

**Mapping the distribution of feeding
Pink-footed and Iceland Greylag
Geese in Scotland**

**A report by the Wildfowl & Wetlands Trust, as part of a programme of
work jointly funded by WWT and Scottish Natural Heritage.**

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July 2012

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This publication should be cited as:

Mitchell, C. 2012. *Mapping the distribution of feeding Pink-footed and Iceland Greylag Geese in Scotland*. Wildfowl & Wetlands Trust / Scottish Natural Heritage Report, Slimbridge. 108pp.

This report was produced as part of a programme of work jointly funded by WWT and Scottish Natural Heritage.

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Executive summary

1. This report involved the construction of sensitivity maps to aid location of onshore wind farms in Scotland, based on the feeding distribution of Pink-footed *Anser brachyrhynchus* and Iceland Greylag Geese *Anser anser*, with special reference to the Special Protection Area (SPA) network. The maps provide an indication of where wind farm development is most likely to come into conflict with these two species. The maps are an indicative tool which enable the identification of areas where impacts of turbines on geese may be of concern. Where sensitivity is high then the maps do not replace the requirement for site specific survey to assess local levels of activity.
2. No systematic/standardised recording of goose feeding distribution records is currently in place. Instead, feeding records were gathered from a variety of sources, including the location of flocks containing colour-marked individuals, flocks of feeding geese observed for breeding success assessment, *BirdTrack* data, county bird records, standardised surveys commissioned by Scottish Natural Heritage (SNH) and *ad hoc* records supplied by goose counters and other birdwatchers.
3. In total, 13,698 Pink-footed and 13,713 Greylag Goose records were used to map known feeding distribution in Scotland. These were plotted in 2,893 and 2,994 1km squares, respectively. Example maps are presented in this report. However, it should be borne in mind that the maps show patterns of distribution based on the identified data sources only. Some historic and recent data sources have yet to be identified and collated. In addition, the intention is to update distribution data in the future, and patterns of distribution may change over time.
4. An examination of *ad hoc* feeding distribution records compared to those collected by standardised surveys indicated an acceptable level of representativeness.
5. The primary outputs of the project were an attributes table (in MS Excel) giving distribution data at the 1km square level and Geographical Information System (GIS) layers (shapefiles). Examples of the latter are provided in this report. Raw data were also provided in a separate spreadsheet so that details of records for an individual 1km square can be cross-referenced.
6. Care should be used when interpreting the maps since the distribution of geese in the wider landscape can change over time. This is especially true of Iceland Greylag Geese which have largely abandoned part of south and east Scotland as wintering areas and have increasingly begun to winter in north Scotland, especially in Orkney. In addition, the number of records in particular areas can vary over time which can also affect apparent distribution. This is particularly true of records of colour marked individuals; as ringing projects stop, the number of records decreases and this can lead to under representation of distribution.
7. No liability is accepted for the presence or absence of species at particular sites contrary to that indicated on the map.
8. The maps will need to be reviewed and updated as new data become available and the sensitivity criteria should be reviewed as new research methods to analyse non-standardised distribution data are developed.
9. A rolling programme of standardised surveys in areas where feeding geese are thought to be present, but limited or no quantitative data exists, would provide a more representative picture of the distribution of feeding geese.
10. Promotion of the results of this study will be used to encourage the value of recording feeding geese and other wildfowl using cropped habitats. It is suggested that *BirdTrack* is used for collating such information.
11. This feeding distribution study provides a platform for extending analyses to other important waterfowl species feeding in cropped habitats away from waterbodies.

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1 Introduction

A strategic approach to planning the location of wind farms is of benefit in safe-guarding bird species, many of which are protected under European law. These species are also an important asset to Scotland's tourist industry, which is Scotland's largest employment sector (Dickie *et al.* 2006).

Geese can be affected by wind farms through collision mortality, displacement from feeding sites and disturbance. Displacement from feeding areas can result from avoidance of the turbines by feeding geese (Larsen & Madsen 2000), although there is recent evidence of some habituation to turbines (Madsen & Boertmann 2008). Collision mortality is thought to be low in geese, which appear to be efficient in avoiding turbines (Patterson 2006), and current SNH advice is to use a 99% avoidance rate in collision risk calculations. However, even if the predicted number of collision casualties is low at any given wind farm development, the cumulative impact could become significant if large numbers of turbines were to be built in areas with high densities of geese. This could be especially significant in the areas around Special Protection Areas (SPAs) designated because of their significant goose roosts.

This report documents the construction of sensitivity maps to aid the location of onshore wind farms in Scotland, based on the distribution of Pink-footed *Anser brachyrhynchus* and Iceland Greylag Geese *Anser anser*, with special reference to the SPA network. The maps provide an indication of known areas where wind farm development is most likely to come into conflict with these two species. However, the nature of the data mean that there is a possibility that other important areas remain undetected. The maps are an indicative tool which enable the identification of areas where impacts of turbines on geese may be of concern. Where sensitivity is high then the map does not replace the requirement for site specific survey to assess local levels of activity.

1.1 Pink-footed Geese

The Pink-footed Goose breeds primarily in central Iceland and in smaller numbers along the east coast of Greenland (Mitchell *et al.* 1999). In early autumn, the geese migrate to winter exclusively in Britain. The British wintering population is discrete from the Svalbard population wintering in the Low Countries and Denmark (Madsen *et al.* 1999).

Regular autumn counts of Iceland/Greenland Pink-footed Geese started in the early 1950s and were systematic from winter 1960/61. During the early autumn, *c.*90% of the population can be counted on as few as 30 roost sites (Mitchell & Hearn 2004). The census continues today and is organised through the Iceland-breeding Goose Census (IGC). The IGC provides an accurate assessment of abundance (Frederiksen *et al.* 2004) and suggests that the population increased from *c.*60,000 birds in the early 1960s to *c.*225,000 in the mid 1990s. The winter distribution is essentially the east and south of Scotland, north west and east England. Range contraction in the wintering quarters from the early 1950s to the early 1970s (with increases in numbers in east central Scotland) was reversed from the late 1980s, with increasing numbers using agricultural land in Lancashire and, notably, sugar beet tops in north Norfolk (Gill *et al.* 1996). Resightings of individually marked birds have shown autumn dispersal from Scotland into Lancashire and Norfolk, followed by late winter movements northwards through England and southern Scotland to important staging areas in east and north east Scotland and the Moray Firth (Fox *et al.* 1994).

Since the mid 1990s, numbers have continued to increase up to a maximum of 351,188 in 2008/09. Despite an eight-fold increase in numbers, the early autumn distribution of Pink-footed Geese in Britain has largely remained congruent with earlier years (Figure 1), with birds particularly loyal to established roost sites. As the population has increased, numbers at many individual roost sites have similarly increased. However, a few roosts have seen dramatic decreases in use. Dupplin Loch, Perthshire, for example, held 62,000 birds in October 1994 (a quarter of the then population), but the five year mean for 2004/05 to 2008/09 was only *c.*700 birds.

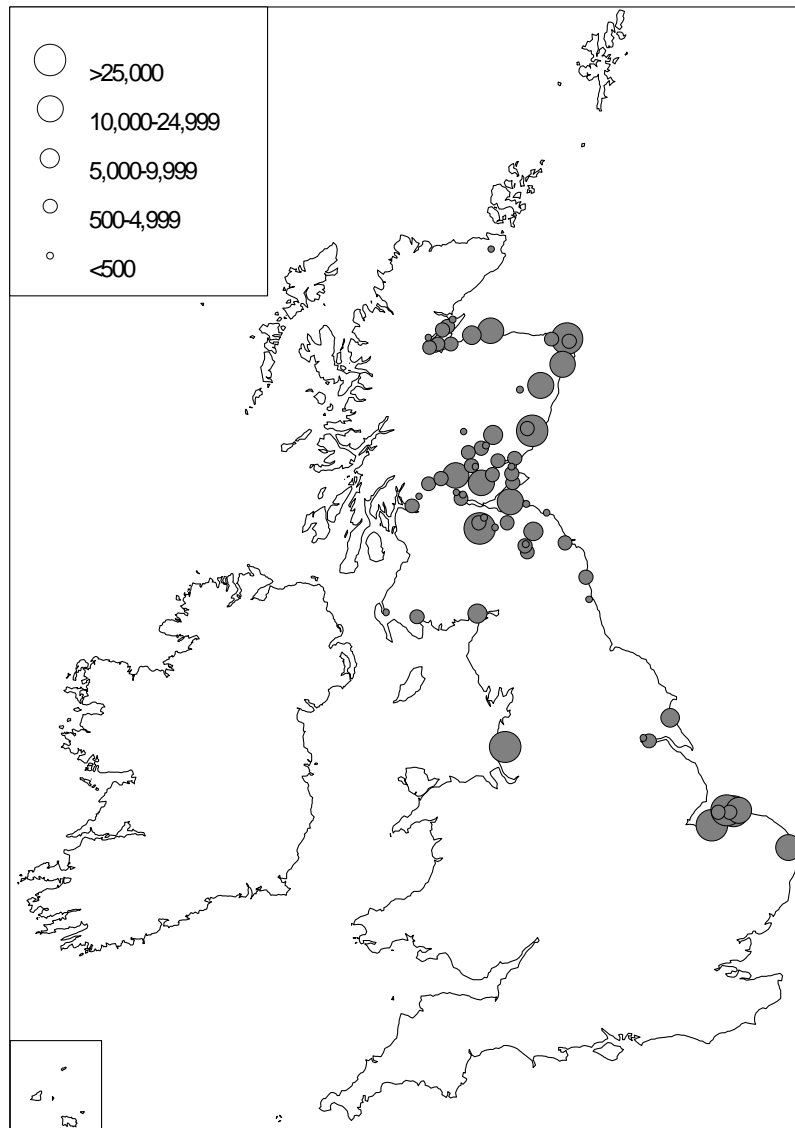


Figure 1. Distribution of Iceland/Greenland Pink-footed Goose population during the non-breeding season (based on autumn IGC counts, 5 year mean peak counts 2006/07 to 2010/11; Mitchell *et al.* 2010a).

The main winter habitat is thought to have been saltmarsh (Owen 1976) but from the late 19th century, the species moved inland to feed on farmland, taking advantage of reservoirs, other freshwater bodies and estuaries for roosting. Pink-footed Geese tend to be conservative in their use of roosts (Owen *et al.* 1986), although these may shift locally in response to disturbance or feeding conditions (Giroux 1991). In north east Scotland, 82% of Pink-footed Geese foraged within 8km (median distance 4km) of traditional roost sites (Bell 1988). Broadly, Pink-footed Geese use stubble fields in autumn gleaning the spilt grain, but with grassland predominating after autumn in most studies of habitat use (Forshaw 1983, Bell 1988, Gill 1996). Fox *et al.* (1994) put these patterns into a national context, suggesting that Pink-footed Geese feeding mainly on grass in spring (principally *Lolium perenne*, the main constituent of the sown sward) were responding to a gradient of plant growth, particularly the high protein content associated with the onset of growth. The geese moved north within Britain during the spring utilising the late occurrence of the ‘spring bite’ as they move towards their ultimate destination – the breeding grounds of Iceland and Greenland.

1.2 Iceland Greylag Geese

The Greylag Goose breeds in lowland areas of Iceland and, in early autumn, the vast majority of birds migrate to winter largely in Scotland, with smaller numbers in Ireland, north England and south west Norway (Hearn & Mitchell 2004). Wintering Greylag Geese were uncommon in east and south Scotland throughout the 19th century (Berry 1939), but had become more numerous at several sites by the 1930s. This was followed by a period of steady increase in the middle of the 20th century, especially so in the 1950s. Regular autumn counts started in the early 1950s and suggest that the population increased from c. 36,000 birds in the early 1960s to c.110,000 individuals in the late 1980s. However, in the early 1990s, numbers declined and c.86,000 were counted in 1994/95. A northward contraction of range on the wintering quarters from the early 1900s to the early 1960s had occurred with an increase in the importance of east central Scotland in the 1960s and north and north east Scotland in the 1980s. A number of autumn roosts became far more important than formerly (e.g. Muir of Dinnet, Loch Eye, Loch of Skene) both in terms of actual numbers and the proportion of the total population they supported.

Since the mid 1990s, overall numbers continued to decrease reaching a low of c.73,100 birds in 2002/03, but since then have increased again, averaging c.106,400 during 2007/08–2011/12. The northward range shift continued and, since the mid 1990s, increasing numbers have wintered in Orkney; by 2008/09, c.60,000 Iceland Greylag Geese were counted on the islands amounting to over half of the total winter population (Figure 2).

The main winter habitat is thought to have been saltmarsh and coastal *Scirpus* beds (Owen 1976), but in Britain little of this habitat remains and many of the inland fens and marshes have been drained for agriculture. Increasingly, from the end of the 19th century, the species moved inland to feed on arable farmland and managed grasslands, taking advantage of reservoirs, other freshwater bodies and estuaries for roosting (Owen *et al.* 1986). Grass is used throughout the winter, especially in Orkney, although typically, cereal stubbles are used in the autumn, followed by potatoes, swedes and carrots if available in mid winter (e.g. Bell 1988). In spring, sown grass and to a lesser extent permanent pasture and winter sown cereals are important.

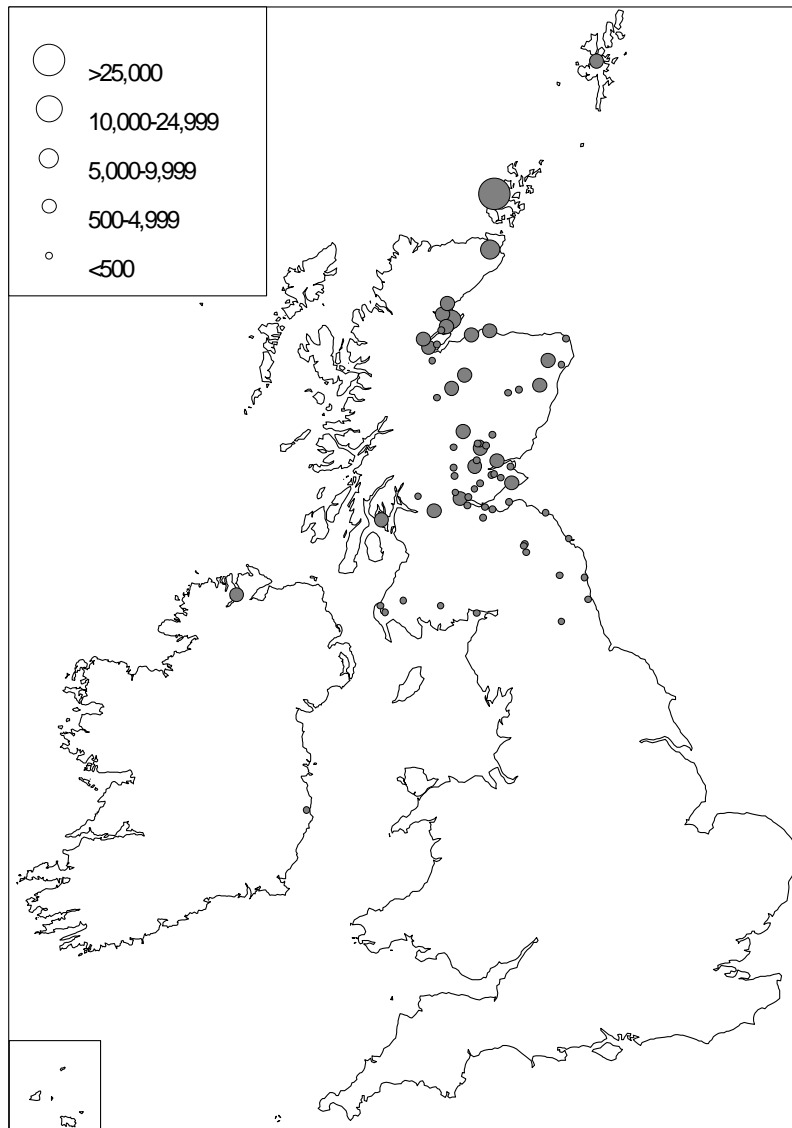


Figure 2. Distribution of Iceland Greylag Goose population in Britain and Ireland during the non-breeding season (based on autumn IGC counts, 5 year mean peak counts 2006/07 to 2010/11; Mitchell *et al.* 2010a).

2 Methods

2.1 Data sources

Information on the feeding distribution of Pink-footed and Greylag Geese is not currently routinely collected for any national scheme and so data from a variety of disparate sources were collated. These included;

- sightings of marked geese (collated by the Wildfowl & Wetlands Trust (WWT) and others);
- counts made when undertaking goose age assessments as part of the WWT/Joint Nature Conservation Committee (JNCC)/Scottish Natural Heritage (SNH) Goose and Swan Monitoring Programme (GSMP);
- standardised surveys of feeding areas (often under contract to SNH);
- data from the 2004/05 WWT SPA feeding distribution study – goose counters provided non-numeric information on the distribution of feeding geese relative to SPAs;
- *BirdTrack* data collated by the British Trust for Ornithology (BTO);
- *Ad hoc* bird records supplied by county recorders, goose counters and other birdwatchers.

A full list of sources is given in Appendix 1.

BirdTrack data collated by the BTO offered the potential for a large number of goose records. However, the majority of these records were collected in such a way that it was not possible to determine if the geese were feeding on the ground or flying over the site and so use of them was limited for this study. It is anticipated that the *BirdTrack* organisers will change the recording system such that observers can in the future record this aspect of a sighting. Nevertheless, sightings of Pink-footed and Greylag Geese recorded in *Birdtrack* were used in this analysis and the way the data were treated is explained below (see 2.3.3).

Counts of geese on waterbodies were excluded because the aim of this study was to map feeding distributions only; much information already exists on the use of waterbodies by roosting and loafing geese through reporting by the IGC and Wetland Bird Survey (WeBS). However, in cases where it was not known if a count in a 1km square referred to birds on a waterbody or feeding on the shore, the count was included.

Data were collated for the period 1986/87 to 2011/12. Winter seasons were considered to run from September through to April (e.g. season 2011/12 refers to records from September 2011 to April 2012 inclusive).

2.2 Data precision

The majority of records (84.5% for Pink-footed Geese and 93.2% for Greylag Geese) were recorded at the 1km square level (e.g. NH1234), the remainder being at the 100m level (e.g. NH123456). Thus, plotting feeding distribution at the field level was beyond the scope of this study. No records of geese recorded at the 10km level (e.g. NH12) or tetrad level (e.g. (NH12V) were included in this analysis.

The 1km square scale for mapping was considered a sufficiently fine resolution to be of use to local planning authorities and other decision makers. It is also the scale used by several other Geographic Information System (GIS) models to produce strategic locational guidance for renewable energy, e.g. Scotland's Renewable Resource (Snodin 2001), the Highland Council Renewable Energy Strategy (Aquatera 2006) and by the Royal Society for the Protection of Birds (RSPB) in producing a bird sensitivity map to provide locational guidance for onshore wind farms in Scotland (Bright *et al.* 2006).

The maximum reliably recorded disturbance distance from wind farms for geese is 600m (Kruckenberg & Jaene 1999). Therefore, as the majority of records were recorded at the 1km level, and it was not possible to tell where in the square the geese were located, the 1km square was not buffered in any way.

2.3 Data manipulation

2.3.1 Manipulation of count data

All counts of less than 10 geese were excluded from the analysis. Duplicate counts were also removed. These occurred, for example, when two or more marked birds were seen in a flock or when a marked bird was seen when undertaking and age count and the flock details were recorded twice. In order to stabilise the variance of the samples, counts of geese were log transformed (natural logarithm).

Annual records were pooled within each of three time periods (1986/87 to 2006/07 (old), 2007/08 to 2011/12 (new) and 1986/87 to 2011/12 (all)) prior to mapping. The 2007/08 to 2011/12 time period represented the most recent five year period of the available data. To remove the possibility of a single year (or count) influencing the analysis, the mean of the natural logarithm of the annual peak counts for each 1km square was calculated for each of the three time periods.

Some records had no quantitative data (i.e. no count). These included data from colour ring sightings, which involved at least one bird, but where no flock size had been recorded. These records were allocated a code for 'present' only and were excluded when determining the mean of the annual peak counts. If, after determining the mean of the annual peak count, a 1km square had a mean of zero, but had records of geese being present, the 1km square was allocated a code for 'present only'. For the mapping exercise, such squares were identified separately (as small red dots; see Key in 3.1).

Creating distribution maps based on records that are collected in a non-standardised way is difficult. Lack of standardised surveying, where the presence/absence of geese in defined areas is known, for the vast majority of the wider countryside severely limits the spatial/statistical analyses that can be performed on such data.

However, in order to map the distribution of feeding geese for this study, a Sensitivity Index (or score) for each 1km square was calculated. Three sources of information/data contributed to the Sensitivity Index, the first being the mean of the natural logarithm of the annual peak counts (see above). Some account of count frequency for each 1km square was also incorporated, as was an assessment of how accurate individual counts of geese were considered to be (quality of counts). The Sensitivity Index was dependent on the parameters included and the weighting given to those parameters. It was considered that mean flock size should have the greatest weighting, since this was more independent of survey effort (which varied significantly across the country) and therefore considered to most closely reflect goose activity in the 1km squares. Count frequency and count quality were given lower weightings due to their uncertainty (see below). This means that the map is rather precautionary in this respect. Using the raw data provided to SNH, alternative Sensitivity Indices, or other ways of identifying core feeding areas, could be derived if necessary.

