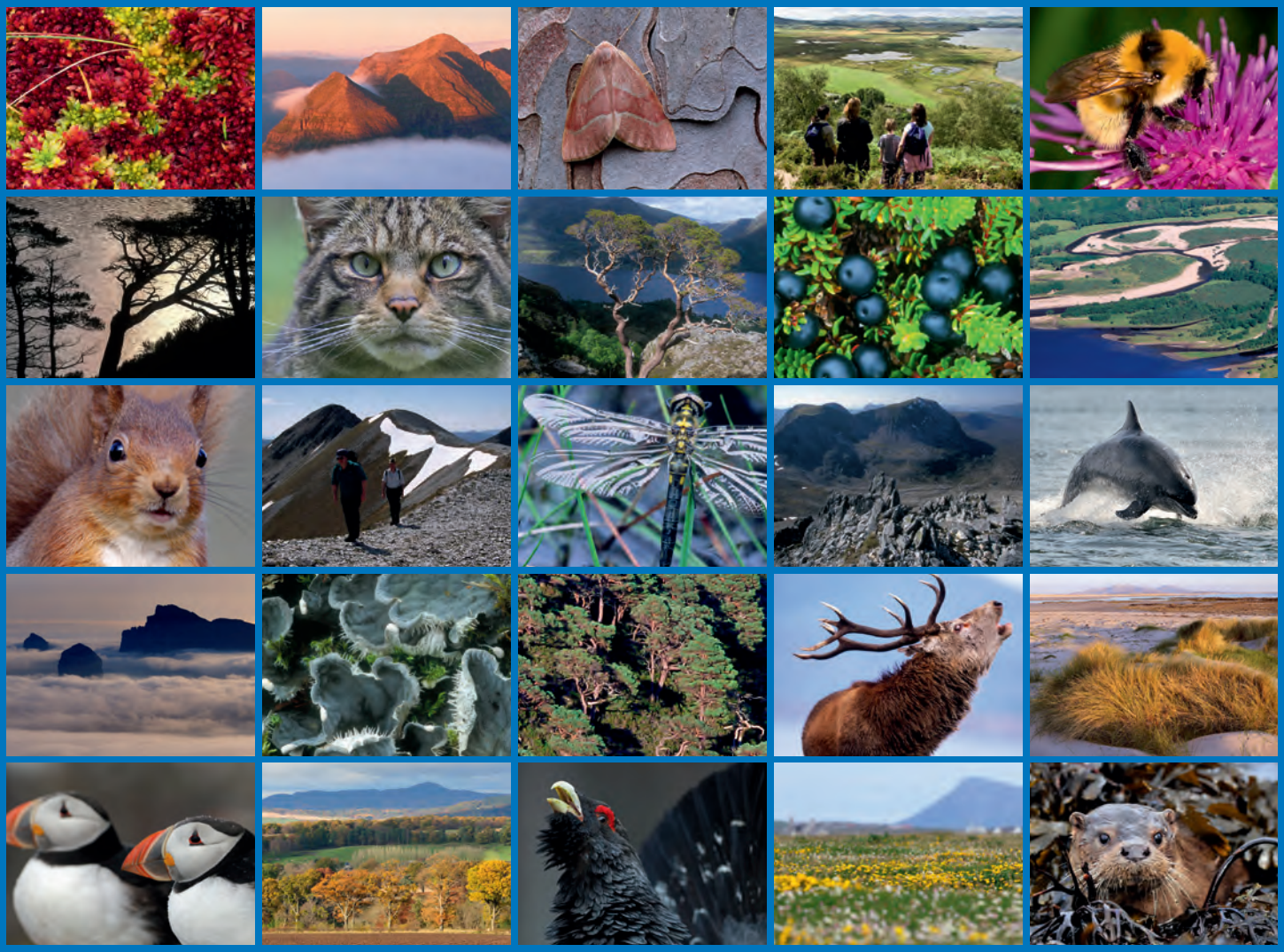
Scottish Natural Heritage
Commissioned Report No. 523b

Survey of the feeding areas, roosts and flight activity of qualifying species of the Caithness Lochs Special Protection Area; 2011/12 and 2012/13



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COMMISSIONED REPORT

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COMMISSIONED REPORT

Summary

Survey of the feeding areas, roosts and flight activity of qualifying species of the Caithness Lochs Special Protection Area; 2011/12 and 2012/13

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Background

Caithness has recently seen a large increase in applications for small-medium scale wind energy developments and increasing afforestation, in areas which are heavily used for foraging by geese and swans from the Caithness Lochs SPA. The current and anticipated wind energy and afforestation developments have the potential to present increasing risks to these species from collision, disturbance and displacement. Therefore updated information on the key species was considered to be desirable.

This 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. This report combines both winter surveys in 2011/12 and 2012/13.

Main findings

- This survey has produced an unbiased description of the birds' feeding distribution and has defined the parts of the area with the highest densities (Figure 5.5). The survey has also identified areas where no geese or swans were recorded.
- 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 geese and swans in the survey area was very similar in both winter surveys (2011/12 and 2012/13). This suggests that the distribution is likely to remain stable in the medium term, with only local changes in the individual fields due to changes in land use (e.g. crop rotation).
- The distribution of flights observed during the survey was broadly similar to the feeding distribution.
- The most common feeding habitats were improved grassland and stubble, the latter used most frequently in autumn.

- Observations at roosts were generally successful in determining the number of each qualifying species using each SPA site and in summarising the birds' departure directions.

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1. INTRODUCTION

The background to the work, as outlined by SNH, is that Caithness has recently seen a large increase in applications for small 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 (www.snh.gov.uk/docs/A423286.pdf). Prior to 2012, knowledge of the distribution of foraging SPA species was both dated and limited, and the impacts of these proposals (single and cumulative) on birds was not clear. The data set at that time was 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 needed 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 and was carried out over two winters, 2011/12 and 2012/13.

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. It should be noted that Site Condition Monitoring by SNH makes use of more recent data and any development proposals that could affect the SPA should assess potential impacts against the most recent population figures.

Greenland white-fronted goose

SPA Citation; 440 birds, representing 3% of the GB wintering population and 1% of the Greenland population. Numbers appear to have declined to less than half of this level in recent years, with two main flocks of approximately equal size, roosting at Broubster Leans and Loch of Mey.

Greylag goose

SPA Citation; 7,190 birds, representing 7% of the GB wintering population and 7% of the Iceland population. 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. 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 between the Caithness Lochs roost sites and feeding areas.

2.2 Approach

The proposed methodology to answer the above questions was of two 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.

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, 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^2 (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 was

4. METHODOLOGY

4.1 Roost observations

The roost sites were observed at dawn from vantage points 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.

Suitable vantage points were located at the roost sites (Figure 3.1). Two vantage points were needed at Calder and Watten, to provide adequate coverage of these long lochs. All of the vantage points were on public roads, so there were no access problems. The vantage points were at the following grid references:

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 (north); ND 209 562
Loch Watten (south); ND 247 549
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 departure directions were recorded (as one of eight points; N, NW, W etc). After the birds' departure, flight lines which appeared to head out of the survey area were followed up if possible, to check whether birds had flown into areas not covered by the road transects (below).

In 2011/12, 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.

4.2 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), 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 be 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.

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 in 2011/12, 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 and number of birds.

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

4.3 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.

4.4 Data capture and analysis

The road transect data were analysed to produce maps of the foraging distribution of each of the 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 10. 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) and different symbols were used to distinguish the two survey years. 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 lines were digitised in ArcGIS 10 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 each month. The data on departure directions were summarised to show the distribution of final departure directions over eight compass points. The principal departure direction for each species from each roost was plotted on the feeding distribution maps. Significant minor directions were shown by shorter lines.

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

Copies of the transect data and roost observations were sent each month to the SNH Nominated Officer.

4.5 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 feeding distribution recorded in 2012/13 (circles in Figures 5.1 to 5.5) was generally very similar to that found in 2011/12 (triangles in Figures 5.1 to 5.5), with only a few exceptions, which will be detailed for the species concerned.

Greenland white-fronted geese were found in only two parts of the survey area; near Broubster and Calder and around Mey (Figure 5.1). In autumn and winter 2011/12, there were two records of flocks to the south-east of Calder, but all other sightings around Broubster and Calder in both years were to the north of the lochs.

Greylag geese were widely distributed throughout the survey area, with concentrations in the west, around Broubster and Calder, and in several fairly discrete patches across the central part of the area and along the north-east coast (Figure 5.2). Greylag geese were absent from an area south-east of Thurso, from an area south of Scarmclate and from most of the higher ground in the north-east of the survey area (Figure 5.2). The distributions in 2011/12 and 2012/13 were very similar.

Pink-footed geese were distributed widely throughout the survey area (Figure 5.3), apart from the area to the south-east of Thurso, the area south of Scarmclate, the south-east coast and from most of the higher ground in the north-east of the survey area (Figure 5.3). The distributions in 2011/12 and 2012/13 were very similar.

Whooper swans were recorded mainly in a triangular area bounded by a line between Broubster, Heilen and Wester (Figure 5.4), with other concentrations around Mey and to the south of Wester. The swans were absent from an area around Thurso, from an area south of Scarmclate and from most of the higher ground in the north-east of the survey area (Figure 5.4). In autumn and winter 2011/12, whooper swans were found further to the north of Broubster and Calder, more frequently north-west of Wick and more frequently around Mey than in 2012/13 (Figure 5.4).

When the records of all four species are combined, it is clear that geese and swans were widely distributed throughout the survey area, apart from an area to the south-east of Thurso and an area south of Scarmclate (Figure 5.5). The birds were also absent from some smaller areas, such as one south of Heilen and one to the west of Wester. The birds' distribution in 2012/13 was generally very similar to that in 2011/12 (Figure 5.5).

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 three of the species, there were few records in one or more seasons, so data were combined. No geese or swans were recorded in bogs or in fields of winter cereal in 2012/13.

Greenland white-fronted goose

Since small numbers of flocks of white-fronted geese were recorded during the transect surveys, it was not possible to analyse the data separately for the three parts of the wintering period, so all records from each year have been combined. Most flocks and geese were found on improved grassland and on stubble fields (Table 5.1), with a few birds on 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 and 2012/13. In each part of the table, the values are percentages of the totals in the last line

2011/12

Habitat	Flocks	Geese
Improved grassland (%)	53.8	59.4
Stubble (%)	30.8	28.3
Unimproved grassland (%)	7.7	0.7
Other (%)	7.7	11.7
Number of flocks/birds	13	768

2012/13

Habitat	Flocks	Geese
Improved grassland (%)	50.0	58.6
Stubble (%)	40.0	41.1
Unimproved grassland (%)	0.0	0.0
Other (%)	10.0	0.3
Number of flocks/birds	10	630

Greylag goose

In autumn, most flocks of greylag geese were found on stubble (Table 5.2). A lower percentage of flocks and geese were recorded on stubble in winter and by spring, the majority 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 and 2012/13. In each part of the table, the values are percentages of the totals in the last line

2011/12

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

2012/13

Habitat	Autumn		Winter		Spring	
	Flocks	Birds	Flocks	Birds	Flocks	Birds
Improved grassland (%)	24.2	16.9	53.1	30.6	74.2	68.5
Stubble (%)	69.7	75.2	32.7	48.3	3.2	19.7
Unimproved grassland (%)	3.0	0.1	6.1	4.4	9.7	8.2
Other (%)	3.0	7.8	8.2	16.6	12.9	3.6
Number of flocks/birds	33	19,285	49	22,197	31	5,076

Pink-footed goose

Relatively few flocks of 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 stubble and improved grassland (Table 5.3). In spring, almost 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 and 2012/13. In each part of the table, the values are percentages of the totals in the last line

2011/12

Habitat	Autumn/winter		Spring	
	Flocks	Birds	Flocks	Birds
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
Other (%)	5.3	1.0	0.0	0.0
Number of flocks/birds	19	10,357	29	20,719

2012/13

Habitat	Autumn/winter		Spring	
	Flocks	Birds	Flocks	Birds
Improved grassland (%)	43.8	47.2	73.2	84.3
Stubble (%)	53.1	52.5	5.4	3.2
Unimproved grassland (%)	0.0	0.0	7.1	6.4
Other (%)	3.1	0.3	14.3	6.1
Number of flocks/birds	32	18,420	56	24,747

Whooper swan

Relatively few flocks of whooper swans were recorded in the survey in spring 2013, so the data have been combined with those from winter. In autumn in both years, 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 and spring, most of the swans were found on improved grassland and stubble, with almost all of the birds on the former in spring 2013 (Table 5.4).

Table 5.4. The habitats and crop types on which whooper swans were recorded in the Caithness Lochs survey area in 2011/12 and 2012/13. In each part of the table, the values are percentages of the totals in the last line

2011/12

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
Other (%)	32.1	20.6	15.4	10.3	10.0	2.9
Number of flocks/birds	28	1,356	13	234	10	279

2012/13

Habitat	Autumn		Winter/spring	
	Flocks	Birds	Flocks	Birds
Improved grassland (%)	6.3	0.7	31.6	50.4
Stubble (%)	75.0	88.9	42.1	40.5
Unimproved grassland (%)	0.0	0.0	0.0	0.0
Other (%)	18.8	10.4	26.3	9.1
Number of flocks/birds	16	1,209	19	706

5.3 Distribution of flight activity

Thirty-five flights by geese and swans were observed during the road transects in 2011/12: 15 by greylag geese; eight by pink-footed geese; eight by unidentified geese; and four by whooper swans (Figure 5.6). In 2012/13, 42 flights were observed: one by Greenland white-fronted geese; 25 by greylag geese; eight by pink-footed geese; three by unidentified geese; and five by whooper swans (Figure 5.7).

In both years, the distribution of flights corresponded fairly closely with the birds' feeding distribution (section 5.1, above).

5.4 Roosts

Broubster Leans

Broubster was used largely by three of the four species, with pink-footed geese recorded only in April 2012 (Table 5.5). In both years, the largest numbers of greylag geese were present in October. Peak numbers (apart from those of pink-footed geese) were higher in 2012/13 than in 2011/12.

Table 5.5. The numbers of geese and swans recorded roosting at Broubster Leans in 2011/12 and 2012/13

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

2012/13

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	1,400	0	0	41	0	1,441
November	337	0	0	3	7	347
December	137	0	0	0	0	137
January	0	0	110	0	17	127
February	470	0	50	17	0	537
March	15	0	40	0	0	55
April	71	0	25	0	0	96

In addition to the birds roosting on Broubster itself, some geese were recorded flying over the area from the west, probably from Loch Saorach or Loch Thormaid. In 2011/12, these were: Greenland white-fronted geese; 45 on 18/10/2011, 100 on 29/11/2011 and six on 11/01/2012 and greylag geese; 254 on 18/10/2011 and 810 on 29/11/2011. In 2012/13, Greenland white-fronted geese were recorded flying from the west on two occasions; 45 birds on 20/10/2012 and an unknown number (heard but not seen) on 15/11/2012. 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 geese and swans departed from the roost in a northward direction, with a substantial number of greylag geese also heading north-east and east (Table 5.6).

Table 5.6. The departure directions of geese and swans from Broubster Leans in 2011/12 and 2012/13. The species codes on this and subsequent tables are: GJ – greylag goose; NW – Greenland white-fronted goose; PG – pink-footed goose; WS – whooper swan. The commonest flight direction for each species is underlined.

2011/12

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	52	80						116	248
NW			45				28		73
PG	50							120	170
WS		26							26

2012/13

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	1,473	642	300						2,415
NW	225								225
WS	44								44

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 in small numbers, only in February, March and April. The highest numbers of birds (mainly greylag geese) were recorded in April in 2011/12 and in December in 2012/13.

Table 5.7. The numbers of geese and swans recorded roosting at Loch Calder in 2011/12 and 2012/13

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

Table 5.7 continued

2012/13

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	0	0	0	13	0	13
November	625	0	0	77	0	702
December	2,760	0	0	0	0	2,760
January	435	0	0	49	0	484
February	79	18	0	16	0	113
March	381	12	0	10	0	403
April	389	3	0	0	0	392

In both years, most geese and whooper swans leaving the roost flew north-east or north, with many greylag geese and whooper swans also flying east in 2011/12 (Table 5.8).

Table 5.8. The departure directions of geese and swans from Loch Calder in 2011/12 and 2012/13

2011/12

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	671	1,679	558	32		55	15	41	3,051
PG	718	38	16						772
WS	2	5	54	10					71

2012/13

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	110	2,384	1,648	101	66			7	4,316
PG	15	10		5					30
WS	8	97	23	12			2	3	145

Loch Heilen

Loch Heilen was used for roosting by greylag geese and whooper swans, but no Greenland white-fronted geese and very few pink-footed geese were recorded roosting there (Table 5.9). In 2012/13, greylag geese were recorded at Heilen largely in November and December while most whooper swans were found in October and November. Peak numbers of greylag geese and whooper swans were much higher in 2012/13 than in 2011/12.