2.3.2 Frequency of counts

For each species, the total number of counts for each 1km square in the three time periods (1986/87 to 2006/07 (old), 2007/08 to 2011/12 (new) and 1986/87 to 2011/12 (all)) was calculated. The counts were then ranked (lowest to highest). The number of counts corresponding to various percentiles above zero could then be determined. For each time period, each 1km square was then allocated a 'Frequency Index' based on the following criteria:

Pink-footed Goose

Percentiles	Number of counts			Frequency Index
	Old records 1986/87 to 2006/07	New records 2007/08 to 2011/12	All records 1986/87 to 2011/12	
0-25%	1	1	1	0.7
25-50%	1	1	1	0.8
50-75%	2-3	2	2	0.9
75-100%	>3	>2	>2	1.0

The process was repeated for Greylag Goose records:

Greylag Goose

Percentiles	Number of counts			Frequency Index
	Old records 1986/87 to 2006/07	New records 2007/08 to 2011/12	All records 1986/87 to 2011/12	
0-25%	1	1	1	0.7
25-50%	1	1	1	0.8
50-75%	2-4	2	2-3	0.9
75-100%	>4	>2	>3	1.0

2.3.3 Quality of count data

Goose feeding distribution records were collected in many ways and from a variety of sources (see Appendix 1). Where the count and location were known to be accurate, from either standardised surveys or *ad hoc* counts, records were allocated a 'Quality Index' of 1.

BirdTrack records, where it was not known if the geese were feeding in or flying over the 1km square, were allocated a Quality Index of 0.9. For any records where no flock size was recorded, but 1 km squares were indicated as supporting feeding geese, records were allocated a Quality Index of 0.9.

Where several sources contributed count data to a single 1km square, the highest Quality Index was used in preference to all other Quality Indices. That is to say, if a 1km square held count data from six different sources, the presence of a single count with a Quality Index of 1 meant that that index value was allocated to the square.

2.3.4 Sensitivity Index

For each of the three time periods a separate Sensitivity Index for each 1km square was calculated by multiplying the mean of the natural log of the annual peak counts by the Frequency Index and the sum was then multiplied by the Quality Index.

One km squares were then ranked (lowest to highest) and various percentiles could then be determined. For maximum comparability, a standardised approach based on four graduated subdivisions was used. These corresponded to 0-25%, 25-50%, 50-75% and 75-100% percentiles above zero. On the distribution maps, the four graduated subdivisions were allocated a code and represented as dark blue dots of varying size, smallest (1 = 0-25%) to largest (4 = 75-100%).

For 1km squares that had a mean annual peak count (and hence Sensitivity Index) of zero but had records of geese being present, the 1km square was allocated a code for 'present only'. These were represented on the maps as small red symbols (dots; see Key in 3.1).

An example of determining the Sensitivity Indices is given below for a fictional 1km square:

There were eight Greylag Goose records for 1km square HY6115 (Orkney):

Date of record	Time period	Source	Count (flock size)	Natural log of count	Frequency Index	Quality Index
25 Oct 2003	Old	Marked bird	None given	present	0.9	0.9
14 Nov 2006	Old	<i>BirdTrack</i>	100	4.605	0.9	0.9
23 Jan 2007	Old	Marked bird	None given	present	0.9	0.9
1 Jan 2008	New	Marked bird	29	3.367	1.0	1
17 Mar 2008	New	<i>BirdTrack</i>	345	5.843	1.0	0.9
3 Oct 2010	New	<i>BirdTrack</i>	200	5.298	1.0	0.9
14 Dec 2011	New	<i>BirdTrack</i>	150	5.011	1.0	0.9
27 Feb 2012	New	IGC count	98	4.585	1.0	1

The mean of the natural logarithm of the annual peak counts for the three time periods were:

1986/87 to 2006/07 (old) 4.605 (derived from 4.605 only)
 2007/08 to 2011/12 (new) 4.880 (mean of 3.367, 5.843, 5.298 and 5.011)
 1986/87 to 2011/12 (all) 4.825 (mean of 4.605, 3.367, 5.843, 5.298 and 5.011)

Records with no flock size given (but geese were recorded as being present) were not included in calculating the mean of the annual peak counts. The count of 98 geese on 27 Feb 2012 was not used in determining the mean of the annual peak counts because the peak count that winter was 150 geese on 14 Dec 2011.

The Frequency Indices for each of the three time periods were:

1986/87 to 2006/07 (old) 0.9 (three records)
 2007/08 to 2011/12 (new) 1 (five records)
 1986/87 to 2011/12 (all) 1 (eight records)

Where several sources contributed count data to a time period, the highest Quality Index was used in preference to all other Quality Indices:

1986/87 to 2006/07 (old) 0.9
 2007/08 to 2011/12 (new) 1
 1986/87 to 2011/12 (all) 1

The Sensitivity Index was then calculated for each time period by multiplying the mean of the natural logarithm of the annual peak counts by the Frequency Index (0.7 to 1). The sum was then multiplied by the Quality Index (0.9 or 1):

1986/87 to 2006/07 (old) $4.605 \times 0.9 \times 0.9 = \mathbf{3.730}$
 2007/08 to 2011/12 (new) $4.880 \times 1 \times 1 = \mathbf{4.880}$
 1986/87 to 2011/12 (all) $4.825 \times 1 \times 1 = \mathbf{4.825}$

From the above method it can be seen that mean flock size had the greatest weighting on calculating the Sensitivity Indices. Thus, the Sensitivity Index of a 1km square based on several counts of high quality would be equal to the mean of the natural logarithm of the annual peak counts for that square. Whereas, the Sensitivity Index of a 1km square based on few counts of lower quality would be lower than the mean of the natural logarithm of the annual peak counts for that square.

2.3.5 Feeding data from standardised surveys

The majority of feeding records were from *ad hoc* non-standardised, or casually, collected records. However, $\approx 12\%$ of records were from standardised surveys where defined areas were checked for the presence of geese (see Appendix 1). These were particularly valuable since they recorded the absence as well as the presence of feeding geese. The 1km squares for which standardised survey data were available are shown as grey symbols on the maps (squares; see Key in 3.1). Thus, where 1km square are shaded grey, but hold no blue symbols indicating the presence of geese, no geese had been recorded in that square during the standardised surveys (see 4.2 Map limitations).

2.4 SPAs and goose roosts

There were 17 SPAs with Pink-footed Goose and 17 SPAs with Greylag Goose cited as interest features (Appendix 2). Some SPAs had both species as interest features, so the total number of SPAs involved in the analysis was 27. SPAs sometimes contain multiple roosts sites. For example Tayside Goose Roosts SPA covers three geographically separate waterbodies (Dupplin Loch, Carsebreck and Rhynd Lochs and Pond of Drummond) and the Firth of Forth SPA includes (at least) three separate goose roosts (Aberlady Bay, Skinflats and Alloa Inch). Principal roost sites either on the SPA or additional sites currently holding more than 1.0% of the population (based on count data from 2010/11; see Appendix 3), were shown on the distribution maps as green symbols (dots; see Key in 3.1).

The SPA boundary was shown on the distribution maps (as a red line) as was a line drawn at 20km around each SPA (black line; see Key in 3.1). This distance is generally taken to be the normal maximum distance geese fly to and from individual roosts (see Patterson 2011). However, note that both Pink-footed and Greylag Geese are known to undertake flights of over 20km (sometimes up to ≈ 30 km) between roost and feeding areas (pers. obs.) although these are considered unusual.

The suite of existing SPAs covers a large proportion of roosting Pink-footed and Greylag Geese in Scotland. However, the proportion of the population using the suite of SPAs may change, with some SPAs holding a larger proportion of the population over time, whilst others hold a smaller proportion, or in some cases are abandoned, notably so for Greylag Geese (Figures 3 and 4, WWT data). Shifts in distribution (either temporary or permanent) can thus affect the mapped distribution of feeding geese around SPAs.

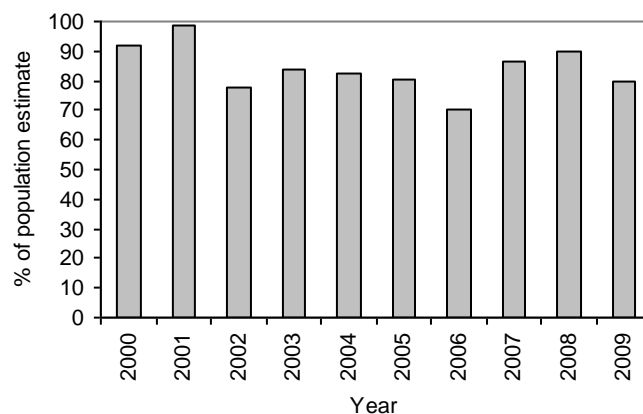


Figure 3. The percentage of the Iceland/Greenland Pink-footed Goose population counted on the UK SPA network at the time of the population estimate.

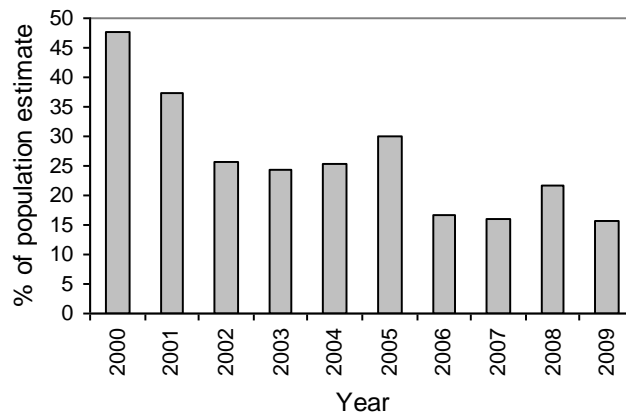


Figure 4. The percentage of the Iceland Greylag Goose population counted on the UK SPA network at the time of the population estimate.

2.5 Attribute tables and creation of sensitivity maps

The primary outputs of this study were two attribute tables (created in MS Excel); one for Pink-footed Goose and one for Greylag Goose (Table 1).

Table 1. Breakdown of components of attributes table (example records for a fictional 1km square HY6115 (Orkney), see 2.3.4.).

Attribute	Attribute type	Example	Comment
1km square	Text	HY6115	
Easting	Text	361555	Locates centre of 1km square
Northing	Text	1015555	Locates centre of 1km square
1986/87 to 2006/07 (old)	Integer	3	Number of records
	Integer	0.9	Highest Quality Index
	Integer	4.605	Mean of natural logarithm of annual peak counts
	Integer	3.730	Sensitivity Index
	Integer	3	Mapping code
2007/08 to 2011/12 (new)	Integer	5	Number of records
	Integer	1	Highest Quality Index
	Integer	4.880	Mean of natural logarithm of annual peak counts
	Integer	4.880	Sensitivity Index
	Integer	4	Mapping code
1986/87 to 2011/12 (all)	Integer	8	Number of records
	Integer	1	Highest Quality Index
	Integer	4.825	Mean of natural logarithm of annual peak counts
	Integer	4.825	Sensitivity Index
	Integer	4	Mapping code

Sensitivity maps were created in ArcView Professional version 3.2. Distribution data (see Table 1) were plotted in ArcView to create a separate data layer for each species.

3 Results

In total, there were 13,698 Pink-footed and 13,713 Greylag Goose records used to map the feeding distribution of geese in Scotland. Excluding some Pink-footed Goose distribution data in Cumbria (167 1km squares, see 3.1 below), summary information was available for 2,726 1km squares for Pink-footed and 2,994 1km squares for Greylag Geese. Compared to the total land surface of Scotland (estimated at 78,387 km²) the feeding distribution of Pink-footed Geese occupied \approx 3.5% and that of Greylag Geese, \approx 3.8% (Figures 5 and 6).

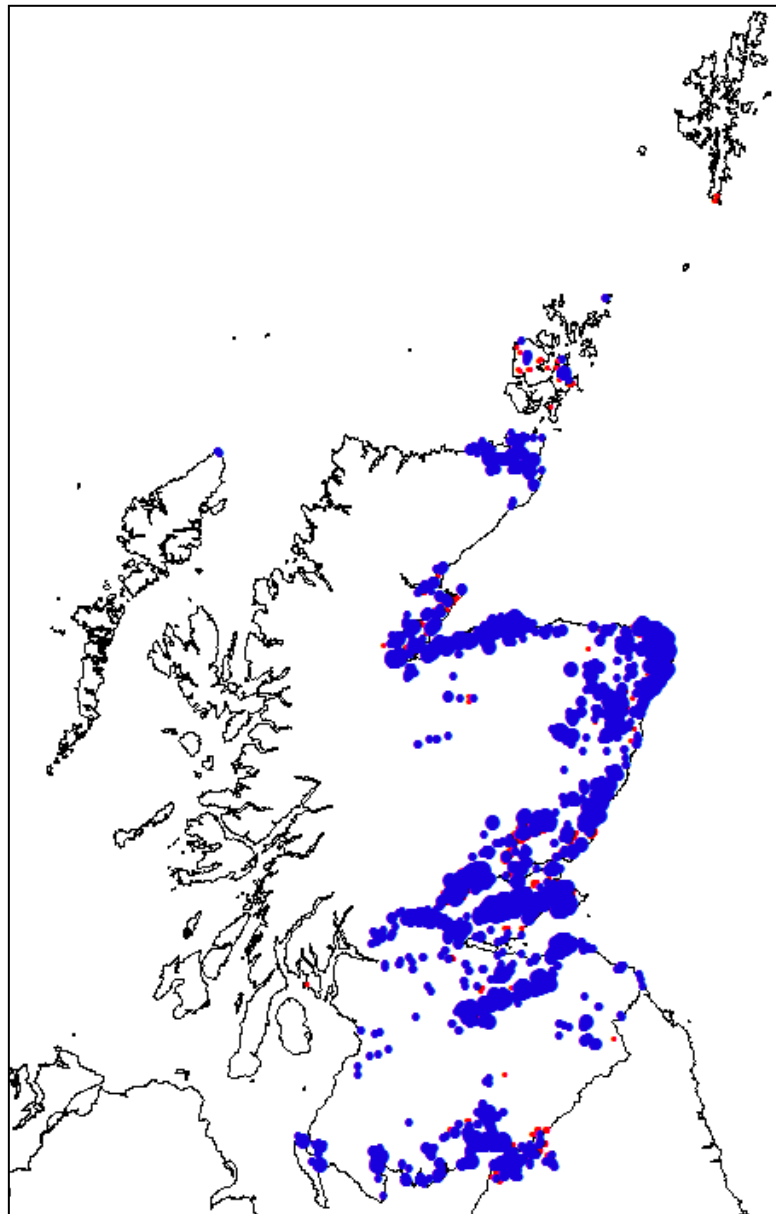


Figure 5. The distribution of feeding records of Pink-footed Geese in Scotland. Based on all data (1986/87 to 2011/12). Sensitivity Index represented by four graduated dark blue symbols (dots) (see 2.3.4 above). One km squares for which no quantitative data exists but geese were known to be present (see 2.3.1 above) represented by small red symbols (dots).

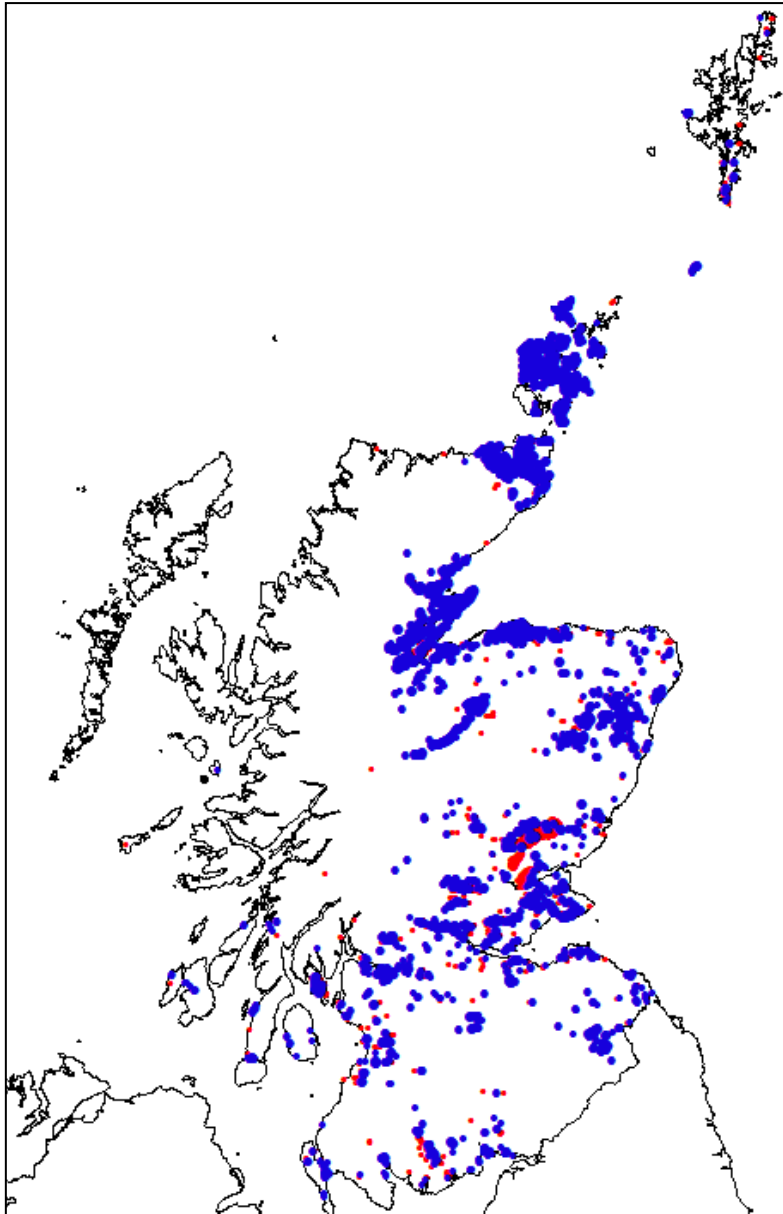


Figure 6. The distribution of feeding records of Greylag Geese in Scotland. Based on all data (1986/87 to 2011/12). Sensitivity Index represented by four graduated dark blue symbols (dots) (see 2.3.4 above). One km squares for which no quantitative data exists but geese were known to be present (see 2.3.1 above) represented by small red symbols (dots).

Records were not evenly distributed over time. The majority of Pink-footed Goose records were from the mid 1990s to the early 2000s. This partly related to the number of colour ring sightings generated by ringing in Iceland and the UK at that time and intensive feeding studies carried out at Loch Leven in winters 1994/95 and 1995/96 (Figure 7). There was a noticeable decline in records from 2002 onwards, with the exception of 2005 when WWT undertook a questionnaire-based study to map the distribution of feeding geese around SPAs. Records from the most recent five year period (2007/08 to 2011/12) contributed 21.9% of the total.

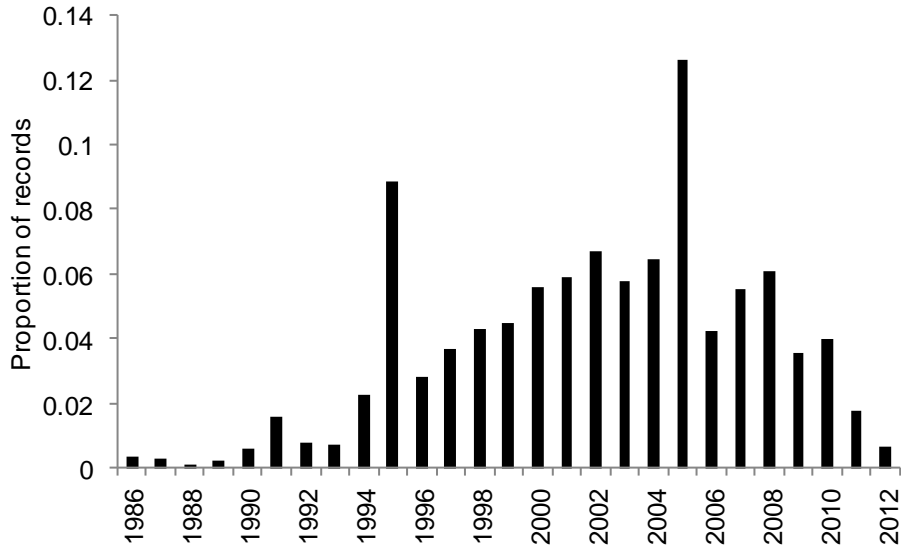


Figure 7. Temporal distribution of Pink-footed Goose records in Scotland used in the mapping analysis.

The majority of Greylag Goose records were also recorded in the late 1990s and early 2000s and again partly related to the number of colour ring sightings generated by ringing in Iceland and the UK (Figure 8). There was a noticeable decline in records from 2001 onwards, with the exception of 2005 when WWT undertook a questionnaire-based study to map the distribution of feeding geese around SPAs and winters 2010/11 and 2011/12 when a specific feeding survey was undertaken and February 2012 when feeding distribution data from Orkney was available for the first time. Records from the most recent five year period (2007/08 to 2011/12) contributed 28.3% of the total.