Table 5.9. The numbers of geese and swans recorded roosting at Loch Heilen in 2011/12 and 2012/13

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

2012/13

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	26	0	0	278	0	304
November	5,750	30	0	625	0	6,405
December	4,527	0	0	64	0	4,591
January	0	0	0	46	0	46
February	3	0	0	79	0	82
March	0	5	0	68	0	73
April	37	0	0	14	0	51

Most greylag geese flew south-west and west from the roost, while most of the whooper swans flew south-east in 2011/12 and south west in 2012/13 (Table 5.10).

Table 5.10. The departure directions of geese and swans from Loch Heilen in 2011/12 and 2012/13

2011/12

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	7	177		45	65	850	21		1,165
WS	6	54	76	161	21	36	36		390

2012/13

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	3	26	37		250	1,465	3,812		5,593
PG					5				5
WS			21	56	23	750	29	18	1,027

Loch of Mey

All four species were recorded roosting at Loch of Mey, although most pink-footed geese were found only in February, March and April (Table 5.11). Very few whooper swans were recorded at the loch in 2012/13. The peak number of greylag geese was higher in 2012/13 than in 2011/12, but the reverse was the case for the other three species.

Table 5.11. The numbers of geese and swans recorded roosting at Loch of Mey in 2011/12 and 2012/13

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

2012/13

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	203	0	0	0	0	203
November	0	0	90	2	29	121
December	106	0	91	0	0	197
January	202	100	40	0	36	378
February	763	2,528	62	4	0	3,357
March	349	1,347	100	0	158	1,954
April	52	3,331	0	2	150	3,535

Most greylag geese and Greenland white-fronted geese leaving the Loch of Mey flew generally southwards, ranging from south-east to south-west (Table 5.12).

Table 5.12. The departure directions of geese and swans from Loch of Mey in 2011/12 and 2012/13

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ						200			200
NW				321	51	90			462
PG				3,200	1,000	3,020			7,200
WS				98		31			129

2012/13

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ			176	1,010	226	104	79		1,675
NW			100	127	86		70		383
PG			174	2,395	2,730	1,907			7,206
WS						2			

Loch Scarmclate

Loch Scarmclate was used for roosting mainly by three of the four species, with a small number of Greenland white-fronted geese recorded at the site only in January 2012 (Table

5.13). Greylag geese were found in every month, with most in October and November. Pink-footed geese occurred in their largest numbers in April. The peak number of greylag geese was higher in 2012/13 than in 2011/12, but the reverse was the case for the other three species.

Table 5.13. The numbers of geese and swans recorded roosting at Loch Scarmclate in 2011/12 and 2012/13

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

2012/13

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	2,406	0	0	34	0	1,490
November	1,361	0	0	0	0	1,361
December	162	0	0	0	0	162
January	963	260	0	29	0	1,252
February	560	648	0	3	44	1,255
March	70	91	0	42	8	211
April	100	2,313	0	11	0	2,424

The greylag geese leaving Loch Scarmclate flew in a wide range of directions, but mainly to the south-east in 2011/12 and north-west, north and south-east in 2012/13(Table 5.14). Most pink-footed geese flew east, with many also going north-eastwards.

Table 5.14. The departure directions of geese and swans from Loch Scarmclate in 2011/12 and 2012/13

2011/12

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	45	128	504	659	500	60		250	2,146
PG	25	4,020	4,305	5				740	9,095
WS	54	25	12	5	37	19			152

2012/13

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	995	550	145	1,110	104	859	200	1,359	5,322
PG	213	1,057	1,506		52	138	172	174	3,312
WS	14		5				26	9	54

Loch Watten

Loch Watten was used for roosting by greylag and pink-footed geese and small numbers of whooper swans, but no Greenland white-fronted geese were recorded there (Table 5.15). Greylag geese were found in large numbers in October, November and March in 2011/12 and in October to November in 2012/13. No pink-footed geese were recorded in 2011/12 but were found in all months in 2012/13, with highest numbers in January, March and April. The peak number of greylag geese was higher in 2011/12 than in 2012/13, while pink-footed geese and whooper swans had higher peak numbers in 2012/13.

Table 5.15. The numbers of geese and swans recorded roosting at Loch Watten in 2011/12 and 2012/13

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

2012/13

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	3,280	276	0	44	0	3,600
November	3,015	132	0	4	0	3,151
December	2,208	343	0	0	80	2,631
January	1,435	1,239	0	0	0	2,674
February	608	218	0	0	50	876
March	254	2,210	0	0	0	2,464
April	669	1,469	0	2	221	2,361

Greylag geese left Loch Watten mainly towards the south-east, with many also flying south (Table 5.16). Most pink-footed geese also headed south-east but a substantial proportion also headed north. The small number of whooper swans flew mainly south-east in 2011/12 and mainly north-east in 2012/13.

Table 5.16. The departure directions of geese and swans from Loch Watten in 2012/13

2011/12

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	381	55	900	5,112	1,089	362	290	1,426	9,615
WS		9	1	15					25

Table 5.16 continued

2012/13

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	347	207	280	5,226	2,317	112	606	109	9,204
PG	1,500	500	950	2,578				159	5,687
WS		48					2		50

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). Most greylag geese were recorded in November, December and March in 2011/12 and December and January in 2012/13. Most pink-footed geese were found in April in both years. The highest number of whooper swans was recorded in November in 2011/12 and in October in 2012/13. All three species found roosting at Loch of Wester had higher peak numbers in 2012/13 than in 2011/12.

Table 5.17. The numbers of geese and swans recorded roosting at Loch of Wester in 2011/12 and 2012/13. In January 2013, all of the birds roosted on the nearby Keiss Links rather than on Wester itself.

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

2012/13

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	14	0	0	504	0	518
November	0	0	0	88	0	88
December	4,379	450	0	29	0	4,858
January	4,000	0	0	28	0	4,028
February	485	640	0	18	0	1,143
March	31	70	0	191	0	292
April	153	3,219	0	0	0	3,372

The great majority of the greylag geese leaving Loch Wester did so in a westerly direction (Table 5.18). Most of the pink-footed geese flew south-east, with many also heading west and south. Most whooper swans flew southwards from Wester.

Table 5.18. The departure directions of geese and swans from Loch of Wester in 2011/12 and 2012/13

2011/12

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ					465		335	270	1,070
PG		1,524			400				1,924
WS					234	13	211	41	499

2012/13

Species	Number of birds in each direction								
	N	NE	E	SE	S	SW	W	NW	Total
GJ	31				46	101	8,816		9,032
PG				2,260	959		1,160		4,379
WS	18		80		415	116	218		852

All roosts combined

In 2011/12, 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).

In 2012/13, all four target species were recorded roosting on the SPA lochs in all months (Table 5.19). The highest numbers of Greenland white-fronted geese were recorded from November to March, with the peak count (150) in January. Over 1,000 greylag geese were recorded in every month, with the peak (14,279) in December. Numbers of pink-footed geese began to build up in January and February and increased greatly in March, with a peak of 10,335 in April. Whooper swans were found in every month, in fluctuating numbers, with a peak of 914 in October (Table 5.19). The peak numbers of greylag geese and whooper swans were higher in 2012/13 than in 2011/12, whereas those of Greenland white-fronted geese and pink-footed geese were higher in 2011/12 than in 2012/13.

Table 5.19. The numbers of geese and swans recorded roosting at the Caithness SPA lochs (combined) in 2011/12 and 2012/13

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

2012/13

Month	Greylag	Pinkfoot	Whitefront	Whooper	Unidentified	Total
October	7,329	276	45	914	0	8,564
November	11,088	132	90	451	36	11,797
December	14,279	793	91	93	80	15,336
January	7,035	1,599	150	152	53	8,989
February	2,968	4,052	112	137	94	7,363
March	1,100	3,735	140	311	166	5,452
April	1,471	10,335	25	27	371	12,229

5.5 Flight height

Flights in the foraging area

Almost all of the greylag geese seen in flight during the road transect survey in 2011/12 were flying above 100m (Table 5.20). 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 in 2011/12.

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

Departures from roosts

All of the geese and swans seen departing from roosts in 2011/12 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, paragraph 7), 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.

In 2011/12, 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 5.22a, last two 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.

For greylag geese and pink-footed geese in 2012/13, the total number of birds counted on the transects over the whole wintering period was higher than the number counted at the roosts, markedly so in pink-footed geese (Table 5.22b, last two lines). In contrast, for Greenland white-fronted geese and whooper swans, the roost total was higher than the transect total. Greenland white-fronted geese, greylag geese and whooper swans had higher counts on the transects than at the roosts in four months out of seven. Pink-footed geese had higher numbers on the transects in all seven months (Table 5.22).

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 and 2012/13

a) 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	

Table 5.22 continued

b) 2012/13

Month	Survey	Greylag	Pinkfoot	Whitefront	Whooper	Total
October	Roost	7,329	276	45	914	8,564
	Transect	4,804	713	8	489	6,014
November	Roost	11,088	132	90	451	11,761
	Transect	15,281	3,529	127	720	19,657
December	Roost	14,279	793	91	93	15,256
	Transect	10,680	2,380	0	118	13,178
January	Roost	7,035	1,599	150	152	8,936
	Transect	5,764	3,060	153	219	9,196
February	Roost	2,968	4,052	112	137	7,269
	Transect	5,753	8,738	189	140	14,820
March	Roost	1,100	3,735	140	311	5,286
	Transect	2,717	10,968	151	222	14,058
April	Roost	1,471	10,335	25	27	11,858
	Transect	2,361	13,779	2	7	16,151
Total	Roost	45,270	20,922	653	2,085	
	Transect	47,360	43,167	630	1,915	

5.7 Day to day variation in numbers of roosting geese and swans

In 2012/13, the survey team took part in coordinated census counts of the SPA lochs, carrying out the counts at Loch Heilen and the Loch of Wester on 10 December 2012, at Loch Heilen, Loch of Mey and Loch Scarmclate on 8 November 2012 and at Loch Heilen on 2 March 2013. Each month, the remaining SPA lochs were counted within a few days of the census, in the course of documenting the flight directions taken by the birds. This gave the opportunity to investigate the amount of variation in count totals which could occur within a short time.

At all of the lochs, there were large differences in the numbers of birds counted on different dates, even when these were only a few days apart (Table 5.23). For example, at Loch Watten in November, counts on consecutive days recorded fairly similar numbers of greylag geese, but very different numbers of pink-footed geese and whooper swans.

Table 5.23. The total numbers of geese and swans recorded in coordinated census counts of the Caithness SPA Lochs and on other dates in 2012/13. For each loch, the first line shows the totals recorded on the coordinated census and the second line shows the totals recorded on the date shown.

November

Site	Date	Greylag	Pinkfoot	Whitefront	Whooper	Total
Broubster Leans	10	1,593	0	52	7	1,652
	15	337	0	0	3	340
Loch Calder	10	252	0	0	73	325
	16	625	0	0	77	702
Loch of Mey	10	550	0	110	0	660
	19	0	0	90	2	92
Loch Scarmclate	10	1,000	200	0	2	1,202
	13	1,361	0	0	0	1,361
Loch Watten	10	3,715	132	0	4	3,851
	11	3,015	276	0	44	3,335

December

Site	Date	Greylag	Pinkfoot	Whitefront	Whooper	Total
Broubster Leans	8	58	0	78	9	145
	10	137	0	0	0	137
Loch Calder	8	261	0	0	18	279
	16	2,760	0	0	0	2,760
Loch Watten	8	400	0	0	0	400
	11	2,208	343	0	0	2,551
Loch of Wester	8	6,710	840	0	21	7,571
	11	4,379	450	0	29	4,858

Table 5.23 continued

March

Site	Date	Greylag	Pinkfoot	Whitefront	Whooper	Total
Broubster Leans	2	30	0	0	9	39
	7	15	0	40	0	55
Loch Calder	2	257	0	0	18	275
	5	381	12	0	10	403
Loch of Mey	2	280	200	100	5	428
	7	349	1,347	100	0	1,796
Loch Scarmclate	2	300	0	0	0	300
	9	70	91	0	42	203
Loch Watten	2	608	43	0	5	656
	6	254	2,210	0	0	2,464
Loch of Wester	2	1,179	1,975	0	277	3,431
	6	31	70	0	191	292

5.8 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 the roost flight directions of each species (red and black lines in Figures 5.1 to 5.4) and concentrations of feeding locations (although sometimes at some distance from the roost). The main exceptions to this were; in 2011/12, a flight line by Greenland white fronted geese to the east from Broubster and in 2012/13, a secondary flight line by greylag geese to the south from Loch Watten (Figure 5.2) and flight lines by whooper swans to the north from Broubster and to the south from Loch of Mey (Figure 5.4).

5.9 Other target species

In the course of the road transect surveys in 2011/12, four other target species were recorded (Table 5.24): 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 5.24. Other target species recorded during the Caithness Lochs transect surveys in 2011/12. 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 24, 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.

In the course of the road transect surveys in 2012/13, two other target species, barnacle goose and European white-fronted goose were recorded (Table 5.25).

Table 5.25. Other target species recorded during the Caithness Lochs transect surveys in 2012/13. The species codes are: BY – barnacle goose and EW – European white-fronted goose. The crop category codes are: IG - improved grassland; OT – other (muddy areas); UG – unimproved grassland.

Date	Time	Grid	Crop	Species	Number	Activity
16/02/2013	10:50	ND 281 655	IG	BY	1	Feeding
16/02/2013	12:15	ND 343 726	IG/OT	EW	3	Feeding
08/04/2013	07:10	ND 251 722	UG	BY	1	Feeding
08/04/2013	07:12	ND 250 714	UG	BY	1	Feeding

No raptors or other target species were recorded on the transects in 2012/13.

6. DISCUSSION

The background to the survey, as defined by SNH in section 2.3 of the Statement of Requirements, was the need "…to be able to adequately assess proposals with connectivity to the SPA in relation to Natura legislation" (see www.snh.gov.uk/docs/A423286.pdf). It is appropriate to discuss to what extent the survey has contributed to such assessment through documentation of the foraging and roosting activity of geese and whooper swans in the area.

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 (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 much of the surveyed part of the north-east of the survey area. 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 seem not to be used regularly by geese and swans (although it should be emphasised that some of this area was not visible from the transect route).

The distribution of geese and swans in the survey area in 2012/13 was very similar to the distribution found in the previous survey in 2011/12. This suggests that the distribution is likely to remain stable in the medium term, with only local changes in the individual fields used by the birds, due to crop rotation or change in land use.

Observations of goose and whooper swan flights contributed relatively little to the assessment of risk, since most flights were recorded in the areas where the majority of feeding flocks were found and conversely, few flights were observed in the areas which were not used for feeding (Figure 5.6). In addition, rather few flights (35 in 2011/12 and 42 in 2012/13) were observed over the whole wintering period. 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.

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 and in summarising the birds' departure directions. However, the survey was less successful in plotting flight lines all the way from the roosts to the feeding areas. The topography around the roosts meant that flocks were usually lost to view long before they reached their feeding areas. In addition, 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. In spite of this,

most of the main departure directions from roosts were in the direction of foraging areas which were identified by the road transects (red and black lines in Figures 5.1 to 5.4).

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. However, 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 which were roosting on the Caithness SPA lochs.

In greylag and pink-footed geese in both years, 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 these species, some birds were roosting at sites other than the SPA lochs. This tendency was most pronounced in pink-footed geese in 2012/13, where it appeared that more than half of the birds in the area were roosting at other sites. The difference between the transect and roost total was less in Greenland white-fronted geese and whooper swans than in the other two species in 2011/12, and was reversed in 2012/13, when slightly more birds were recorded at roosts than on the transects (Table 5.22).

The repeat counts of the geese and swans on the SPA lochs in November and December 2012 and in February 2013 (Table 5.23) showed that numbers at a given site could vary considerably within a few days. This suggests that individuals and flocks move around the area a great deal and use a number of different roost sites. With so many lochs in the area, it is possible that the birds may sometimes use the roost loch closest to their last feeding site of the day, rather than returning to the loch they used the previous night. .

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 and around the Loch of Mey. 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.

Thirty-five flights by geese and swans in 2011/12 and 42 in 2012/13 were recorded during the road transect surveys. The distribution of flights was broadly similar to the feeding distribution.

The commonest feeding habitat was improved grassland and stubble, the latter 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 by species. Most departure directions were towards feeding areas identified by the road transect survey.

A comparison of the number of birds counted at the SPA roosts and the number recorded in the feeding area showed that for greylag and pink-footed geese, the number counted in the feeding area was higher than the number counted at the roosts in both years. The difference was greatest in pink-footed geese, suggesting that especially for this species, a significant proportion of the birds roosted at sites other than the SPA lochs. The difference between the transect and roost total was less in Greenland white-fronted geese and whooper swans than in the other two species in 2011/12, and was reversed in 2012/13, when slightly more birds were recorded at roosts than on the transects

Repeat counts of the geese and swans on the SPA lochs in November, December and February showed considerable short-term variation in numbers at each site. This has implications for Site Condition Monitoring and emphasises the need for as many counts as possible to be made at each SPA loch over the wintering period.