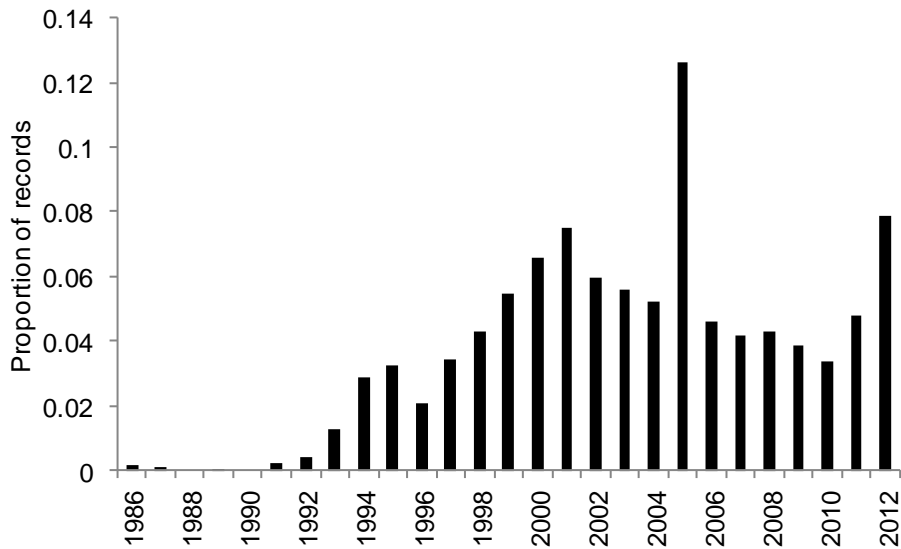


Figure 8. Temporal distribution of Greylag Goose records in Scotland used in the mapping analysis.

Due to the way the Sensitivity Indices were calculated (see 2.3.4) the indices were correlated with the mean of the natural logarithm of annual peak counts for each 1km square (Figures 9 and 10). There is less confidence (ie a lower Sensitivity Index) for data points below the fitted perfect correlation line (indicative only).

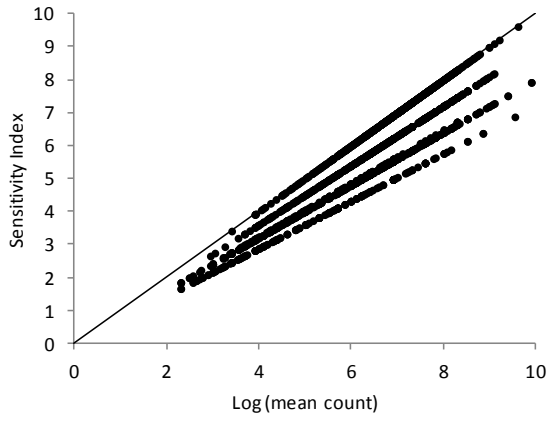


Figure 9. Relationship between the mean of the natural logarithm of annual peak counts for a 1km square and the calculated Sensitivity Index for that square for records of Pink-footed Geese.

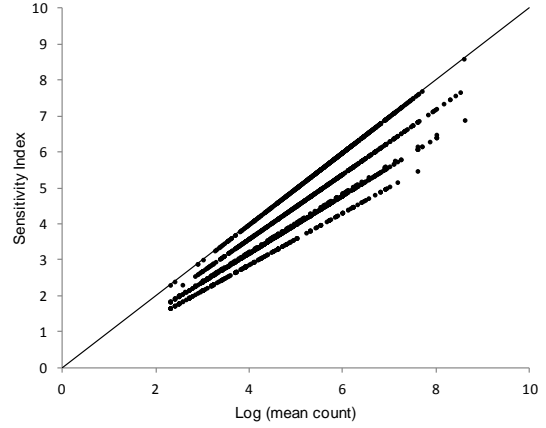


Figure 10. Relationship between the mean of the natural logarithm of annual peak counts for a 1km square and the calculated Sensitivity Index for that square for records of Greylag Geese.

3.1 Feeding distribution around individual Special Protection Areas

ArcView output maps are given for the 27 SPAs in Appendix 4 (example, in Figure 11). Note that feeding distribution data for the Solway Firth includes data from 167 1km squares in Cumbria since the Upper Solway Flats and Marshes SPA covers areas in both Scotland and England.

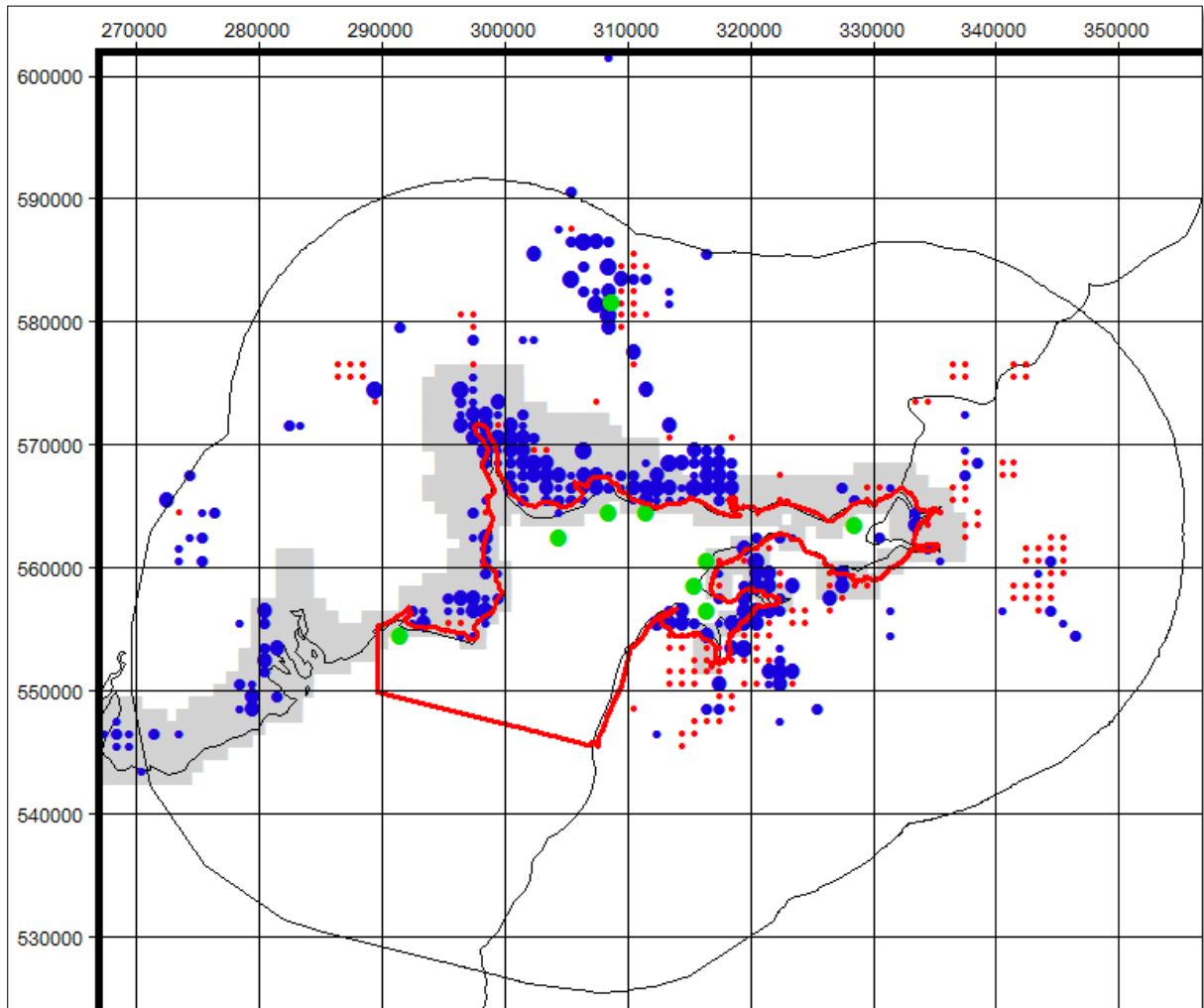


Figure 11. Feeding distribution (all records) of Pink-footed Geese in relation to the Upper Solway Flats and Marshes SPA shown with a line drawn at 20km from the SPA boundary. For Key see below.

For each of the maps, the following symbols were used:

- 1) Sensitivity Index represented by four graduated dark blue symbols (dots) (see 2.3.4 above).
- 2) 1km squares for which no quantitative data exists but geese were known to be present (see 2.3.1 above) represented by small red symbols (dots).
- 3) The SPA boundary (thick red line).
- 4) Important roosts either within the SPA boundary (if known) or other nearby waterbodies (see 2.4 above) represented by green symbols (dots).
- 5) 20km line surrounding the SPA boundary (black line).
- 6) 1km squares subject to standardised surveys (shaded grey) (see 2.3.5 above).

3.2 Representativeness of the data

Two exercises were undertaken to compare the summary 1km data derived from *ad hoc* observations with data from intensive standardised surveys of goose use in two different areas.

3.2.1 *Ad hoc* count data versus known flight activity information

In a recent review, Pink-footed Goose flight activity data at different distances from SPA roosts were obtained from surveys carried out at proposed wind farm sites in north east Scotland (Patterson 2011). Flight activity data (expressed as the number of geese per km² per hour of observation) was collated from published material from viewing sites at known distances from Loch of Strathbeg SPA. These data were lumped into 2km bands at increasing distance from the roost. In order to avoid the high values of flight activity at points closest to the roost, bands started at 4-5km from the roost. Flight activity data were then compared to mean annual peak counts for 1km squares from this study, also lumped into 2km bands at increasing distance from the roost.

Both flight activity and numbers of feeding geese were highest at 4-5 and 6-7 km from the roost and both declined at greater distances from the roost (Figure 12).

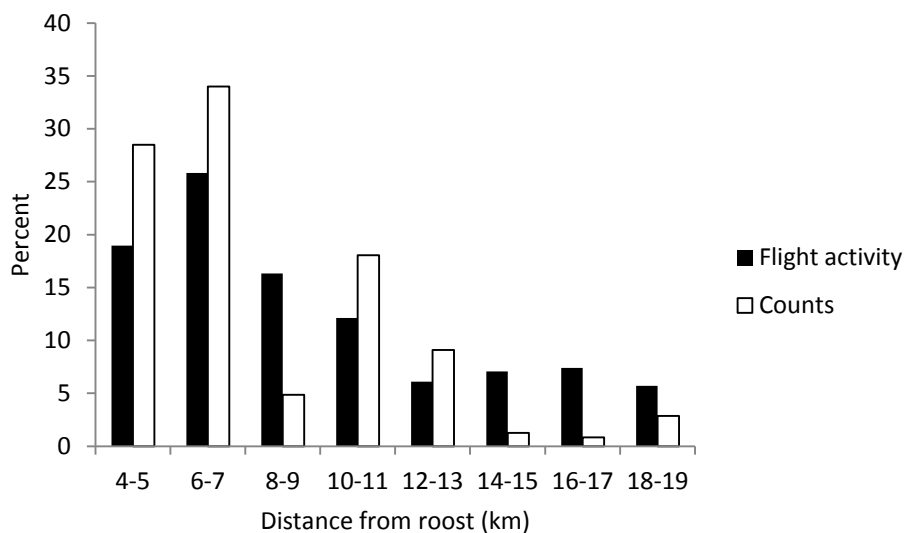


Figure 12. Percent of flight activity (the number of Pink-footed Geese per km² per hour of observation) and *ad hoc* feeding counts in 2km bands from the Loch of Strathbeg SPA roost.

The flight activity values showed a positive significant relationship with the feeding data ($r^2 = 0.725$, $P=0.007$, Figure 13) suggesting that bands with the greatest flight activity also supported the highest numbers of feeding geese.

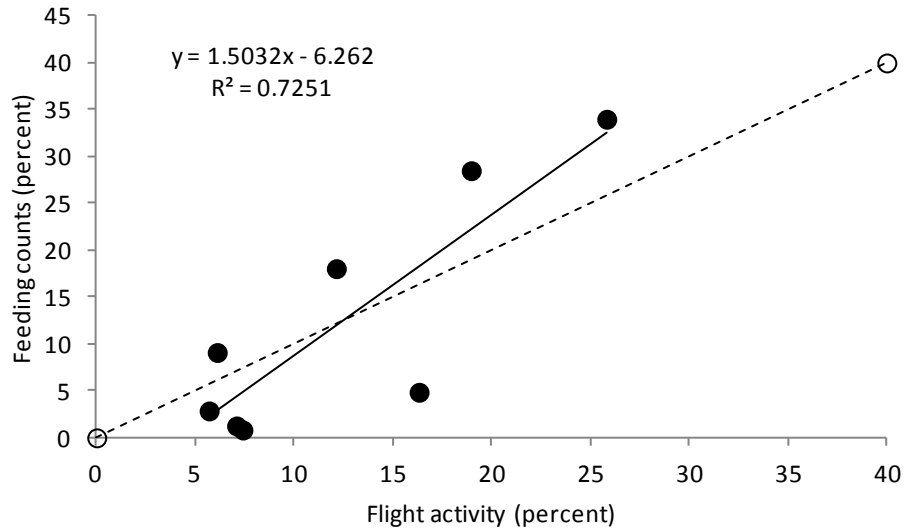


Figure 13. Relationship between flight activity (the number of Pink-footed Geese per km² per hour of observation) and *ad hoc* feeding counts in 2km bands from the Loch of Strathbeg SPA roost. Dashed line represents a perfect positive relationship (for reference only).

3.2.2 *Ad hoc* count data versus data collected from a standardised survey

During winter 1994/95, the distribution of Pink-footed Geese feeding around Loch Leven SPA was recorded through a standardised survey (Hearn & Mitchell 1995). From December to March, 1,474 fields were checked two or three times each week and this generated 746 records of feeding geese.

There was a significant difference between the 1km squares containing records from both sources (n=52), records from the 1994/95 standardised survey only (n=20) and records from all other sources only (n=4) ($X^2 = 19.5$, $P < 0.01$, Figure 14). This suggests that a greater proportion of 1km squares (68.4%) held geese recorded from both data sources, although this particularly study site had a large number of marked birds and a particularly keen ring reader which generated a large number of *ad hoc* counts.

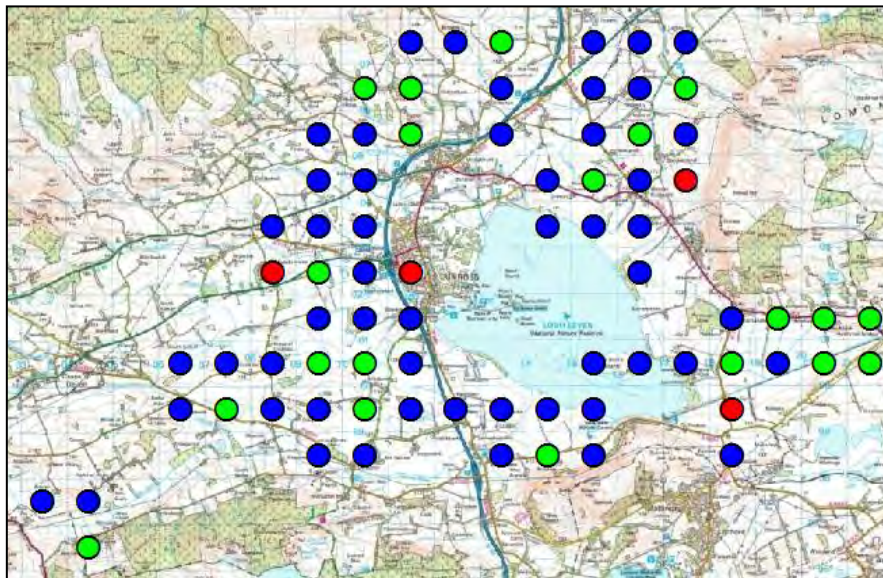


Figure 14. The distribution of peak counts of >100 Pink-footed Geese recorded during the 1994/95 standardised survey only (green), during *ad hoc* counts only (red) and recorded in both data sources (blue).

4 Discussion

4.1 Map applications

The rapid increase in the number of wind farms proposed in Scotland has led to the potential for conflict with bird conservation interests. As of July 2012, Scotland had 143 operational onshore windfarms (2,914 MW), 126 consented projects (granted planning approval but have not yet become operational) (3,693 MW) and 171 in planning under consideration (3,977 MW)¹. It is important to minimise this conflict as many of the species of concern are specially protected under Annex 1 of the EU Birds Directive and are also an important part of Scotland's natural heritage, contributing significantly to its economy. The maps are intended to provide a strategic view of the sensitivities of Pink-footed and Greylag Geese in Scotland to onshore wind farm development and so facilitate locational guidance for wind farms to minimise conflict. The maps created in this study are an indicative tool but do not replace the need for the standard site-specific assessments of the impact of wind turbines/developments on geese as appropriate.

A greater need for important agricultural feeding areas for geese and swans to be identified and protected is widely recognised, including within the EU Birds Directive. Consequently, extensions to existing SPAs for geese and swans that encompass some key feeding areas are being considered. Their identification and management will require a robust data collection and assessment protocol, and whilst this currently does not exist in the UK, and is outwith the focus of this study, the results and methods presented here provide a starting point for the further development of a monitoring programme for goose and swan feeding areas that can be extended to other species and regions.

4.2 Map limitations

The following caveats need to be taken into account when using the maps:

- The maps have been developed from available information. However, data deficiency (primarily a lack of nil counts) means that the maps are not comprehensive. Gaps in standardised survey coverage mean that there is no guarantee these species do not occur in 1km squares with no known coverage. Outwith areas of standardised survey, an absence of goose records could be because of the absence of geese or the absence of records/recorders.
- Example maps are presented in Appendix 4. However, it should be borne in mind that these represent patterns of distribution based on the identified data sources only (Appendix 1). Some historic and recent data sources have yet to be identified and collated. In addition, the intention is to update distribution data in the future, and patterns of distribution may change over time.
- There are fewer records from the most recent period (from 2007/08 to 2011/12) partly due to the shorter time period (five years) and partly due to the reduction in the number of geese being ringed in recent years and a subsequent reduction in the number of sightings.
- At some sites, a reduction in feeding records may also represent an absence, or reduction in the number of geese. For example, there has been a gradual shift in the winter distribution of Iceland Greylag Geese from large parts of east central and north east Scotland to Orkney (e.g. Mitchell 2011). Thus, sites such as Loch of Strathbeg, Montrose Basin and Muir of Dinnet no longer support internationally important numbers of Iceland Greylag Geese. The maps should therefore be interpreted in conjunction with results from any available local surveys (e.g. Patterson *et al.* 2012), recent roost count data (see Appendix 3), annual IGC reports (e.g. Mitchell 2011), a review of goose use of SPAs (Mitchell & Hall 2012) and the Waterbird Review Series reports for Pink-footed Geese (Mitchell & Hearn 2004) and for Iceland Greylag Geese (Hearn & Mitchell 2004).
- The maps were created by collating data that were largely collected for other purposes and thus data collection protocols were not tailored specifically to the requirements of this project. For example, *Birdtrack* records have been included, yet it is not known if the geese were flying over or feeding in a 1km square.

¹ From <https://restats.decc.gov.uk/cms/scotland> (accessed on 5/7/2012).

- Distribution data collected in a non-standardised way cannot be easily analysed. The Sensitivity Index is not based on spatial analysis (or modelling) but is simply based on the abundance of geese recorded in 1km squares and attempts to take into account the number of records from that 1km square and the quality of the raw data.
- The maps are not a substitute for site-specific assessments of the impact of wind turbines/developments on geese, but are intended as an indicative map of areas of highest likely bird sensitivity, to help guide decision-makers in the early stages of the planning process.
- The maps will require updates to add new survey data for Pink-footed and Greylag Geese as they become available (see 4.5.1).
- Attention must also be given to recent changes in the distribution of both populations (notably for Greylag Geese).
- No liability is accepted for the presence or absence of species at particular sites contrary to that indicated on the map.

4.3. British Greylag Geese

The abundance and distribution of the breeding British Greylag Goose population has increased in the last thirty years (see Mitchell *et al.* 2010b for a review and Mitchell *et al.* 2012). This has led to monitoring challenges in the areas where this and the migratory Icelandic population both occur in winter. At the site level, the abundance of the summering British Greylag Goose population needs to be established, and assuming that these birds are largely sedentary, this figure needs to be subtracted from winter counts in order to calculate winter estimates of the Iceland population. For example, there were an estimated 21,360 British Greylag Geese on Orkney in August 2012, and this figure will be deducted from winter counts to estimate the number of Iceland Greylag Geese present. Regular summer counting only occurs in a small number of areas.

This presents any analysis of the feeding distribution of Greylag Geese in Scotland with challenges. Whilst attempts have been made to estimate the abundance of both populations in areas of overlap, unless summer-caught marked individuals are involved, in some parts of Scotland it is almost impossible to tell which population feeding geese belong to. In Shetland, Orkney, Caithness and Badenoch & Strathspey, for example, it is not unusual to see a flock of Greylag Geese containing marked individuals from both the Iceland and British populations (pers. obs.). For the current analysis, apart from records of colour ringed birds known to be from the Iceland population, no attempt was made to distinguish between records of Greylag Geese from either population. Thus, care needs to be given when interpreting feeding distribution maps of Greylag Geese where both populations occur. One of the benefits of maintaining a ringed cohort of both populations is the ability to distinguish the provenance of Greylag Geese encountered in the field.

4.4 Representativeness of the data

Apart from a relatively few standardised surveys, the majority of feeding records were recorded in an *ad hoc*, non-standardised or casual manner. Inevitably, feeding records recorded in this way were prone to biases. Casual records may simply reflect the distribution of fields checked by individual observers. Or flocks may not have been recorded where no age count was carried out or the flock did not contain a marked individual. More records may be generated close to key bird watching sites or even the homes of, or regular routes travelled by, observers. Records of geese feeding in fields are often not recorded by birdwatchers and, generally, have not been of interest to county bird recorders. In some areas, this has contributed to a lack of detailed knowledge about the feeding areas preferred by geese around roosts.