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ANNEX 1: 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. In the Figure, some labels are obscured: the two flights by pink-footed geese near Mey are numbers 30 and 31; the flight by unidentified geese at the coast beside Wester is number 18.

Record	Date	Time	Species	Number	Height (m)	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

ANNEX 2: RECORDS OF GOOSE AND SWAN FLIGHTS OBSERVED WITHIN THE CAITHNESS LOCHS SURVEY AREA IN 2012/13

The species codes are as in Annex 1. The record numbers refer to labels on flight lines plotted in Figure 5.7.

Record	Date	Time	Species	Number
1	19/10/2012	07:57	NW	9
2	19/10/2012	08:07	GJ	100
3	19/10/2012	08:53	WS	12
4	19/10/2012	15:40	WS	21
5	10/11/2012	09:20	GJ	24
6	10/11/2012	09:50	WS	12
7	10/11/2012	10:05	PG	500
8	10/11/2012	12:40	PG	600
9	13/11/2012	12:00	GJ	400
10	13/11/2012	12:10	PG	20
11	13/11/2012	14:05	GJ	2500
12	13/11/2012	14:05	PG	50
13	13/11/2012	15:10	GJ	250
14	15/11/2012	09:37	GJ	75
15	15/11/2012	10:50	GJ	100
16	15/11/2012	10:55	GJ	105
17	15/11/2012	13:15	GJ	74
18	10/12/2012	14:20	GJ	77
19	13/12/2012	11:38	GJ	500
20	13/12/2012	11:38	GJ	600
21	13/12/2012	12:52	GJ	120
22	12/02/2013	11:10	PG	1000
23	12/02/2013	14:40	GJ	250
24	12/02/2013	14:50	GJ	300
25	16/02/2013	13:00	GJ	300
26	06/03/2013	08:00	GJ	37
27	06/03/2013	08:50	GJ	300
28	06/03/2013	09:40	WS	6
29	06/03/2013	09:50	GJ	90
30	06/03/2013	10:05	GJ	40
31	06/03/2013	15:40	GJ	250
32	07/03/2013	10:00	GJ	57
33	07/03/2013	10:00	OU	100
34	07/03/2013	12:05	PG	180
35	07/03/2013	13:05	GJ	350
36	09/03/2013	10:20	OU	500
37	10/03/2013	10:15	OU	15
38	07/04/2013	15:10	GJ	140
39	08/04/2013	06:45	PG	700
40	08/04/2013	07:25	PG	100
41	09/04/2013	09:16	GJ	2
42	10/04/2013	07:00	WS	7

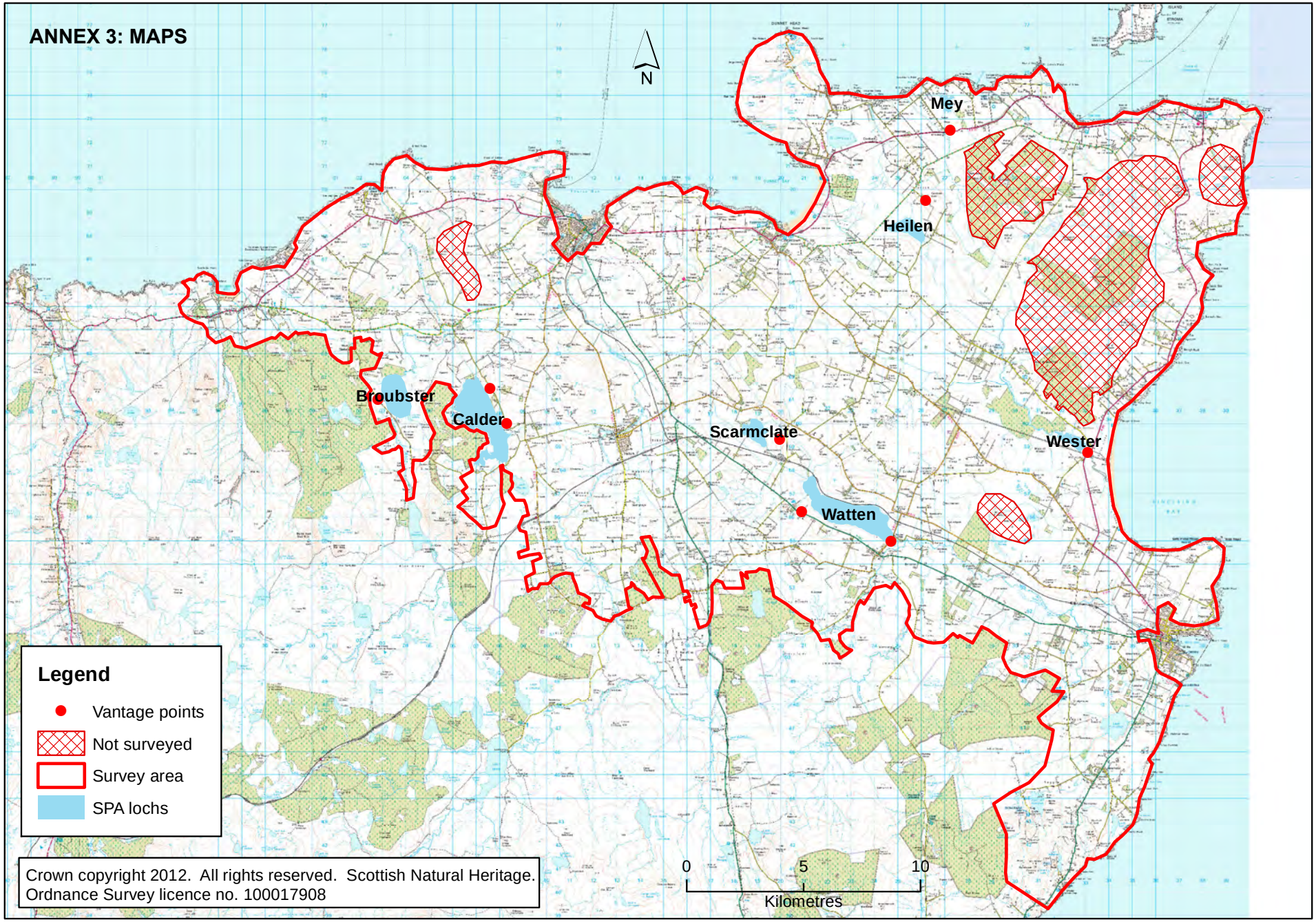

Figure 3.1. The Caithness Lochs bird survey area.

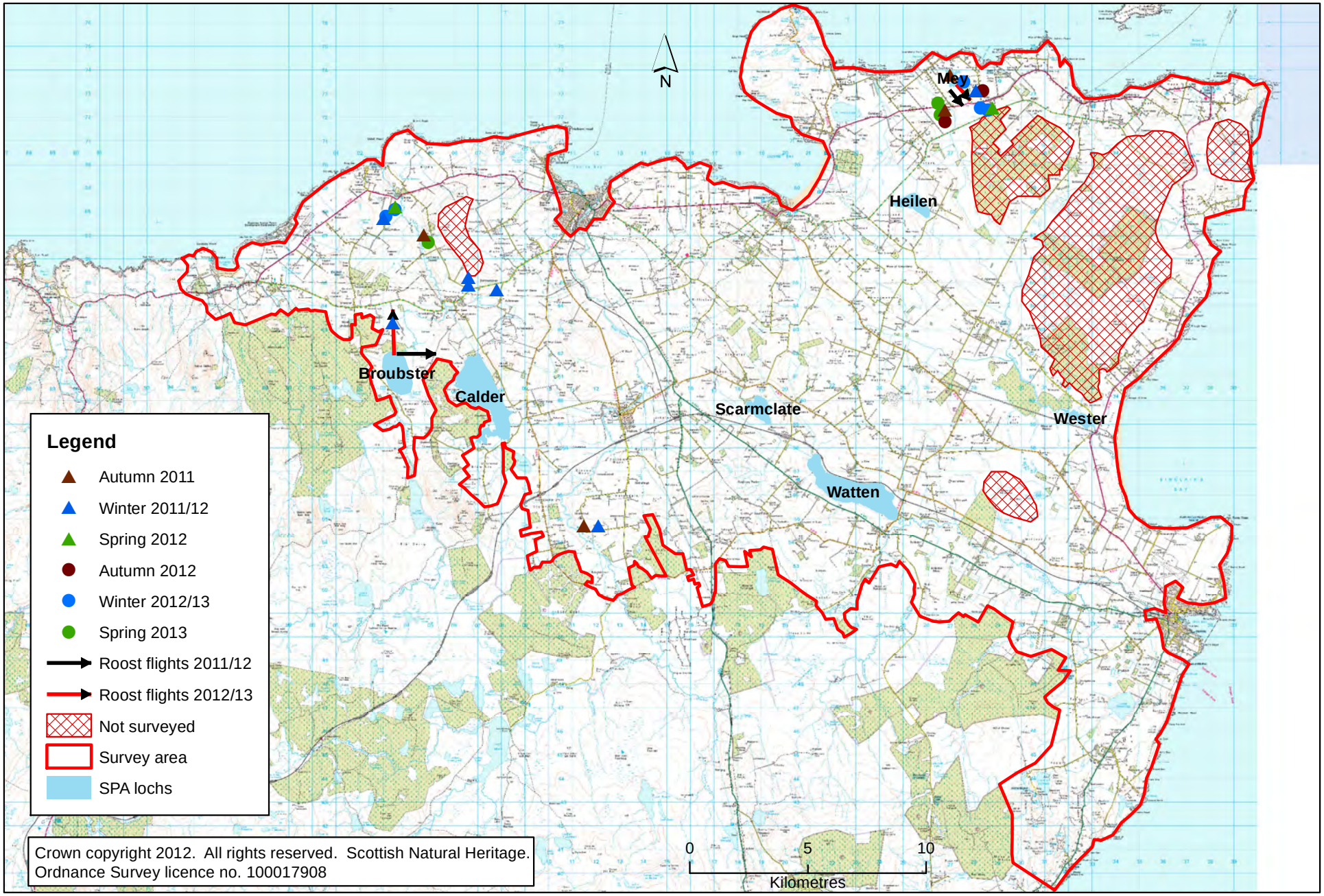

Figure 5.1. The distribution of sites used by Greenland white-fronted geese in the Caithness Lochs survey area in 2011/12 and 2012/13.

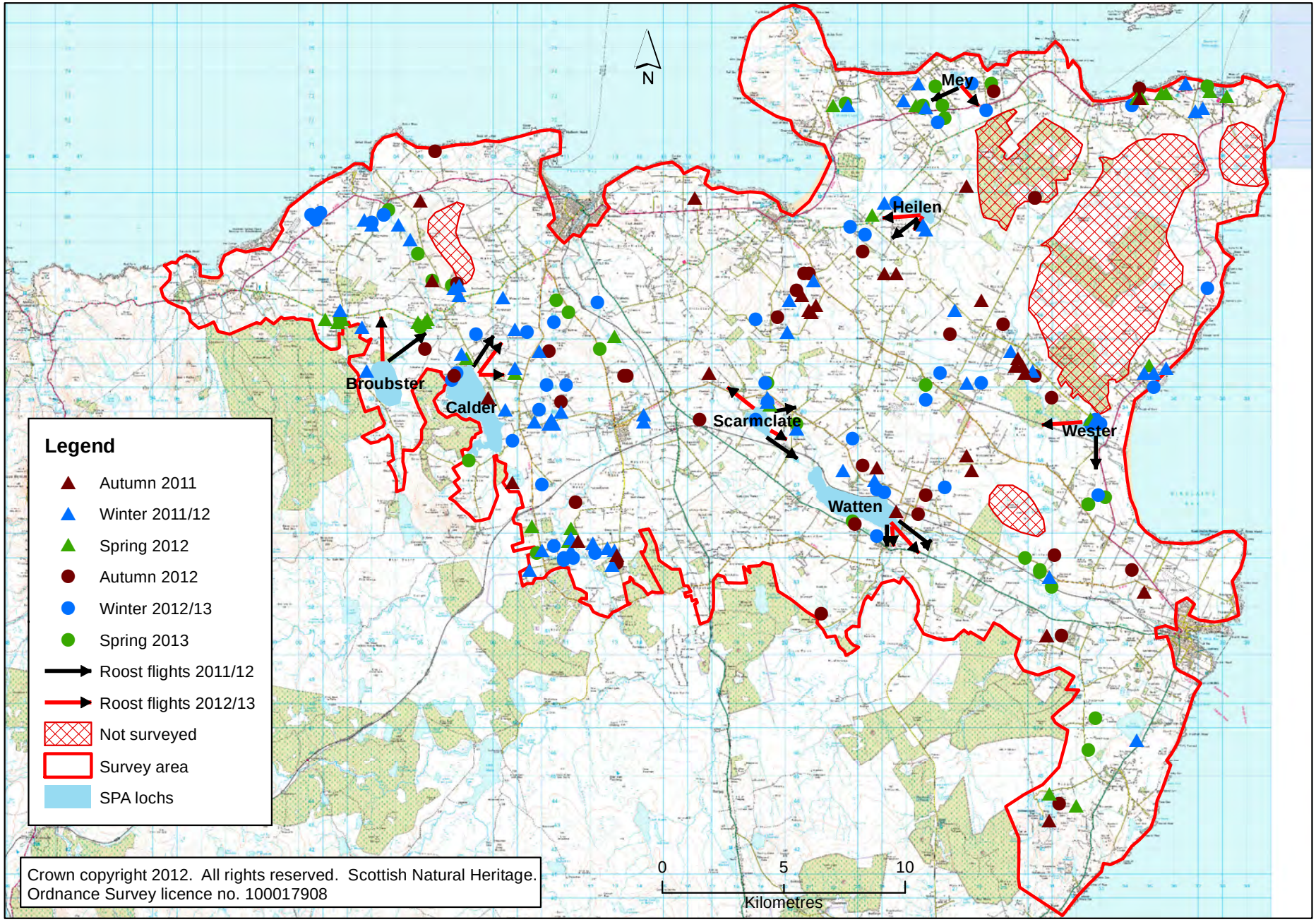

Figure 5.2. The distribution of sites used by greylag geese in the Caithness Lochs survey area in 2011/12 and 2012/13.

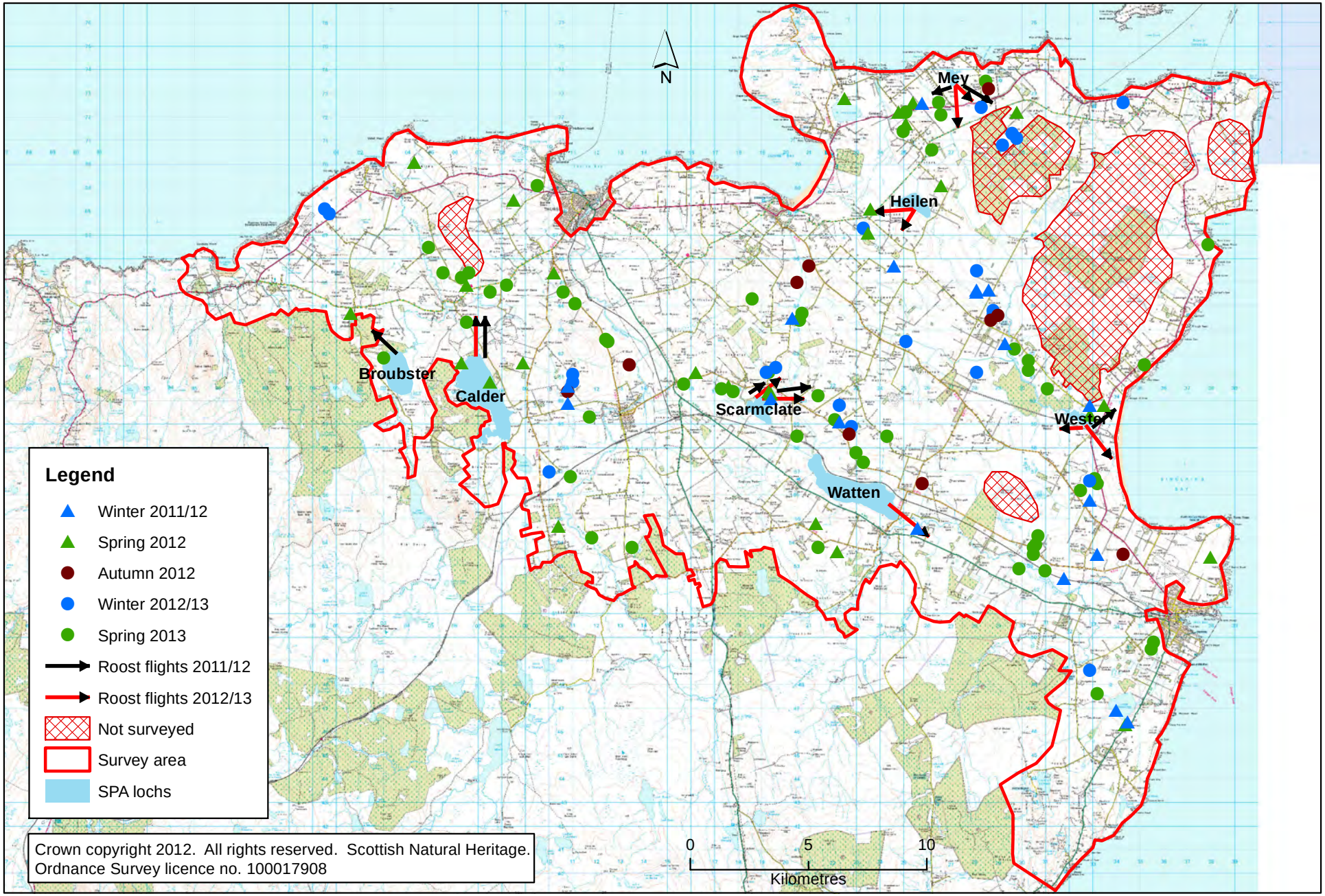

Figure 5.3. The distribution of sites used by pink-footed geese in the Caithness Lochs survey area in 2011/12 and 2012/13.