However, the two analyses of the representativeness of the data (3.2) suggest that *ad hoc* records showed a broadly similar distribution to those collected from standardised surveys and therefore some degree of confidence could be attached to presenting data from both sources together. At Loch Leven, a greater proportion of 1km squares (68.4%) held geese recorded from both data sources. However, this was a particularly well monitored site and there is a likelihood that data from other sites will contain fewer *ad hoc*

counts. There is, therefore, a need for standardised survey effort at other key sites if a true picture of feeding distribution is to be obtained.

There has been a gradual shift in the winter distribution of Iceland Greylag Geese from large parts of east central and north east Scotland to Orkney (e.g. Mitchell 2011). Thus, sites such as Loch of Strathbeg, Montrose Basin, Muir of Dinnet etc no longer support internationally important numbers of Iceland Greylag Geese. As indicated above, the maps should therefore be interpreted in conjunction with information from other data sources.

4.5 Recommendations

4.5.1 Updating the sensitivity maps

The maps were created using information currently available. There will be a need to review and update the maps as new data become available, as well as to review the sensitivity criteria as new research methods to analyse non-standardised distribution data are developed. There are various surveys which may make useful updates or additions to the map, which were not available within the timescale of the current project, for example BTO Atlas data. Fieldwork for the most recent bird atlas was conducted in 2007-2011, and is due to be published in 2013, after which it may be possible to incorporate these data for wintering Pink-footed and Greylag Geese, and ideally other species feeding in cropped habitats.

The 2004/05 WWT SPA feeding distribution study identified areas where goose counters had indicated the presence of feeding geese, but no quantitative data was requested (identified as small red dots on the maps). Other data sources also indicated the presence of feeding geese but no quantitative data was provided (e.g. a record of a colour ringed goose but no flock size was recorded). A rolling programme of standardised surveys in these areas would assess a truer picture of the distribution of feeding geese. Potential feeding areas could be surveyed once every three or five years – a sampling method used for the WeBS Low Tide Counts (see Holt *et al.* 2011)

4.5.2 Recording feeding geese

The value of recording feeding geese (and other species – see 4.5.3 below) will be emphasised through the distribution of this report, and summary results will be promoted through articles in publications such as the *WeBS Newsletter* and *GooseNews* and through direct communication with goose counters and other birdwatchers. Thus attempts will be made to encourage goose watchers and other birdwatchers to regularly record the location of feeding flocks. Recording the location of feeding flocks can be accommodated in *BirdTrack* once the recording of whether a bird/flock is in flight or on the ground is made mandatory.

Standardised recording of feeding geese – noting the presence/absence of geese on set routes - is extremely valuable in assessing the true distribution of the birds in the landscape. More sophisticated analyses of spatial data, for example the distribution of geese in relation to landscape features, are possible once data deficiency issues (primarily a lack of nil counts) are addressed.

4.5.3 Mapping the feeding distribution of other species in the UK

This feeding distribution mapping study provides a platform for extending analyses to other important waterfowl species feeding in cropped habitats away from waterbodies, for example, other goose species, Whooper Swans *Cygnus cygnus*, Bewick's Swans *Cygnus columbianus bewickii*, Wigeon *Anas penelope* etc. These species can occur throughout the UK and a joined-up approach to monitoring and mapping the feeding distribution of these species could be extended to other areas. This should be undertaken in a targeted way. For example, proposed wind turbine developments close to the Ouse Washes SPA in the Fens (Cambridgeshire/Norfolk) and their potential impact on wintering Bewick's and Whooper Swans are a specific urgent need.

5 Acknowledgements

Christine Urquhart has been involved in planning and reviewing the project and is thanked. Larry Griffin and Colette Hall provided technical help with ArcView. Peter Cranswick, Larry Griffin, Geoff Hilton and Stuart Newson kindly advised on the treatment of count data. Baz Hughes, Richard Hearn and Christine Urquhart kindly read and improved an earlier version of the report.

All goose counters and observers recording marked individuals and contributing feeding records are thanked and in particular Eric Meek, Ian Patterson, David Patterson, George Brown, Allan Brown, Alan Leitch, Kenny Graham, Ian Francis, Ian Stenhouse, Frank Mawby, Peter Cranswick and Larry Griffin. The BTO (Nick Moran) kindly provided *BirdTrack* data and all those observers who contributed data to *BirdTrack* are thanked. Bob Swann has kindly administered the Iceland Greylag Goose sightings database and is thanked for providing distribution data.

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Appendix 1. Data sources.

Author/contact	Data type	Time period covered	Area covered	Pink-footed Geese	Greylag Geese	Report citation
WWT	Colour ring sightings of individually marked geese	1987 to 2011	Whole of Scotland	8,217 (60.0%)		
R. L. Swann	Colour ring sightings of individually marked geese	1987 to 2011	Whole of Scotland		7,906 (56.3%)	
BTO	<i>Birdtrack</i>	2000 to 2010	Whole of Scotland	1,033 (7.5%)	2,825 (20.1%)	
WWT	WWT/SNH feeding goose project	1993/94	Various parts of Scotland		220 (1.6%)	Stenhouse & Mitchell (1994)
I.Francis	North east Scotland Bird Records database	2000 to 2010	NE Scotland (Aberdeenshire)	523 (3.8%)	280 (2.0%)	
L. Griffin (WWT)	Barnacle Goose surveys around the Solway Estuary (Standardised Survey)	2006/07 to 2010/11	Solway Estuary	333 (2.4%)		
D. Patterson (WWT)	Casual observations	1994/95	Dumfries & Galloway	122 (0.9%)	12 (0.1%)	
A. Brown & L. Brown	West Water Reservoir SSSI Pink-footed Goose Study 2004-05 to 2006-07	2004/05 to 2006/07	Lothians	92 (0.7%)		Brown & Brown (2007)
A. Brown & L. Brown	Pink-footed Goose feeding distribution in relation to Goose roosting sites in the Lothians	2004/05 to 2006/07	Lothians	108 (0.8%)		Brown & Brown (2009)
A. Brown	Pink-footed Goose status at Cameron Reservoir, Fife	2007/08 to 2008/09	Fife	263 (1.9%)		Brown (2009)
A. Brown & L. Brown	Pink-footed Goose Status at Fala Flow SSSI/SPA and links to feeding areas	2009/10 to 2010/11	Lothians	100 (0.7%)		Brown & Brown (2011)

	in winters 2009/10 and 2010/11					
C. Mitchell (WWT)	Own observations	1987 to 2012	Whole of Scotland	39 (0.3%)	241 (1.7%)	
WWT	Grey goose age counts	1987 to 2012	Whole of Scotland	490 (3.6%)	413 (2.9%)	
WWT	Goose distribution and feeding around Loch Leven NNR (Standardised Survey)	1994/95	Loch Leven, area, Perth & Kinross	627 (4.6%)	93 (0.6%)	Hearn & Mitchell (1995)
WWT	SPA feeding distribution study	2004/05	Selected SPAs within Scotland	1,111 (8.1%)	1,012 (7.2%)	
I. Patterson	SPA feeding study (Standardised Survey)	2011/12	Caithness	45 (0.3%)	110 (0.8%)	
I. Patterson	SPA feeding study	2004	Loch of Strathbeg	207 (1.5%)		Patterson & Thorpe (2006)
F. Mawby	Pink-footed Goose distribution around the Solway Firth	2008	Solway Firth	135 (1.0%)		Mawby (2008)
WWT	IGC counts	1987 to 2011	Scotland		102 (0.7%)	
RSPB Scotland (Golspie)	Feeding counts	2008 to 2011	Caithness		38 (0.3%)	
P. Cranswick (WWT)	Feeding counts	1991/92	Lothians/Borders	132 (1.0%)	44 (0.3%)	Cranswick (1992)
A. Leitch (RSPB Scotland)	Feeding counts	2011/12	Orkney		417 (3.0%)	
G. Brown (feeding distribution maps)	Feeding areas	2008	Fife	121 (0.9%)		
Total				13,698	13,713	

Appendix 2. SPAs in Scotland with Greylag or Pink-footed Goose as qualifying species.

Site Code		SPA	Greylag Goose	Pink-footed Goose
UK9005012	1	Upper Solway Flats and Marshes		Y
UK9001171	2	Caithness Lochs	Y	
UK9001621	3	Loch Eye	Y	
UK9001622	4	Dornoch Firth and Loch Fleet	Y	
UK9001623	5	Cromarty Firth	Y	
UK9001624	6	Inner Moray Firth	Y	
UK9001625	7	Moray and Nairn Coast	Y	Y
UK9002201	8	Loch Spynie	Y	
UK9002211	9	Loch of Strathbeg	Y	Y
UK9002221	10	Ythan Estuary, Sands of Forvie and Meikle Loch		Y
UK9002261	11	Loch of Skene	Y	
UK9002791	12	Muir of Dinnet	Y	
UK9003111	13	Loch Ken and River Dee Marshes	Y	
UK9003191	14	Castle Loch, Lochmaben		Y
UK9004031	15	Montrose Basin	Y	Y
UK9004051	16	Loch of Kinnordy	Y	Y
UK9004061	17	Loch of Lintrathen	Y	
UK9004111	18	Loch Leven		Y
UK9004121	19	Firth of Tay & Eden Estuary	Y	Y
UK9004131	20	Cameron Reservoir		Y
UK9004231	21	Gladhouse Reservoir		Y
UK9004241	22	Fala Flow		Y
UK9004251	23	West Water		Y
UK9004281	24	Greenlaw Moor		Y
UK9004291	25	Din Moss – Hoselaw Loch	Y	Y
UK9004401	26	South Tayside Goose Roosts	Y	Y
UK9004411	27	Firth of Forth		Y

Appendix 3. IGC goose counts.

The accepted threshold values used to identify sites of international importance are those holding 1% of the population estimates are currently 3,500 for Pink-footed Goose and 980 for Iceland Greylag Goose (Wetlands International 2012). The following tables show the mean peak IGC counts (based on counts from 2006/07 to 2010/11) for Pink-footed and Iceland Greylag Geese at all SPAs and non SPAs holding internationally important numbers.

a) Pink-footed Goose

SPA	Status	Mean IGC peak count 2006/07 to 2010/11 (1)
Sites holding internationally important numbers		
Loch of Strathbeg	SPA	51,969
West Water	SPA	40,471
Montrose Basin	SPA	27,961
Firth of Forth	SPA	18,484
Loch Leven	SPA	17,853
Loch of Skene, Aberdeenshire		17,605
Ythan Estuary, Sands of Forvie and Meikle	SPA	14,332
South Tayside Goose Roosts	SPA	13,317
Upper Solway Flats and Marshes	SPA	10,792
Moray and Nairn Coast	SPA	9,070
Greenlaw Moor	SPA	6,140
Loch of Lintrathen, Angus		5,151
Kilconquhar Loch, Fife		5,069
Middlemuir, Aberdeenshire		4,791
Fala Flow	SPA	4,083
Firth of Tay/Eden Estuary	SPA	3,766
SPAs no longer holding internationally important numbers		
Gladhouse Reservoir	SPA	2,625
Cameron Reservoir	SPA	374
Castle Loch, Lochmaben	SPA	67
Din Moss – Hoselaw Loch	SPA	30
Loch of Kinnordy	SPA	0

Notes:

- (1) Mean derived from any IGC count (*i.e.* from any month, October, November or December).

b) Iceland Greylag Goose

SPA	Status	Mean IGC peak count 2006/07 to 2010/11 (1)
Sites holding internationally important numbers		
Orkney		62,538
Caithness Lochs	SPA	8,826
Dornoch Firth & Loch Fleet	SPA	4,824
Loch Eye	SPA	4,471
Isle of Bute		1,488
Firth of Tay & Eden Estuary	SPA	1,458
Loch of Skene	SPA	1,358
Loch Garten (and lower Strathspey)		1,086
SPAs no longer holding internationally important numbers		
Inner Moray Firth	SPA	873
Cromarty Firth	SPA	752
Loch Spynie	SPA	658
Loch Ken & Dee Marshes	SPA	457
Loch of Lintrathen	SPA	410
Moray and Nairn coast	SPA	352
South Tayside Goose roosts	SPA	337
Loch of Strathbeg	SPA	287
Montrose Basin	SPA	169
Muir of Dinnet	SPA	161
Din Moss – Hoselaw Loch	SPA	99
Loch of Kinnordy	SPA	0

Notes:

- (1) Mean derived from any IGC count (*i.e.* from any month, October, November or December).

Appendix 4. Example sensitivity maps.

For each SPA and for each species for which the site is designated, two maps are presented; one showing the distribution of all feeding records (from the period 1986/87 to 2011/12) and one showing the distribution of feeding records from the most recent five years (2007/08 to 2011/12).

Key:

For Figures 15 to 86, the following symbols were used:

- 1) Sensitivity Index represented by four graduated dark blue symbols (dots) (see 2.3.4 above).
- 2) 1km squares for which no quantitative data exists but geese were known to be present (see 2.3.1 above) represented by small red symbols (dots).
- 3) The SPA boundary (thick red line).
- 4) Important roosts either within the SPA boundary (if known) or other nearby waterbodies (see 2.5 and Appendix 3 above) represented by green symbols (dots).
- 5) 20km line surrounding the SPA boundary (black line).
- 6) 1km squares subject to standardised surveys (shaded grey) (see 2.3.5 above).

Interpreting the maps

The maps show the distribution of feeding geese based on available data. There are fewer records from the most recent period (from 2007/08 to 2011/12) partly due to the shorter time period (five years) and partly due to the reduction in the number of geese being ringed in recent years and a subsequent reduction in the number of sightings.

However, at some sites, a reduction in feeding records may also represent an absence, or reduction in number of geese. There has been a gradual shift in the winter distribution of Iceland Greylag Geese from large parts of east central and north east Scotland to Orkney (e.g. Mitchell 2011). Thus, sites such as Loch of Strathbeg, Montrose Basin and Muir of Dinnet no longer support internationally important numbers of Iceland Greylag Geese. The maps should therefore be interpreted in conjunction with results from any available local surveys (e.g. Patterson *et al.* 2012), recent roost count data (see Appendix 3), annual IGC reports (e.g. Mitchell 2011), a review of goose use of SPAs (Mitchell & Hall 2012) and the Waterbird Review Series reports for Pink-footed Geese (Mitchell & Hearn 2004) and for Iceland Greylag Geese (Hearn & Mitchell 2004).

1. Upper Solway Flats and Marshes (UK9005012): Pink-footed Geese

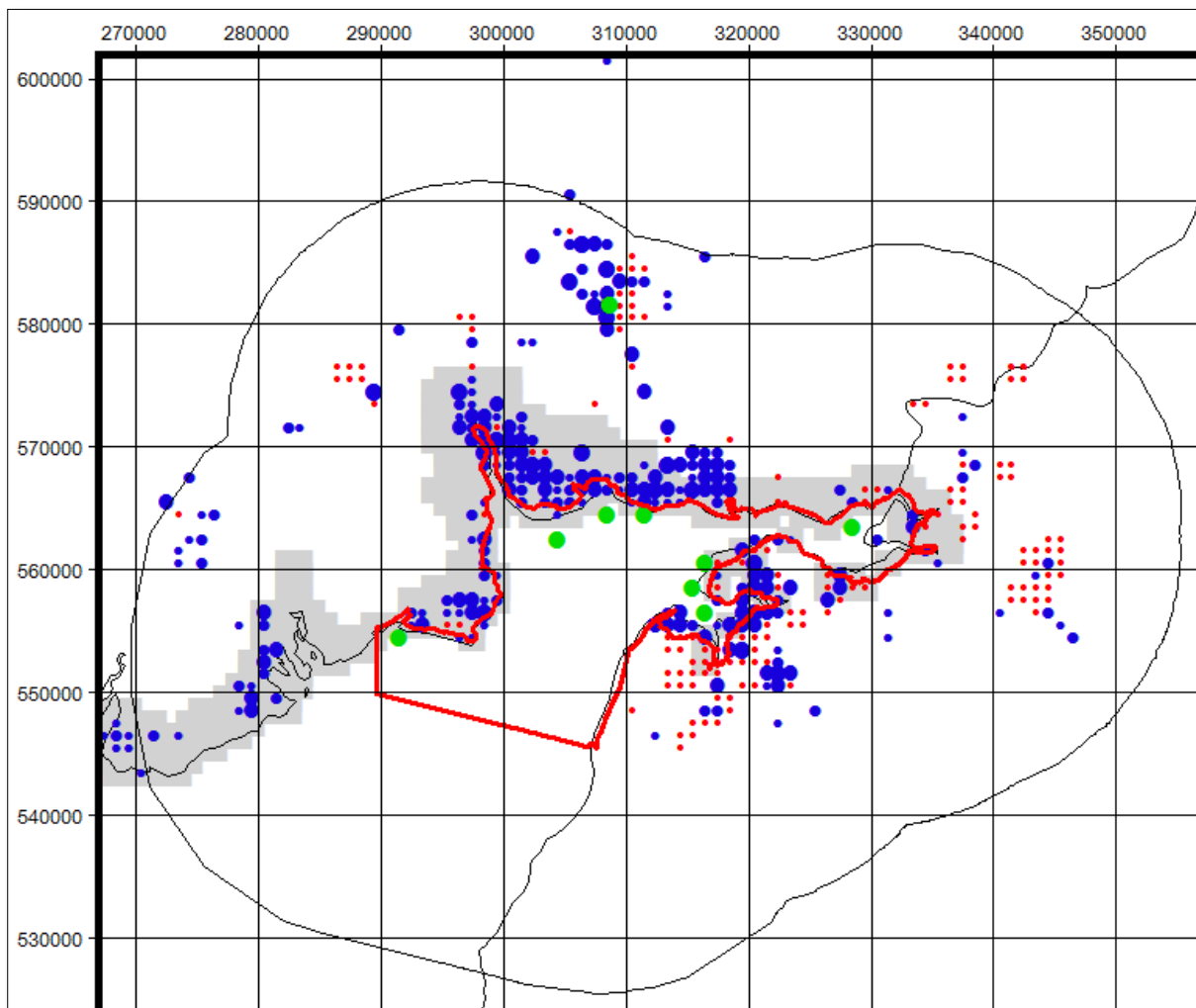


Figure 15. Feeding distribution (1986/87 to 2011/12 - all records) of Pink-footed Geese in relation to the Upper Solway Flats and Marshes SPA. For key see page 35.

Roost locations and feeding distribution

The number of Pink-footed Geese using the Inner Solway increased from the 1960s to the mid 1990s, followed by a decline in the late 1990s. The maximum count was 28,850 in March 1991 (but see below). The roosts locations of Pink-footed Geese on the SPA shift depending on the tides and prevailing weather conditions (Mawby 2008). The main roosts are at Moricambe Bay, at the confluence of the rivers Waver and Wampool, on the Blackshaw and Priestside Banks between the channels of the Nith and the Annan Water, and on the extensive sandflats off the Rockcliffe Marsh. Regularly used locations for roosting birds are shown as green dots. The main feeding areas are on the farmland on either shore and on the saltmarshes, but they also extend inland for example up Nithsdale and Annandale, for up to 20-25km. The geese are regular, often in large numbers on the west shore of the Nith, both at Kirkconnel Merse and behind Southernness and along to Southwick Water. On the landward side there are further feeding grounds which occupy the greater part of the coastal lowlands, notably in the stretch between Dumfries and Annan. See also Mawby (2008).

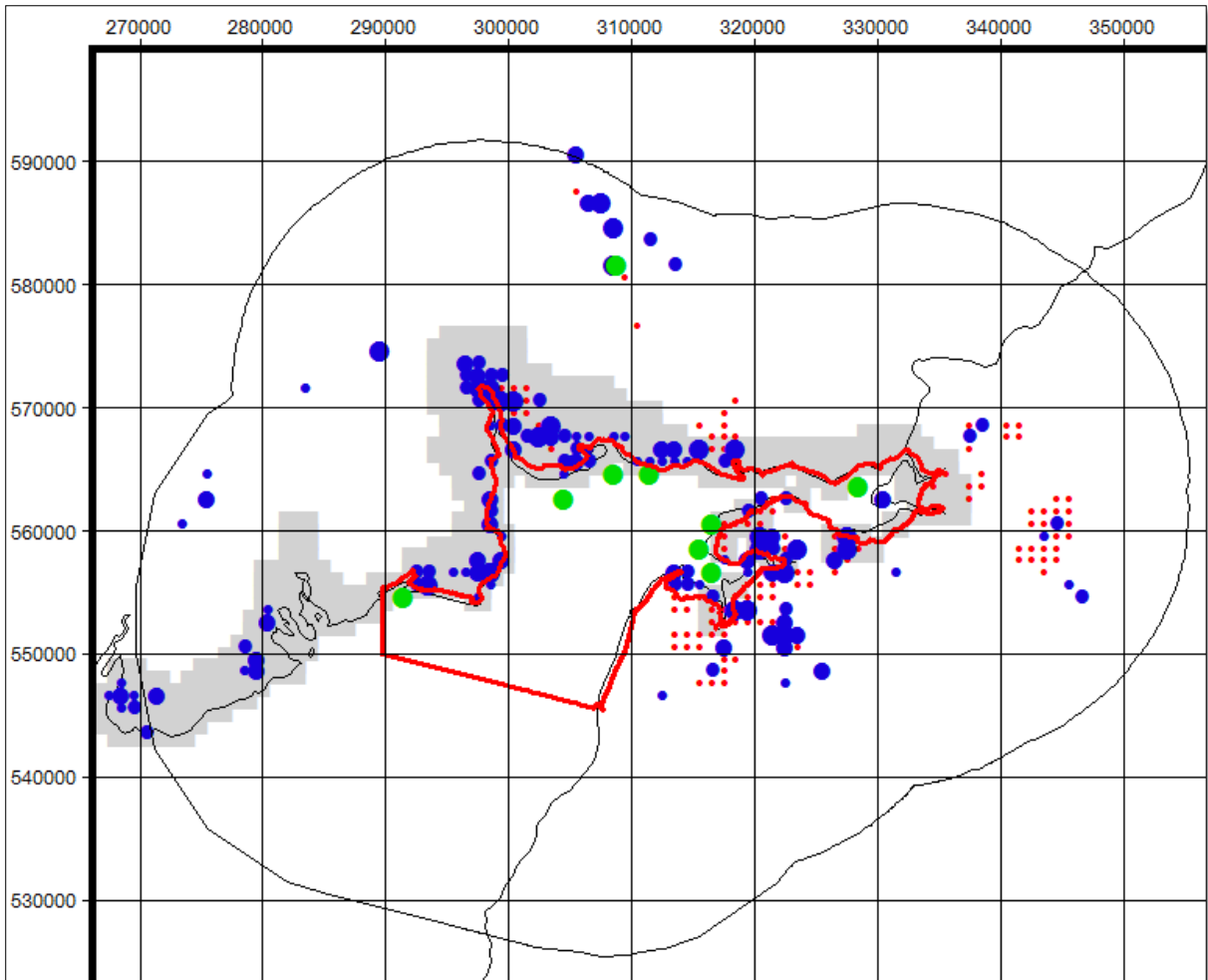


Figure 16. Feeding distribution (2007/08 to 2011/12 - new records) of Pink-footed Geese in relation to the Upper Solway Flats and Marshes SPA. For key see page 35.

The most recent records available (2007/08 to 2011/12) show a broadly similar distribution to those shown for all records (Figure 15). Numbers of birds using the Inner Solway Firth have not changed significantly between the early 2000s and the late 2000s (Mitchell & Hall 2012), with an exceptional influx in winter 2010/11 due to cold weather (a record 49,942), and the feeding records are likewise similar to earlier years.

2. Caithness Lochs (UK9001171): Greylag Geese

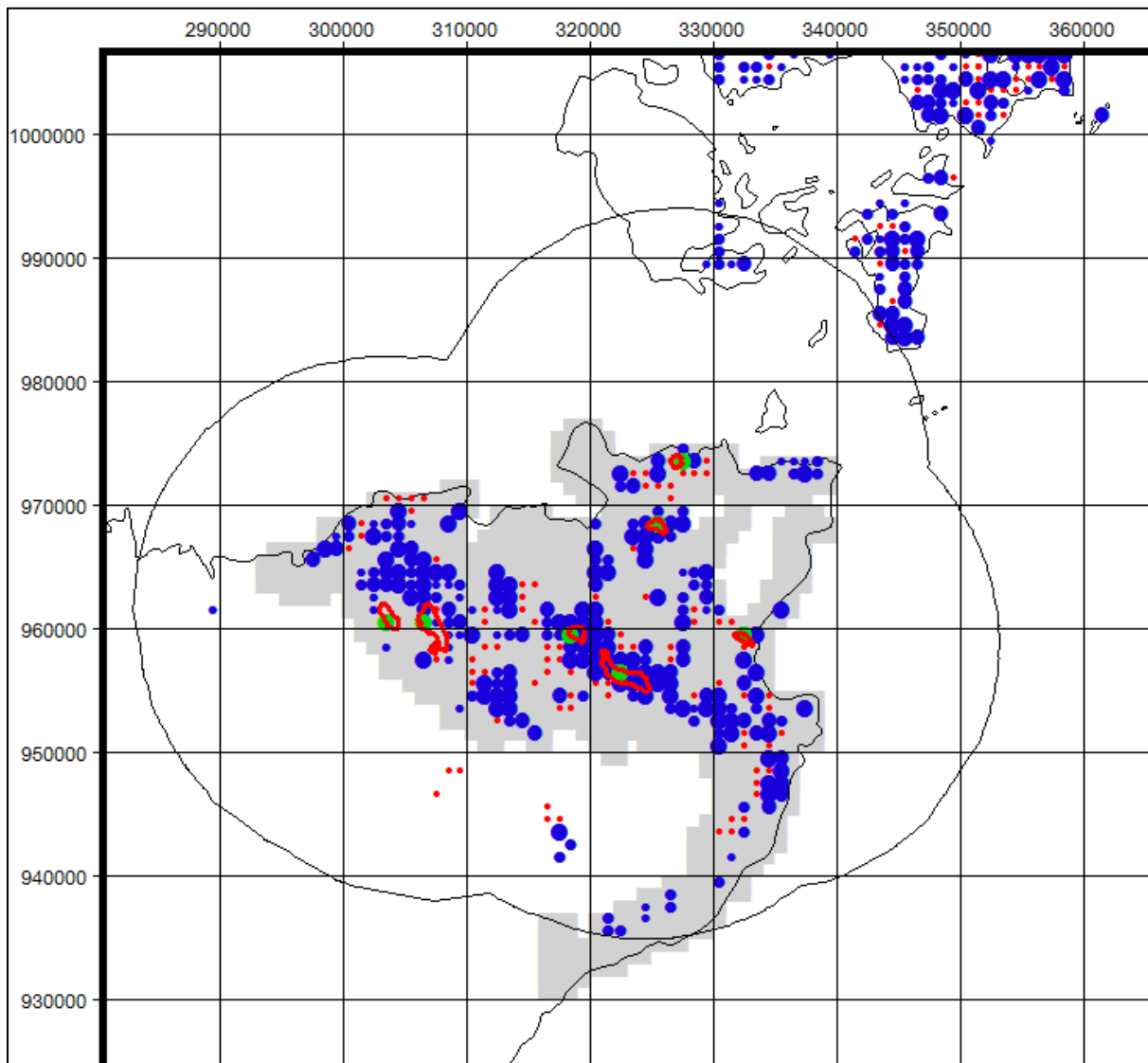


Figure 17. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Caithness Lochs SPA. For key see page 35.

Roost locations and feeding distribution

In the 1960s, only a few hundred Greylag Geese migrating from Iceland stopped in the Caithness area. Since the mid 1970s however, an increasing number of geese have started to remain for much of the winter, with an average of 4,000 to 6,000 birds and a peak count of 12,731 in October 1998. Greylag Geese use extensive feeding areas north of Broubster Leans and Loch Calder, especially in the Westfield area, south of Halkirk, along the Wick River Valley between Watten and Upper Gillock and the Burn of Lyth. Smaller numbers were recorded close to St John's Loch, Loch of Mey, Loch Heilen, along the northeast coast near Canisbay/John o'Groats and north and northwest of Lybster. See also Patterson *et al.* (2012).

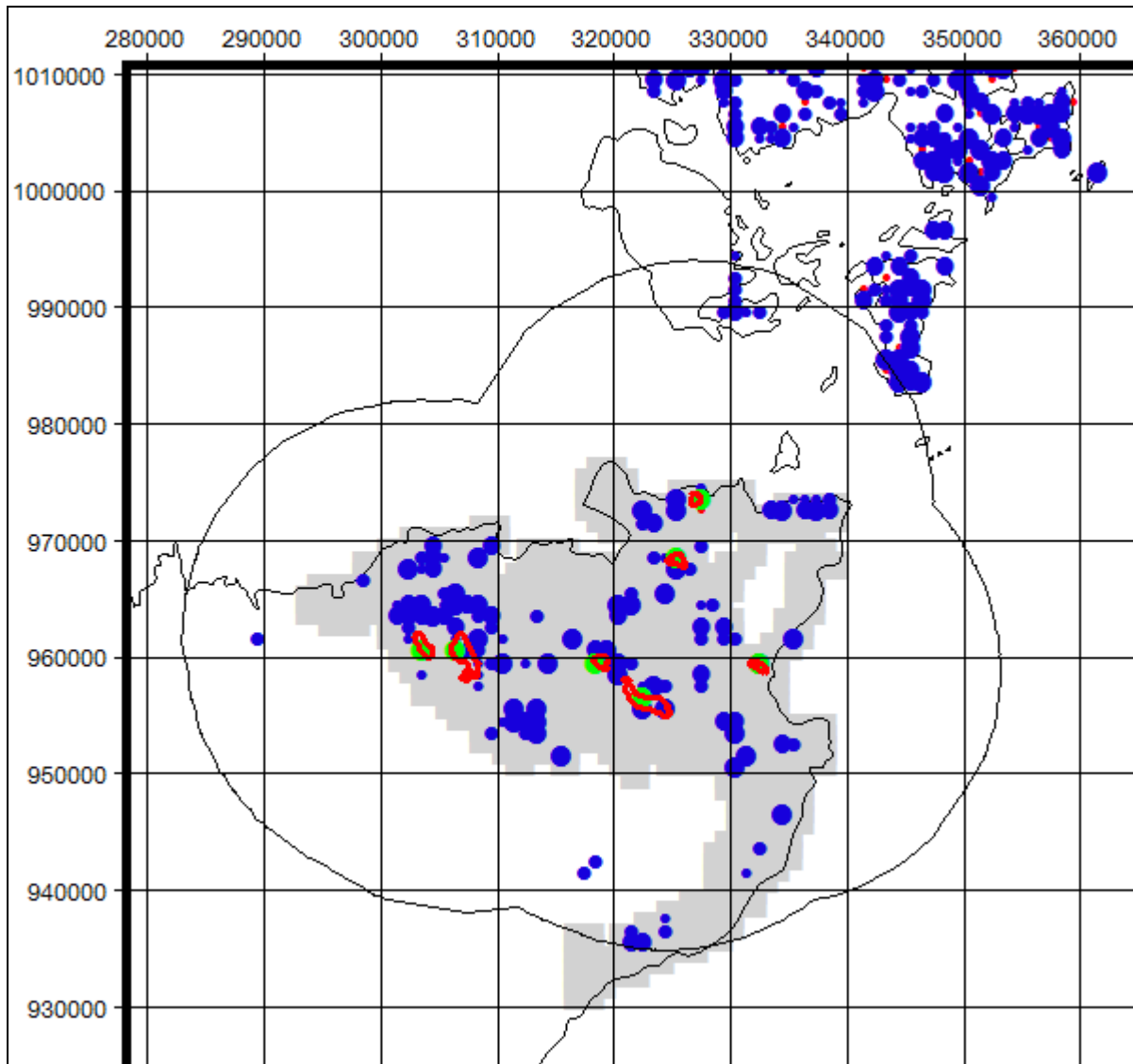


Figure 18. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Caithness Lochs SPA. For key see page 35.

The distribution of feeding records in the most recent five years remains broadly similar to previous years although there are fewer records notably along the Wick River Valley and around Loch Heilen. Numbers of birds using Caithness have not changed significantly between the early 2000s and the late 2000s (Mitchell & Hall 2012). See also Patterson *et al.* (2012).

3. Loch Eye (UK9001621): Greylag Goose

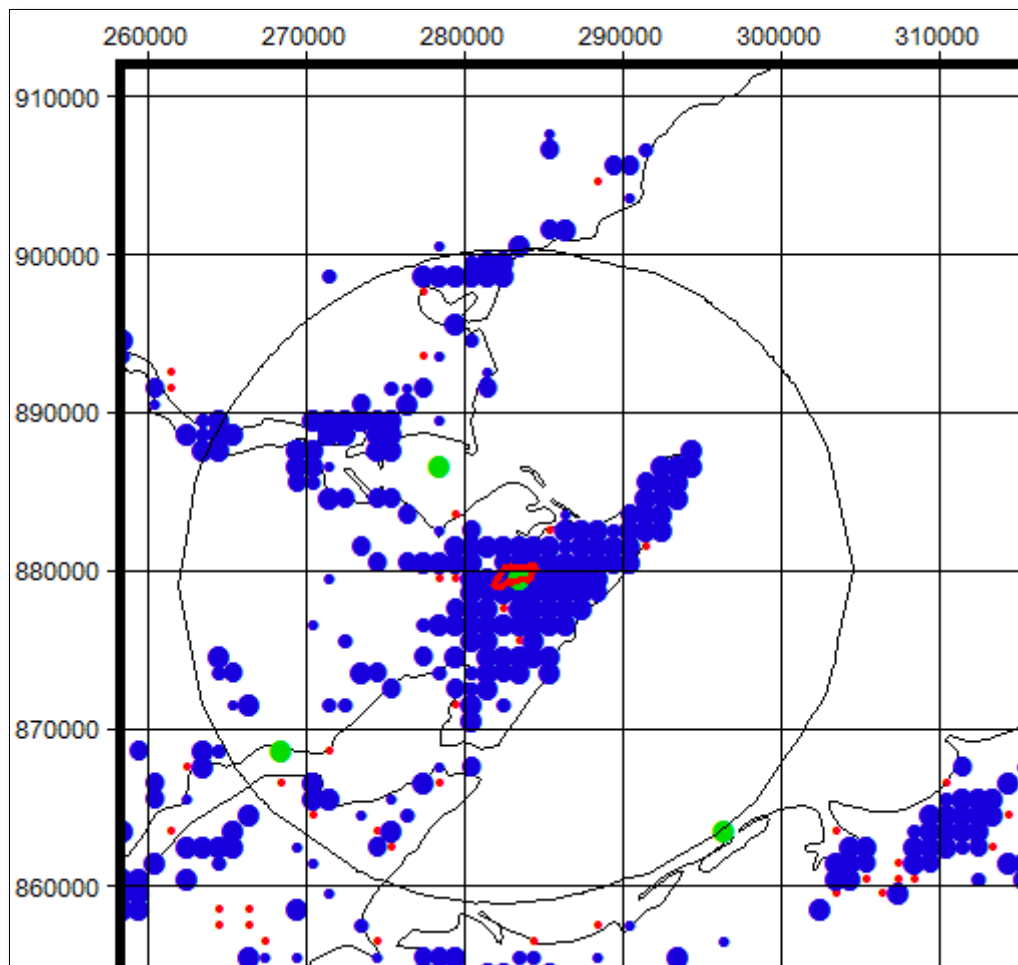


Figure 19. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Loch Eye SPA. For key see page 35.

Roost locations and feeding distribution

Loch Eye used to be the preferred roost for Iceland Greylag Geese when they first arrived in the Moray Basin and held 38,000 birds in November 1981 (Hearn & Mitchell 2004). Throughout the 1980s numbers remained high but variable and since the 1990s a decline has been evident (Mitchell & Hall 2012). In the autumn, Greylag Geese tended to feed on stubbles close to Loch Eye and then disperse more widely, feeding as far as Tain, north up to Wilkhaven and south to the Nigg Bay area. Occasionally they would wander as far as Delny near Invergordon or Ardrross, north of Alness. They occasionally crossed over to the Black Isle and fed in the Cromarty-Udale Bay area, using the latter as a roost.

Several thousand Iceland Greylag Geese were ringed at Loch Eye from the early 1990 to the early 2000s by Highland Ringing Group and WWT. This resulted in a large number of re-sightings of individually marked birds especially locally which provided valuable information on the distribution of feeding flocks.

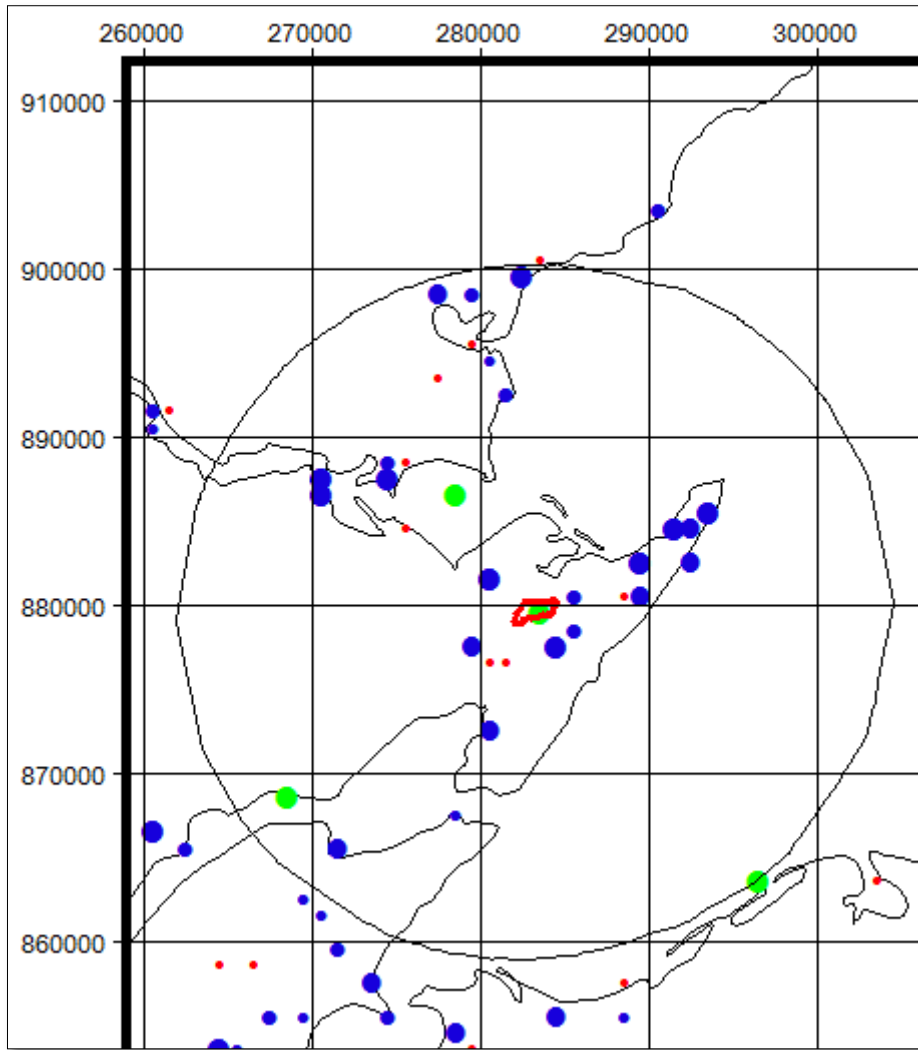


Figure 20. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Loch Eye SPA. For key see page 35.

The reduction in records of feeding geese in the Loch Eye area is a reflection of the decline in the number of birds using the roost (Appendix 3 and Mitchell & Hall 2012) and partly cessation of ringing at the site (and hence a reduction in the number of re-sightings).

4. Dornoch Firth and Loch Fleet (UK9001622): Greylag Goose

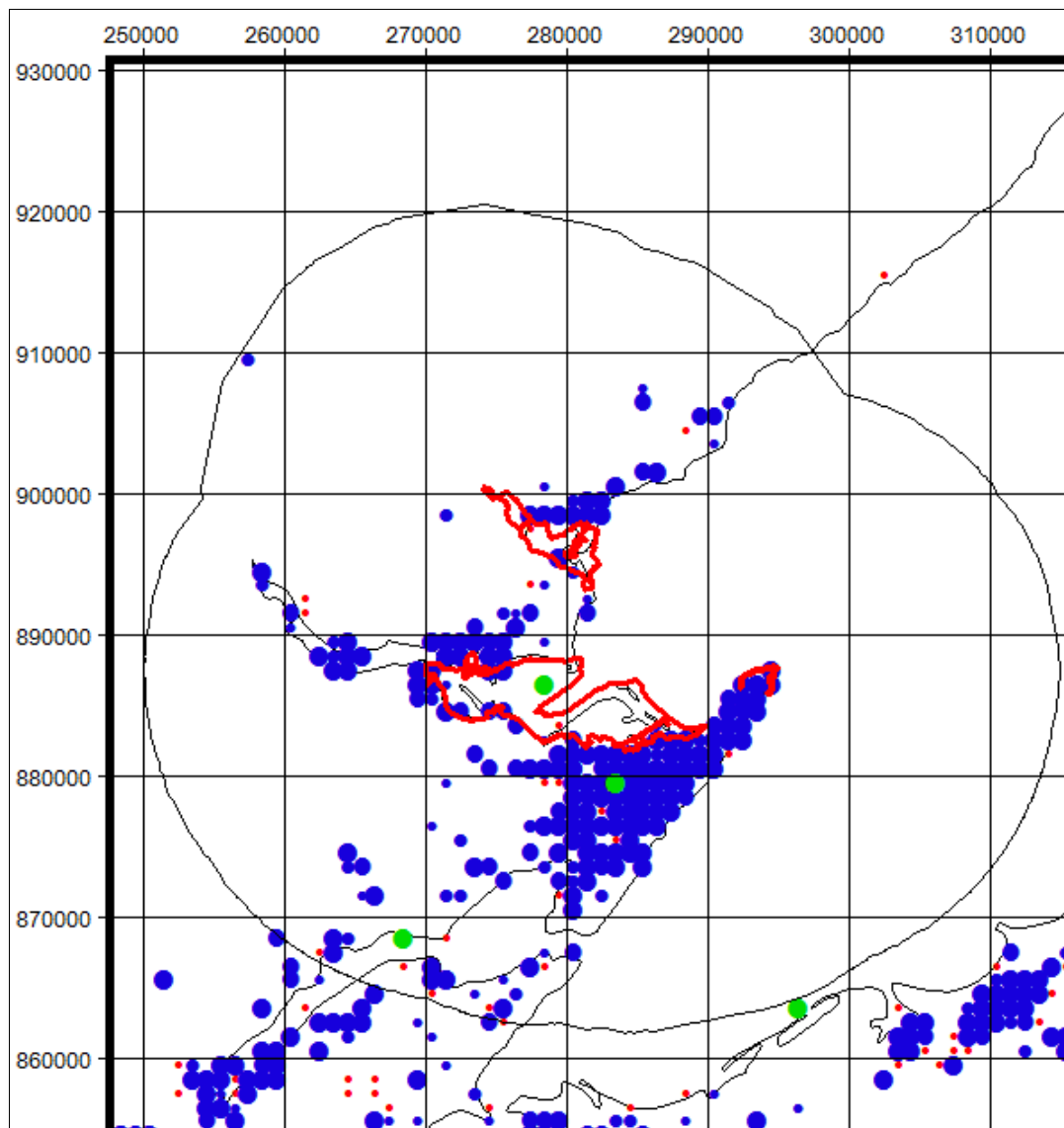


Figure 21. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Dornoch Firth and Loch Fleet SPA. For key see page 35.