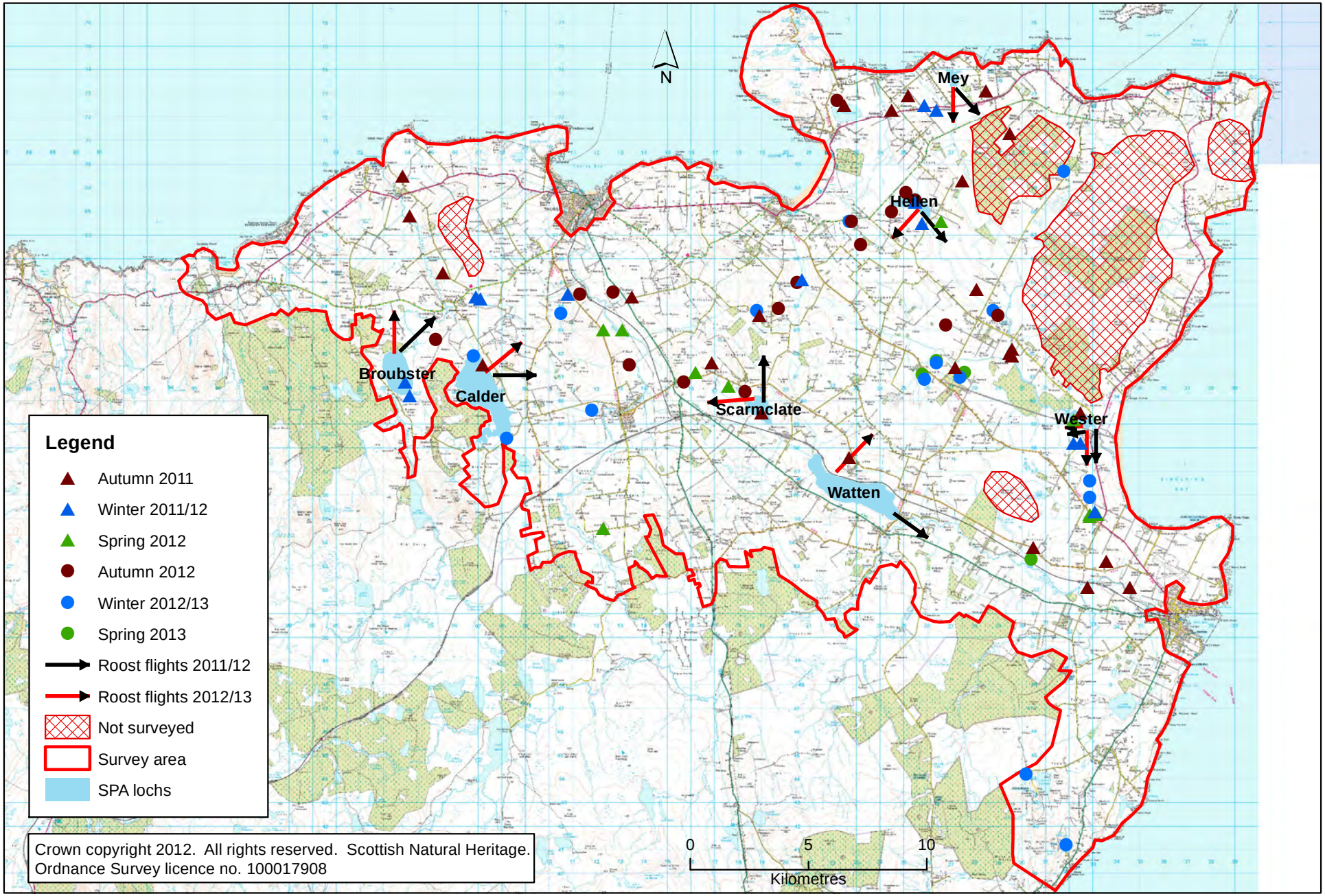

Figure 5.4. The distribution of sites used by whooper swans in the Caithness Lochs survey area in 2011/12 and 2012/13.

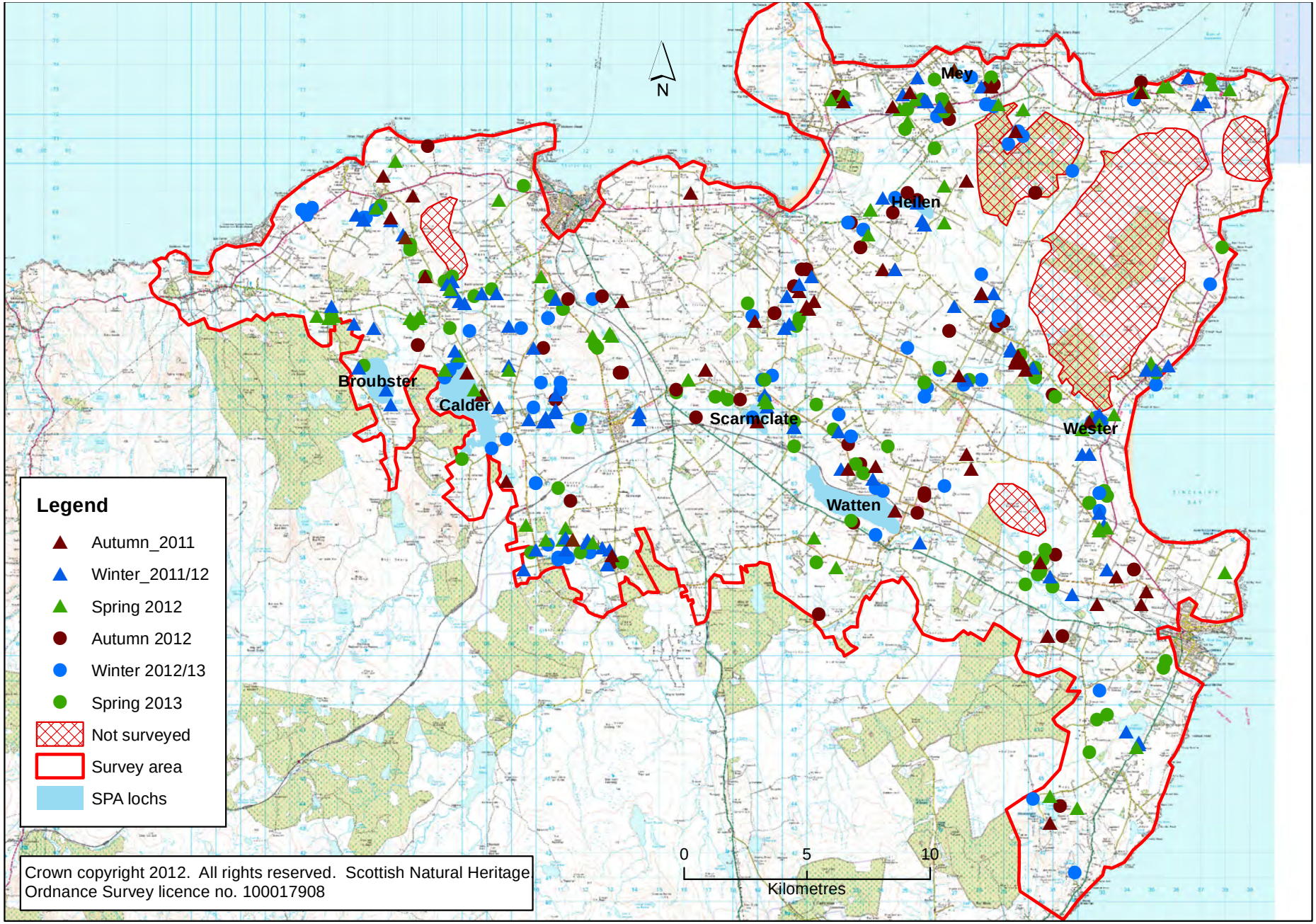

Figure 5.5. The locations used by geese and swans (of all species) in the Caithness Lochs survey area in 2011/12 and 2012/13.