Roost locations and feeding distribution

In the past the Dornoch Firth was less important for roosting Iceland Greylag Geese than the Beaulie or Cromarty Firths, but it now regularly supports more than 2,000 birds (Mitchell & Hall 2012). Unlike the other firths in the Moray Basin, the Dornoch has less grass and arable land immediately surrounding the shores, and that which does exist is concentrated in a narrow strip, generally less than 1km wide. There are a number of areas throughout the length of the firth that are utilised by feeding Greylag Geese, including those around Bonar Bridge, Chreich and Cuthill, as well as the more traditional sites of Ardmore Bay and around Loch Evelix. Inver, Tain and Edderton Bays, the Morrish More and the land stretching up to the town of Dornoch are also used by these birds at times.

Iceland Greylag Geese roosting at Loch Fleet mix with c.1,000 British Greylag Geese and records of feeding birds locally will inevitably include a mix of the two. Feeding tends to be to the north of the site (towards the town of Brora) and also in Strathfleet towards Kirkton.

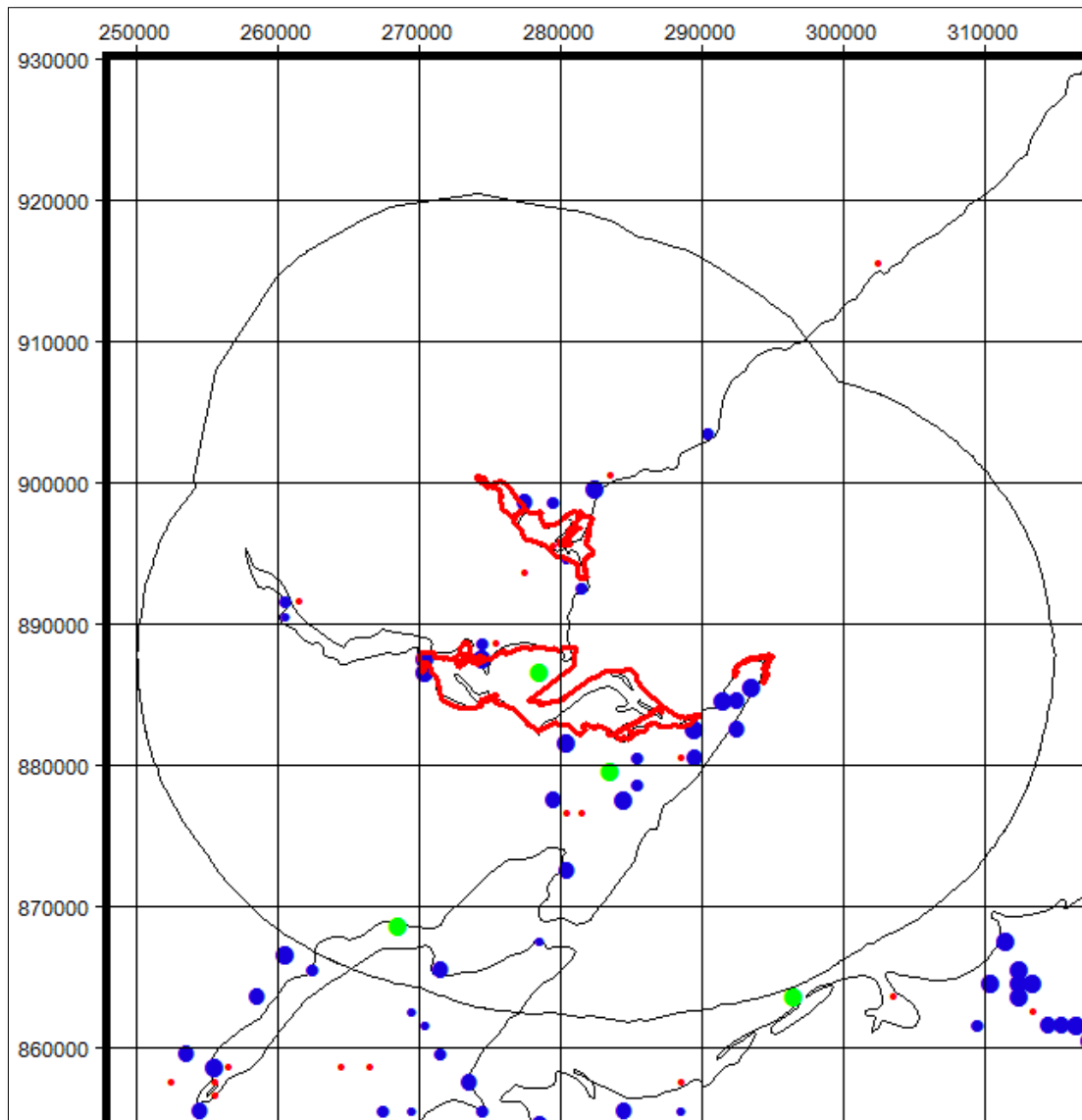


Figure 22. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Dornoch Firth and Loch Fleet SPA. For key see page 35.

The reduction in records of feeding geese in the Dornoch Firth area is a reflection of fewer feeding records, partly due to a cessation of ringing at nearby Loch Eye (and hence a reduction in the number of re-sightings), since the numbers using the site have not changed significantly between the early 2000s and the late 2000s (Mitchell & Hall 2012).

5. Cromarty Firth (UK9001623): Greylag Goose

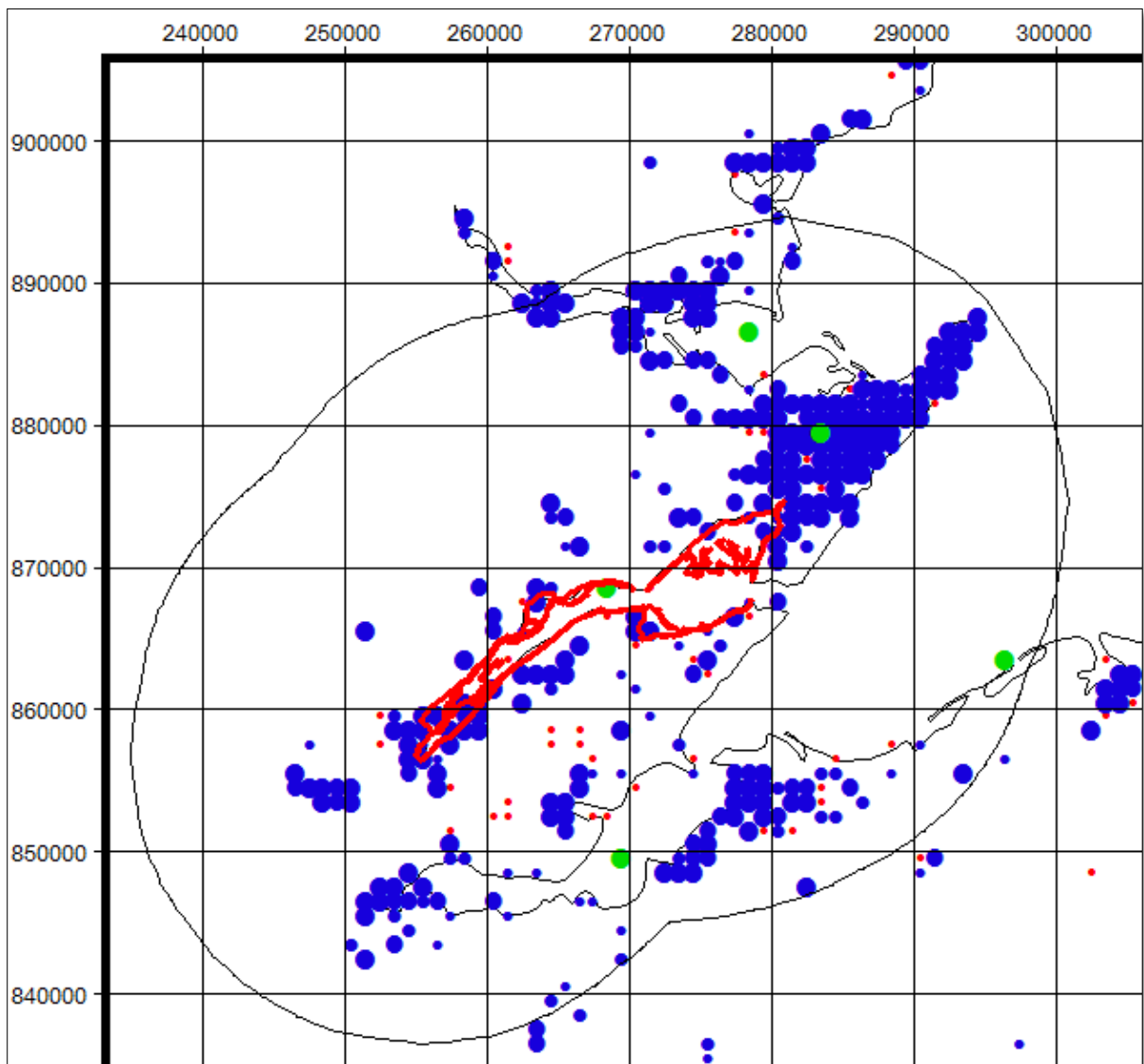


Figure 23. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Cromarty Firth SPA. For key see page 35.

Roost locations and feeding distribution

The firth is surrounded by a narrow strip of arable land on the northern shore, with similar mixed farming extending further inland in Easter Ross and on the Black Isle. The number of Iceland Greylag Geese roosting there varies considerably with often fewer than 500 birds recorded and a maximum of 7,370 counted in November 1994 (Hearn & Mitchell 2004).

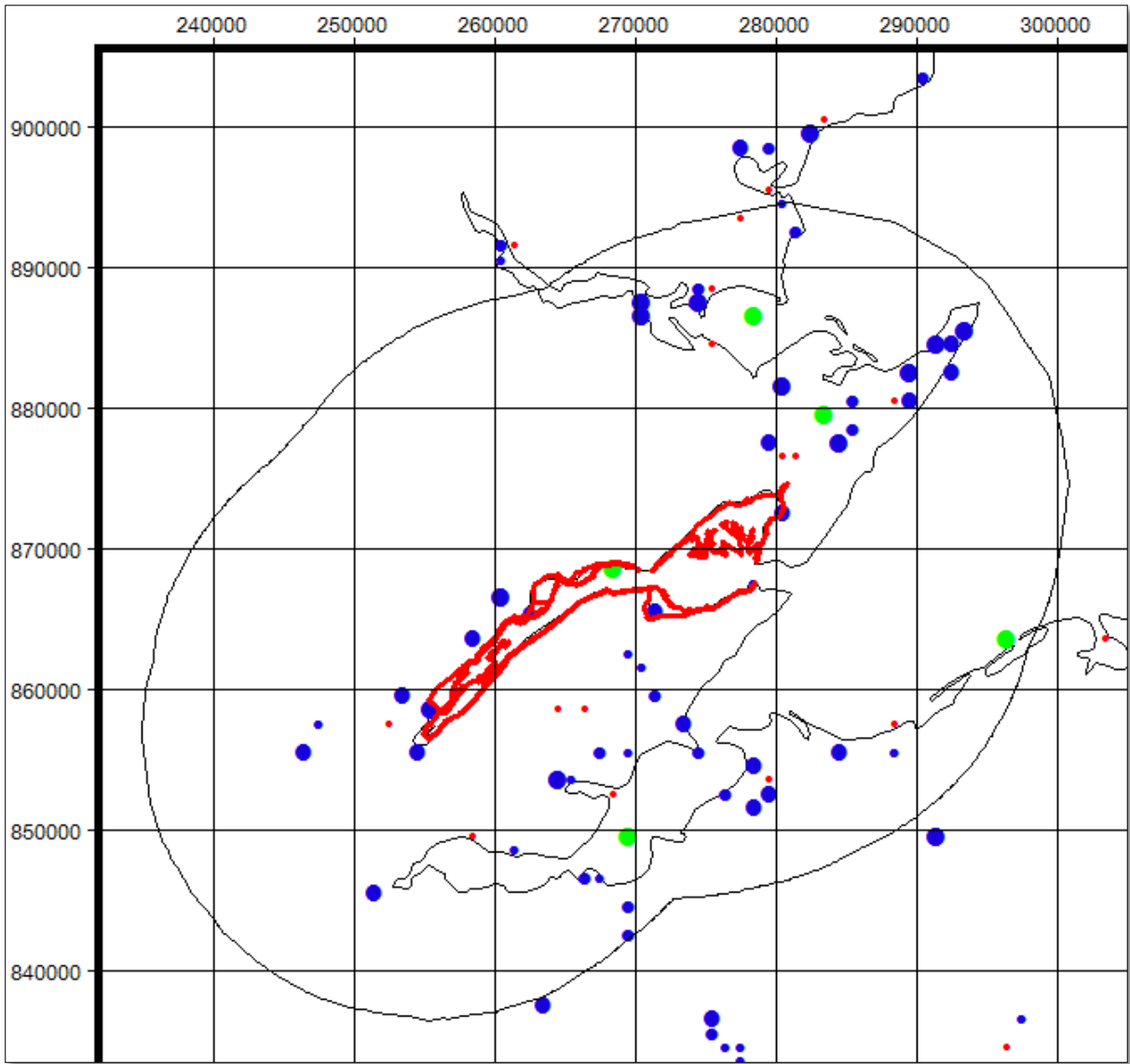


Figure 24. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Cromarty Firth SPA. For key see page 35.

The reduction in records of feeding geese in the Cromarty Firth area is a reflection of fewer feeding records, partly due to a cessation of ringing at nearby Loch Eye (and hence a reduction in the number of re-sightings), since the numbers using the site has not changed significantly between the early 2000s and the late 2000s (Mitchell & Hall 2012).

6. Inner Moray Firth (UK9001624): Greylag Goose

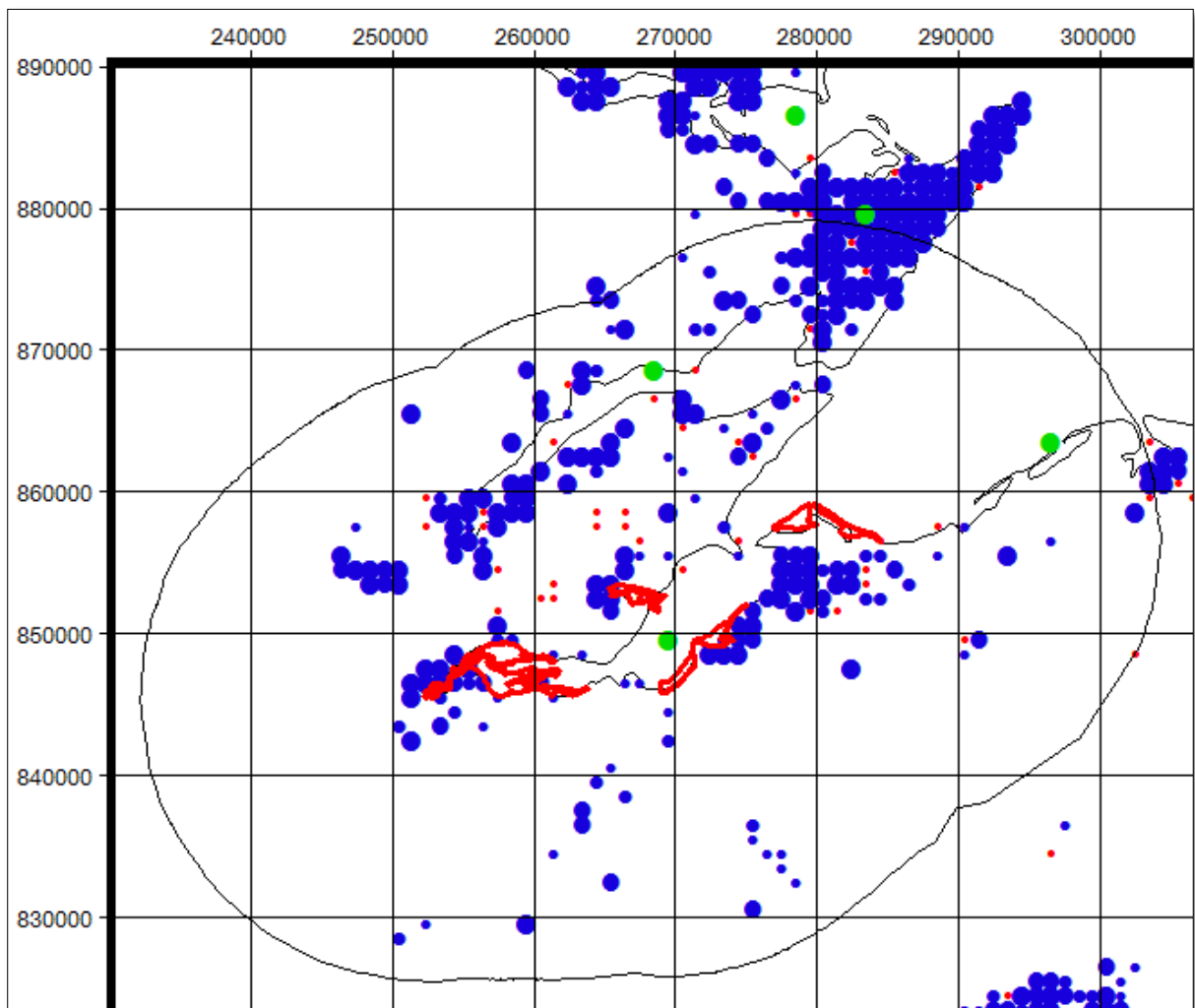


Figure 25. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Inner Moray Firth SPA. For key see page 35.

Roost locations and feeding distribution

The main Iceland Greylag Goose roosts are Castle Stuart Bay, the Beaully Firth and Munloch Bay. Numbers have declined since the late 1980s (e.g. 10,000 Greylag Geese were counted at Beaully Firth in November 1987 and 5,000 counted at Munloch Bay in November 1987 and 1988). Feeding areas are on farmland to the west of Beaully Firth close to Munloch Bay and on the southern shore of the Inner Moray Firth. Greylag Geese roosting at Munloch Bay feed primarily on the Black Isle close to the roost as well as west to areas around Conon Bridge and Tore.

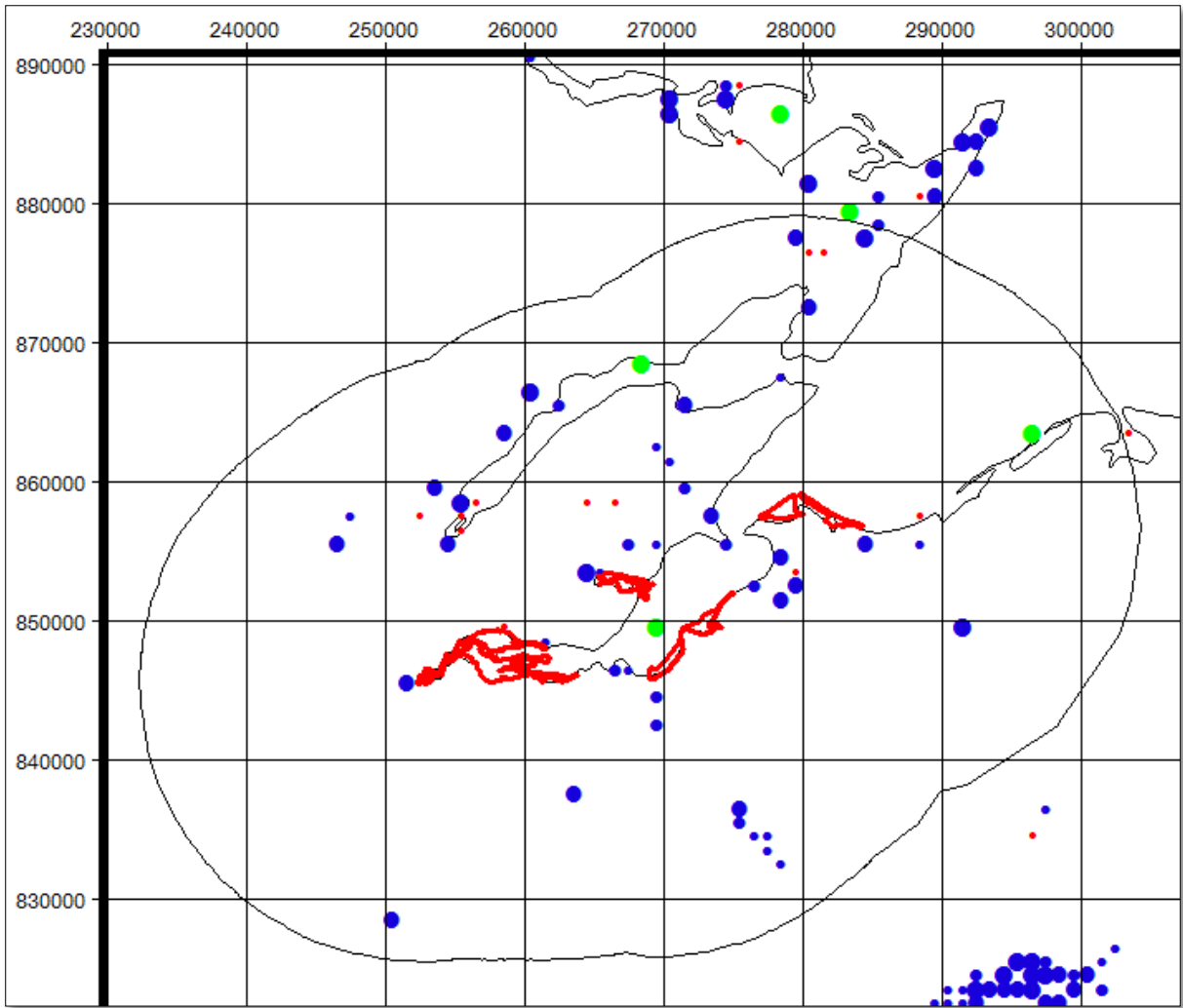


Figure 26. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Inner Moray Firth SPA. For key see page 35.