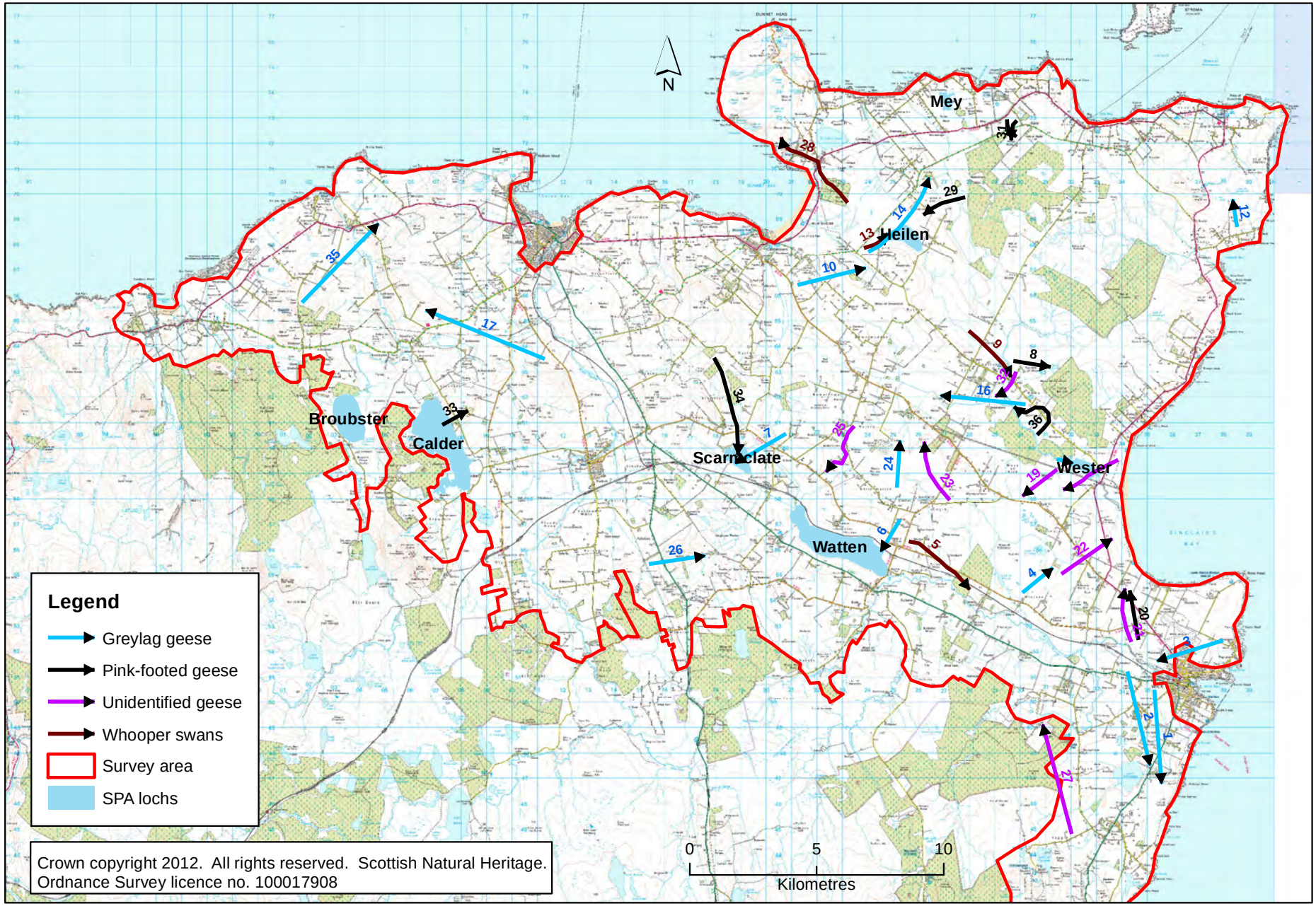

Figure 5.6. Flights by geese and whooper swans in the Caithness Lochs survey area in 2011/12.
The numbers on the flight lines refer to record numbers in Annex 1.

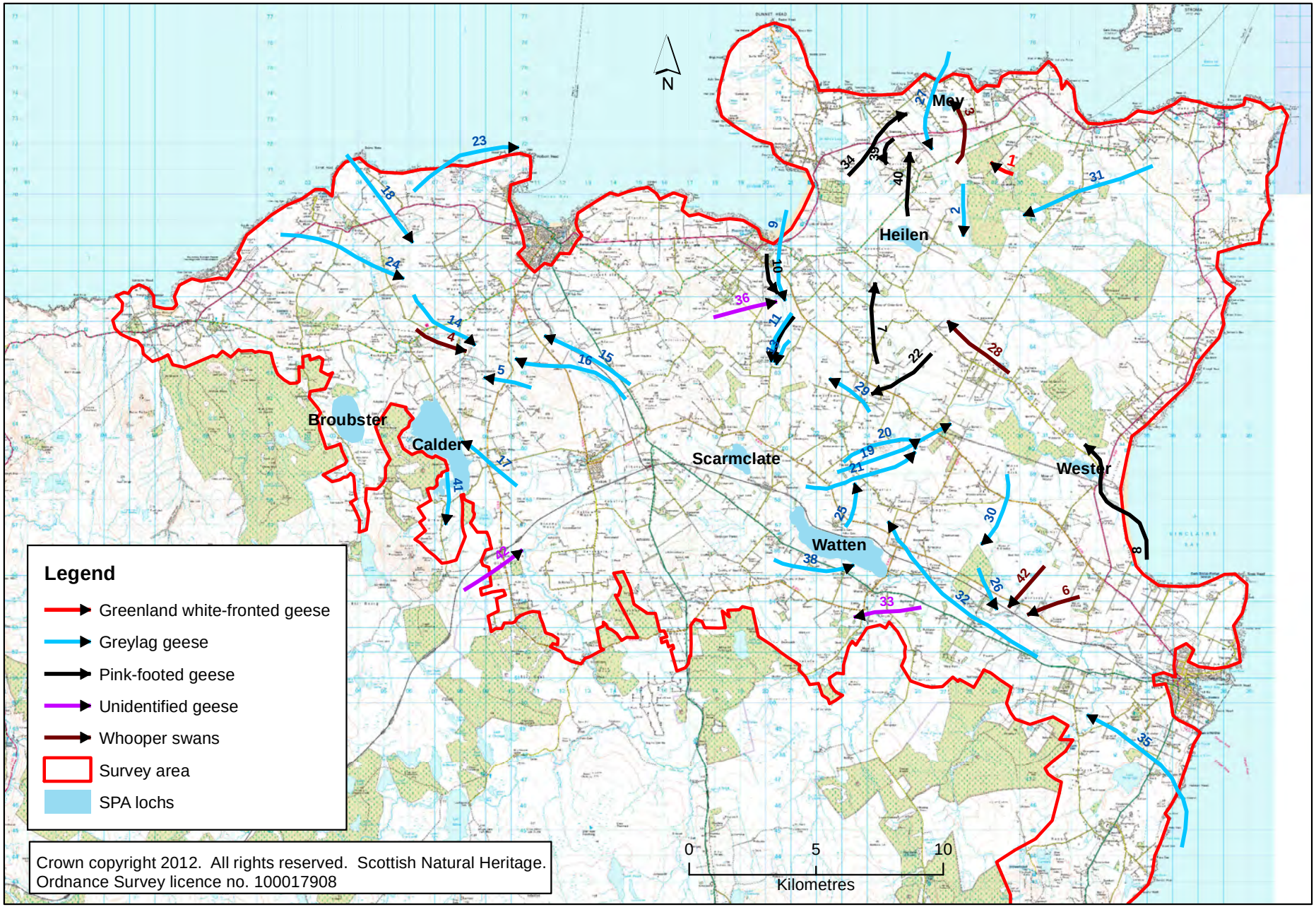

Figure 5.7. Flights by geese and whooper swans in the Caithness Lochs survey area in 2012/13.

The numbers on the flight lines refer to record numbers in Annex 2.

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