The reduction in records of feeding geese in the Inner Moray Firth area is a reflection of fewer feeding records, partly due to a cessation of ringing at nearby Loch Eye (and hence a reduction in the number of re-sightings), and a large decline in numbers counted using the roosts (Appendix 3 and Mitchell & Hall 2012).

7a. Moray and Nairn Coast (UK9001625): Greylag Goose

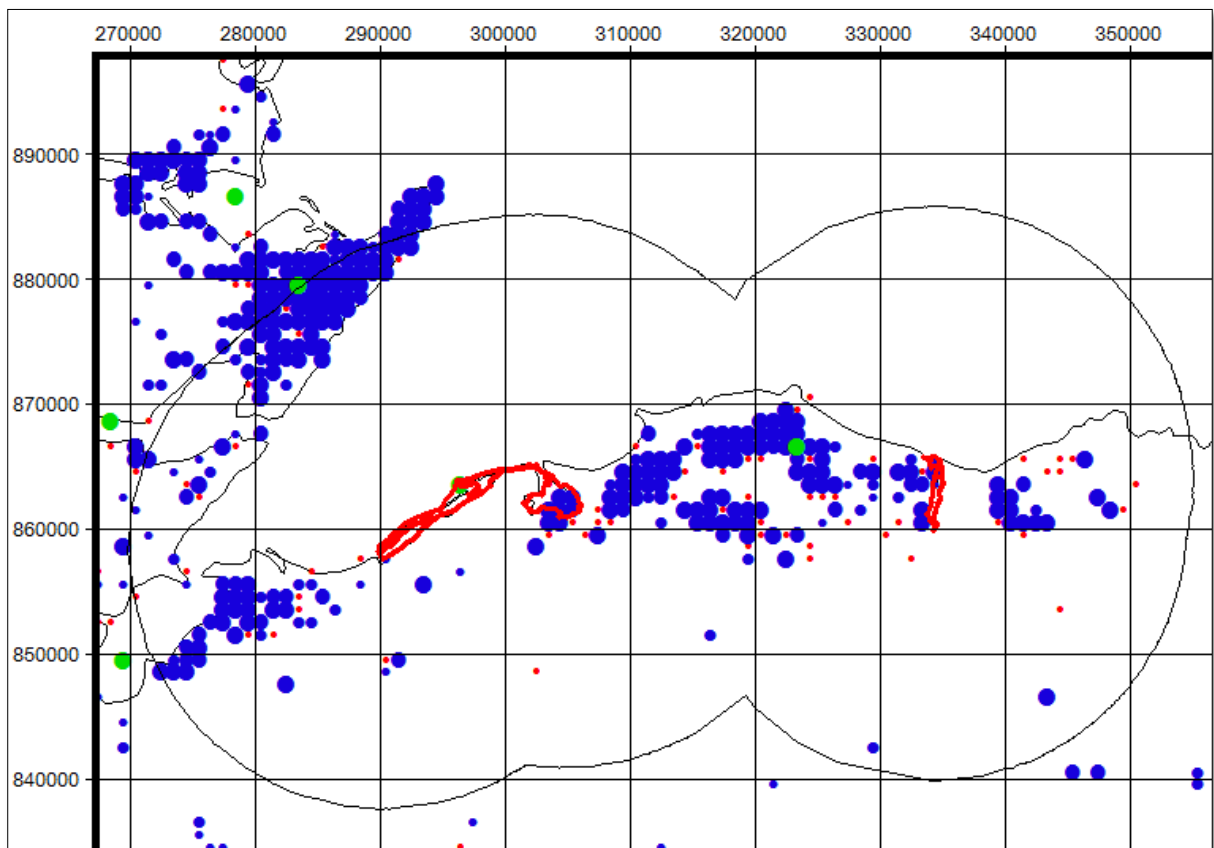


Figure 27. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Moray and Nairn Coast SPA. For key see page 35.

Roost locations and feeding distribution

The main Iceland Greylag Goose roost was Findhorn Bay, including a maximum of 6,077 counted there in April 1990 and smaller numbers also roost on the Nairn Bar. Birds also use Loch Spynie (see below). Arable/grass land between Findhorn and Lossiemouth provide the main feeding areas and also inland south of Elgin. The number of geese using Findhorn Bay especially has declined since the early 2000s.

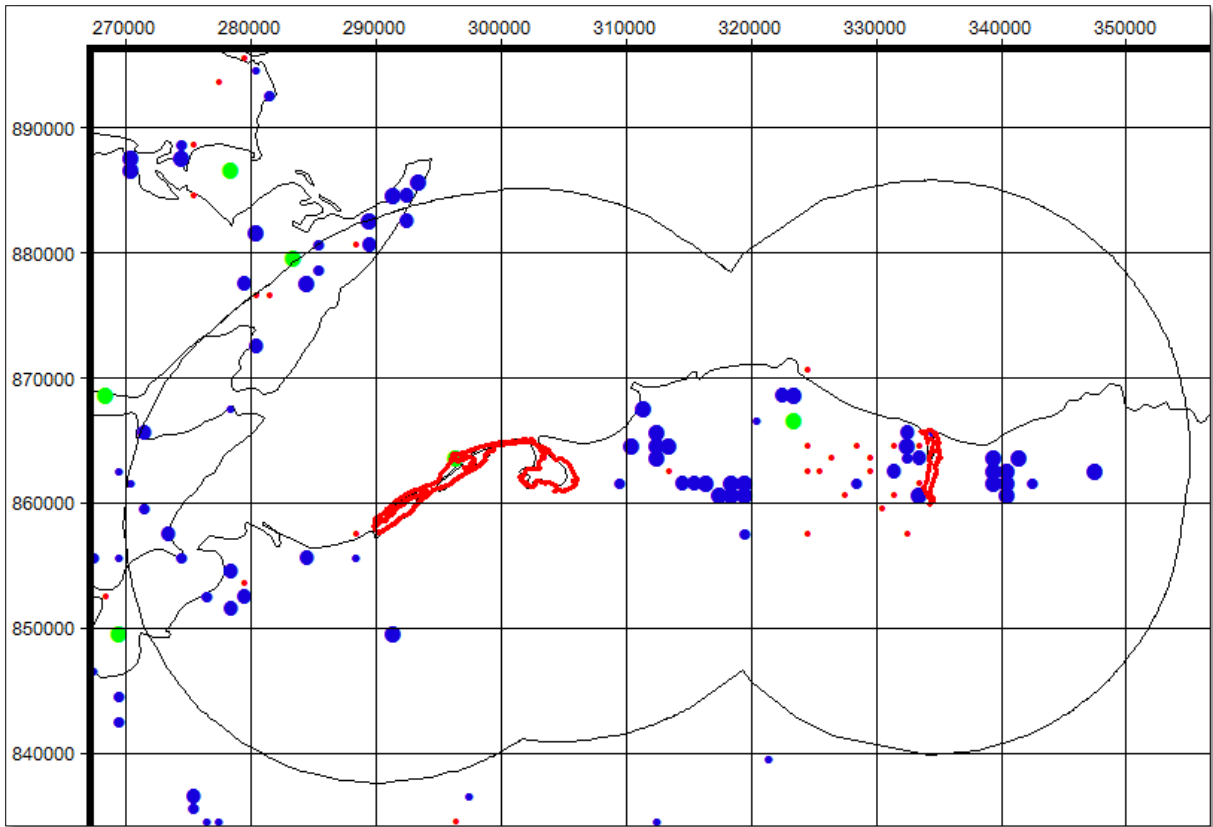


Figure 28. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Moray and Nairn Coast SPA. For key see page 35.

The reduction in records of feeding geese in the Moray and Nairn Coast area is a reflection of fewer feeding records, partly due to a cessation of ringing at nearby Loch Eye (and hence a reduction in the number of re-sightings) and a large decline in numbers counted using the roosts (Appendix 3 and Mitchell & Hall 2012).

7b. Moray and Nairn Coast (UK9001625): Pink-footed Goose

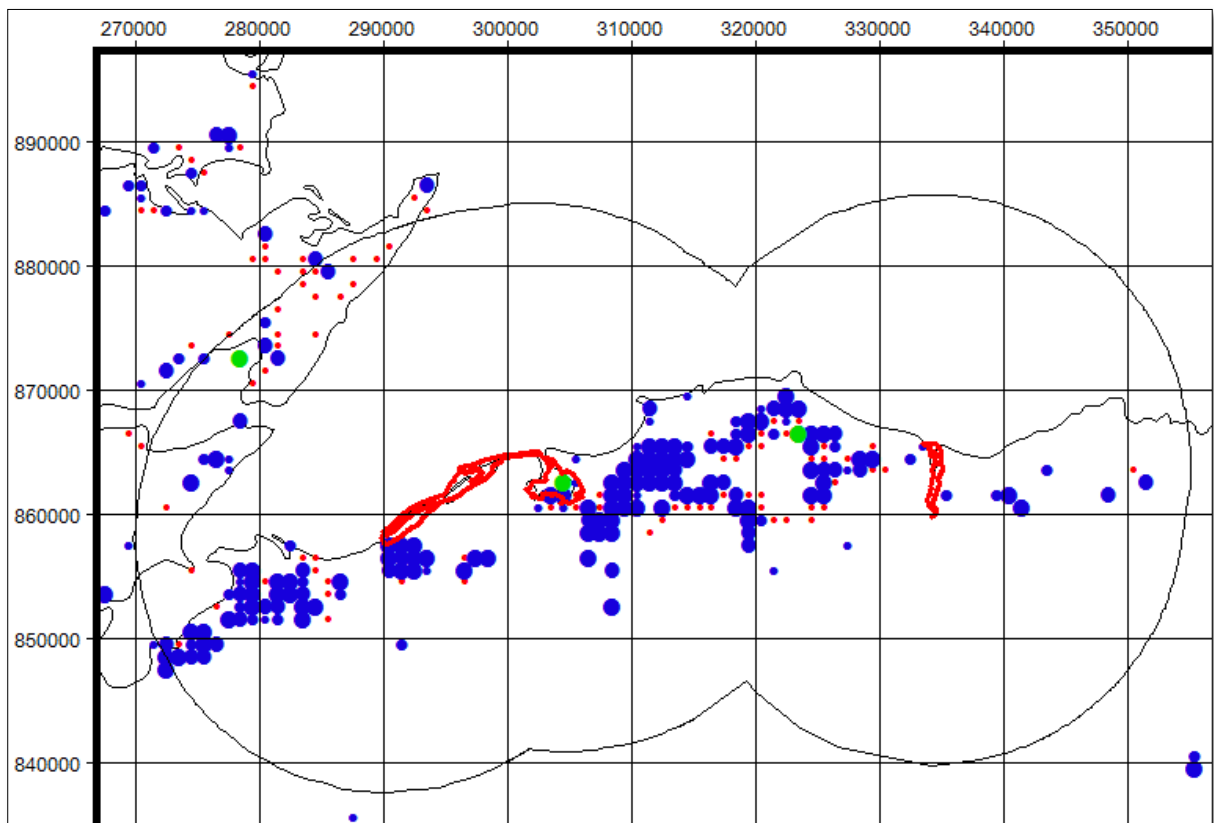


Figure 29. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Moray and Nairn Coast SPA. For key see page 35.

Roost locations and feeding distribution

Pink-footed Geese primarily roost at Findhorn Bay and formerly in the Loch Spynie/Lossiemouth/Spye Bay area. The main feeding areas are to the south and east of Findhorn Bay, notably between Kinloss and Coltfoot, Miltonduff and fields to the northwest and south east of Loch Spynie. Birds feeding in square NH95, near Auldearn may fly from Findhorn Bay, but are more likely to roost in the Moray Firth or at Loch Flemington.

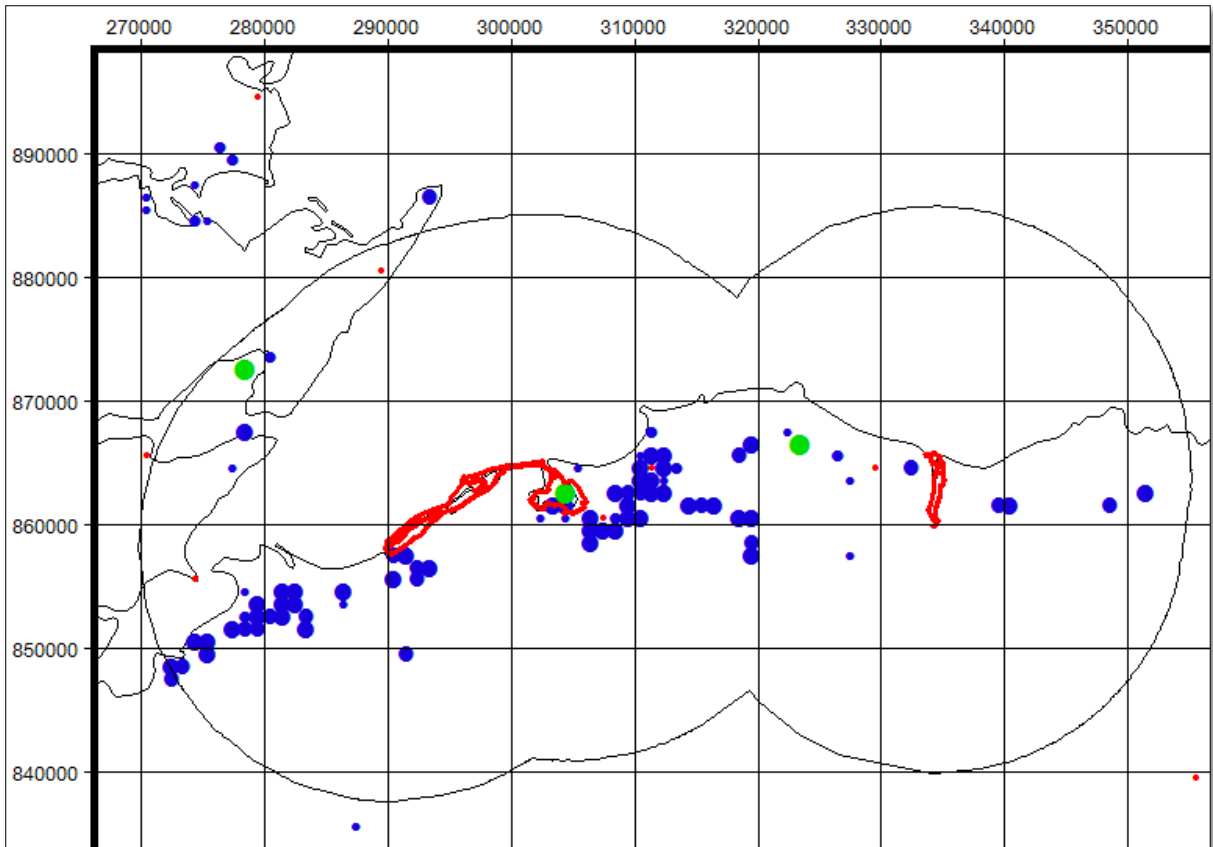


Figure 30. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Moray and Nairn Coast SPA. For key see page 35.

The reduction in records of feeding Pink-footed Geese in the Moray and Nairn Coast area is a reflection of fewer feeding records since there has been no significant change in numbers counted using Findhorn Bay between the early 2000s and late 2000s (Mitchell & Hall 2012). However, Pink-footed Geese now rarely roost in any number in the Loch Spynie/Lossiemouth/Spey Bay area.

8. Loch Spynie (UK9002201): Greylag Goose

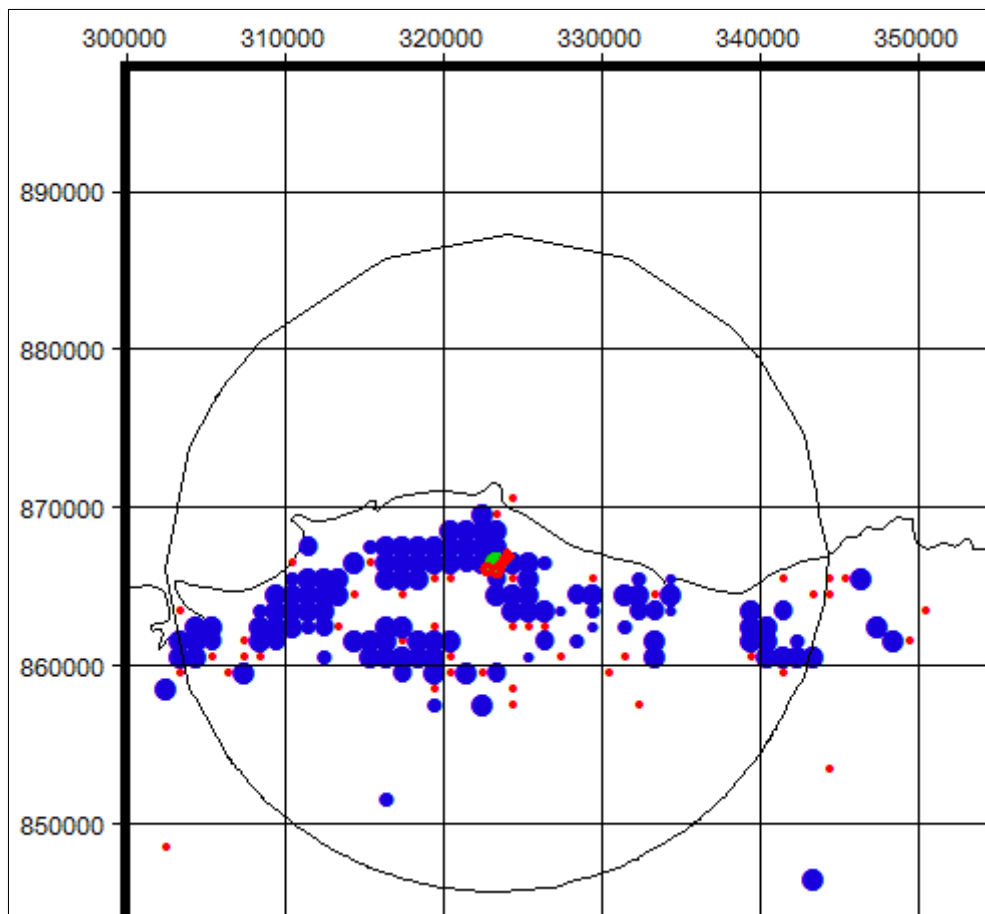


Figure 31. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Loch Spynie SPA. For key see page 35.

Roost locations and feeding distribution

During 1960/61 to 1979/80 there was a stable roosting population of just under 2,000 Iceland Greylag Geese. Since the mid 1980s, this number increased significantly, peaking at 12,000 in October 1989. Throughout the 1990s, peak counts were generally between 3,000 and 7,000 birds. However, since that time numbers have declined dramatically, the site having been apparently abandoned since 2007/08. Feeding areas tended to be within 6-7km of the loch. At first they concentrated on stubble fields, switching to traditional grass fields. The main sites were the Ardivot-Salterhill-Silverhill triangle, the fields east of the A941, just south of Lossiemouth and the fields just east of the River Lossie. In some winters, the areas around Lochill-Urquhart and Coeskie were also important.

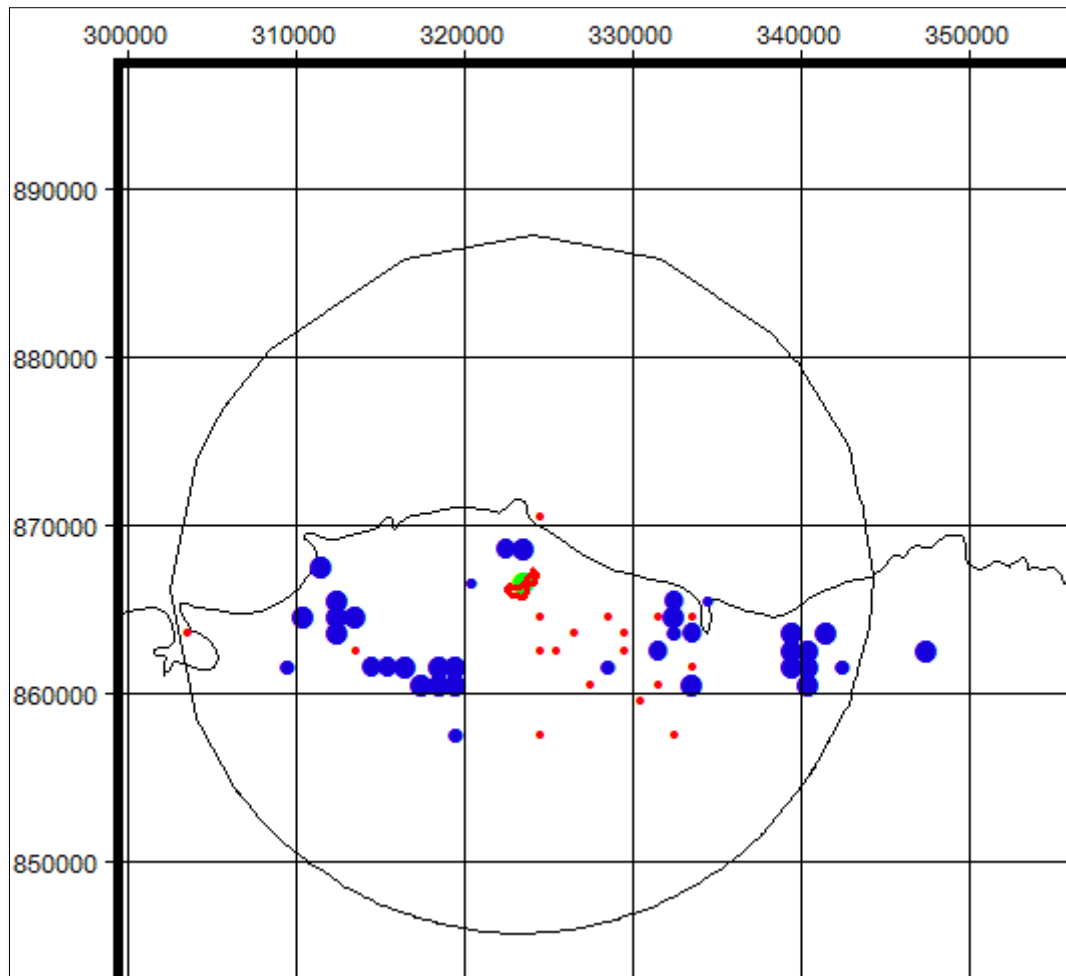


Figure 32. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Loch Spynie SPA. For key see page 35.

The reduction in records of feeding Pink-footed Geese in the Loch Spynie area is a reflection of fewer feeding records and a marked reduction in the number of geese roosting at Loch Spynie between the early 2000s and late 2000s (Mitchell & Hall 2012). However, records in NJ16 and NJ36 clearly indicate the presence of small numbers of Iceland Greylag Geese in the area, the birds either roosting at Loch Spynie or other roosts nearby.

9a. Loch of Strathbeg (UK9002211): Greylag Goose

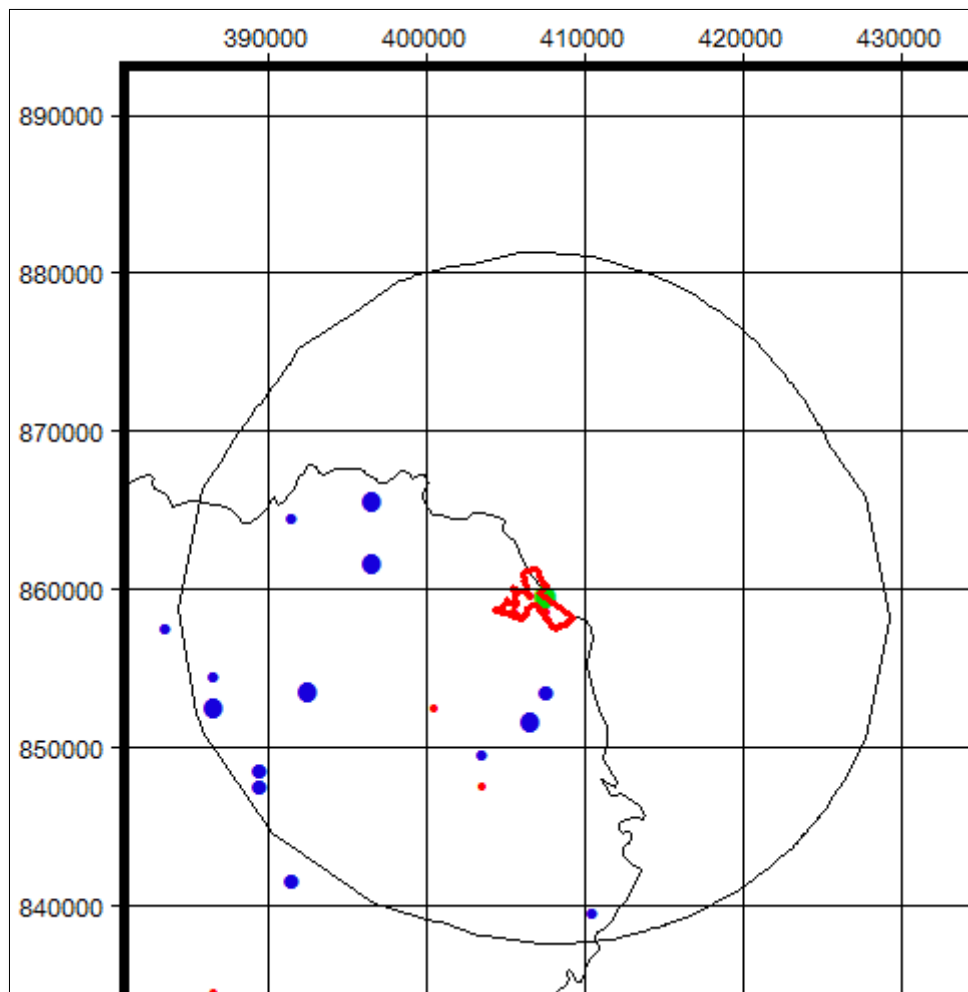


Figure 33. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Loch of Strathbeg SPA. For key see page 35.

Roost locations and feeding distribution

Loch of Strathbeg used to be an important roost for Iceland Greylag Geese during the 1960s to 1980s, regularly holding 5,000 to 10,000 birds throughout the winter during the 1970s and 1980s (Hearn & Mitchell 2004). During the early 1990s, however, numbers fell dramatically to just a few hundred birds. The timing of this decline coincides with an increase in numbers roosting at Muir of Dinnet (see below) and Loch of Skene, although both the latter sites were also virtually abandoned in the late 1990s/early 2000s. The feeding areas close to Loch of Strathbeg were not well documented and few records exist for this analysis.

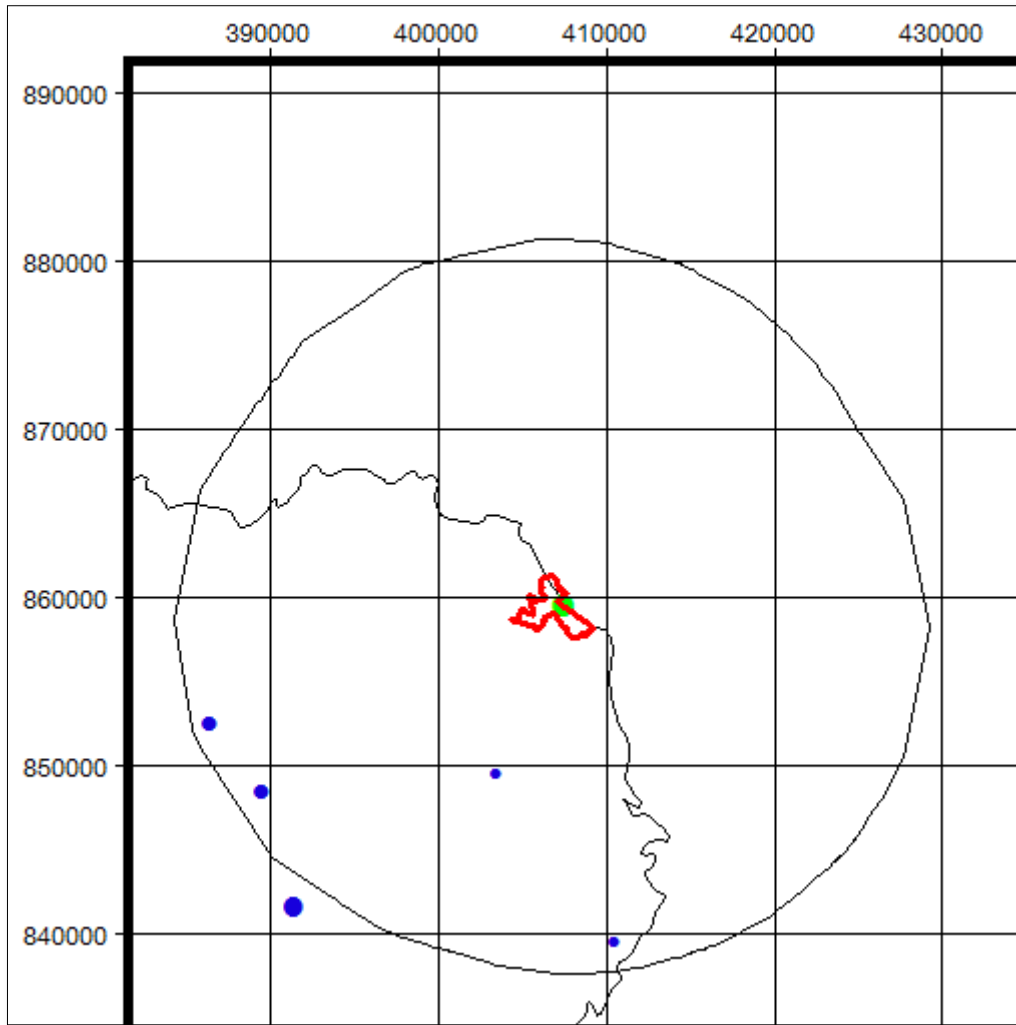


Figure 34. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Loch of Strathbeg SPA. For key see page 35.

With so few Iceland Greylag Geese now wintering in north east Scotland, there are very few feeding records.

9b. Loch of Strathbeg (UK9002211): Pink-footed Goose

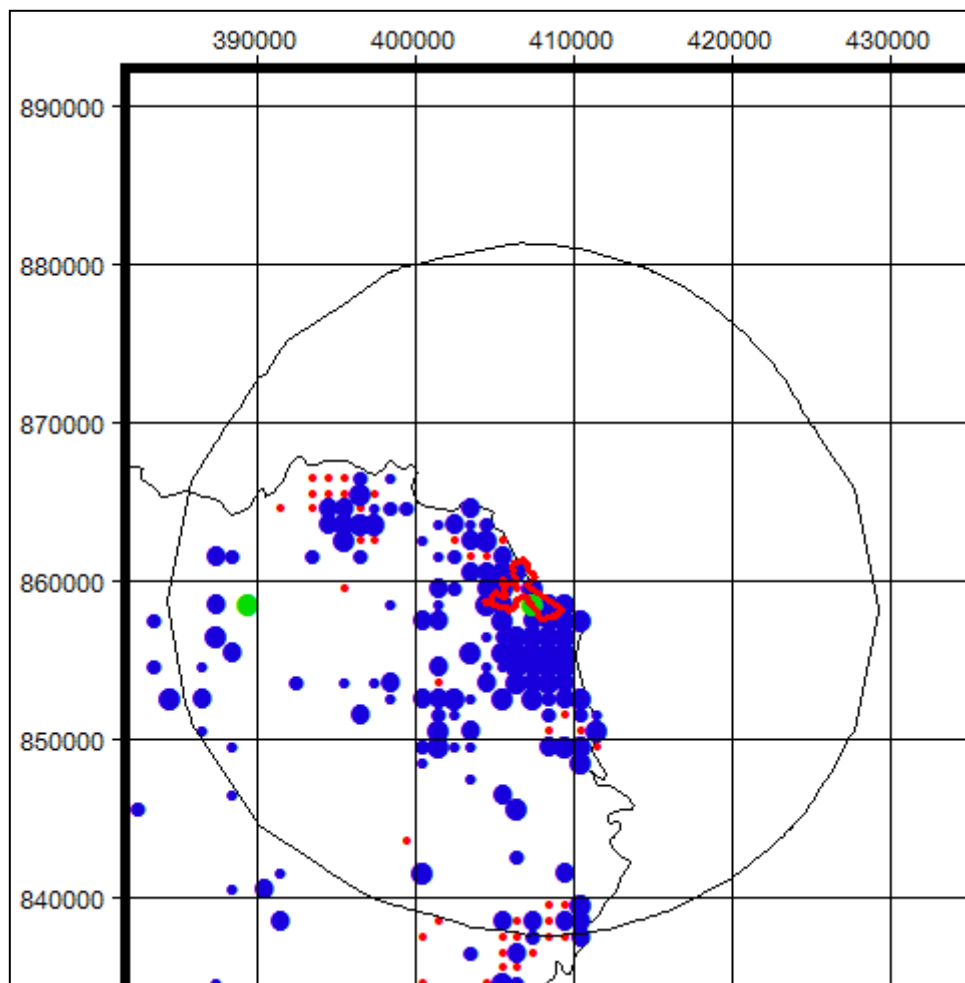


Figure 35. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Loch of Strathbeg SPA. For key see page 35.

Roost locations and feeding distribution

Loch of Strathbeg is one of the main roost sites for Pink-footed Geese in the UK (Appendix 3) and has supported over 60,000 geese. The increase in numbers is in line with the growth of the overall population (Mitchell & Hearn 2004). The main roost is at the loch, although geese have also started to use Middlemuir (New Pitsligo) in recent years (see Appendix 3). The main feeding areas surround the loch especially in NK06, NK05 and NH96 near Mid Ardlaw. Geese can be found feeding south to NK03, although these are just a likely to be from Meikle Loch/Ythan Estuary. The geese can also range as much as 15km (or beyond) to the west of the Mormond Hill. See also Patterson & Thorpe (2006).

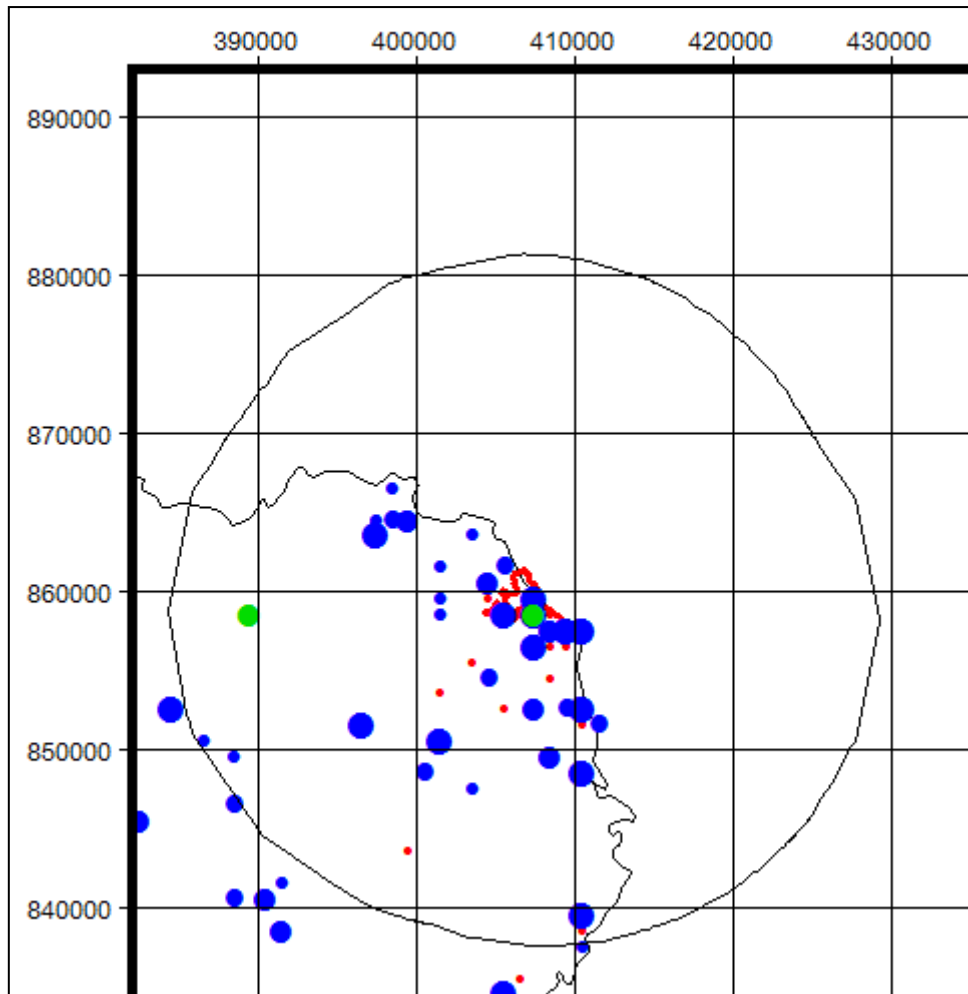


Figure 36. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Loch of Strathbeg SPA. For key see page 35.

Although there are fewer feeding records than the overall period (Figure 35), the feeding areas are through to be broadly similar to those in earlier years. There has however, been a decline in the peak number of geese counted at the loch in recent years, the highest counts occurring in 2003/04 to 2005/06.

10. Ythan Estuary, Sands of Forvie and Meikle Loch (UK9002221): Pink-footed Goose

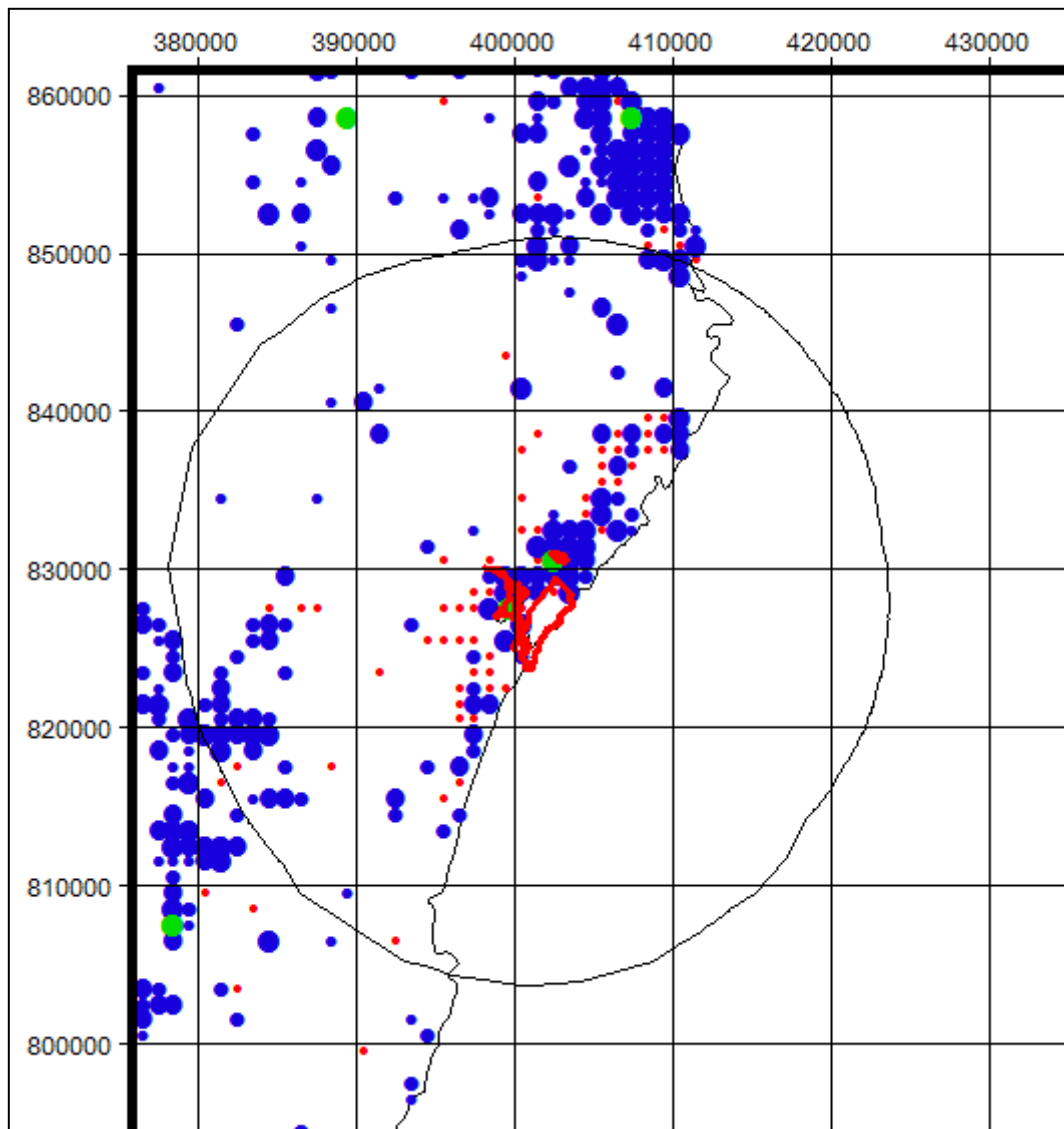


Figure 37. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Ythan Estuary, Sands of Forvie and Meikle Loch SPA. For key see page 35.

Roost locations and feeding distribution

Pink-footed Geese roost either at Meikle Loch (especially in the autumn and winter) or the Ythan Estuary (especially in the spring after the foreshore hunting season has ended). The main feeding grounds are widely spread especially to the northeast of the roosts in NK03, to the south along the Aberdeenshire coast to Balmedie and west to Ellon and probably to NH82 around Old Meldrum.

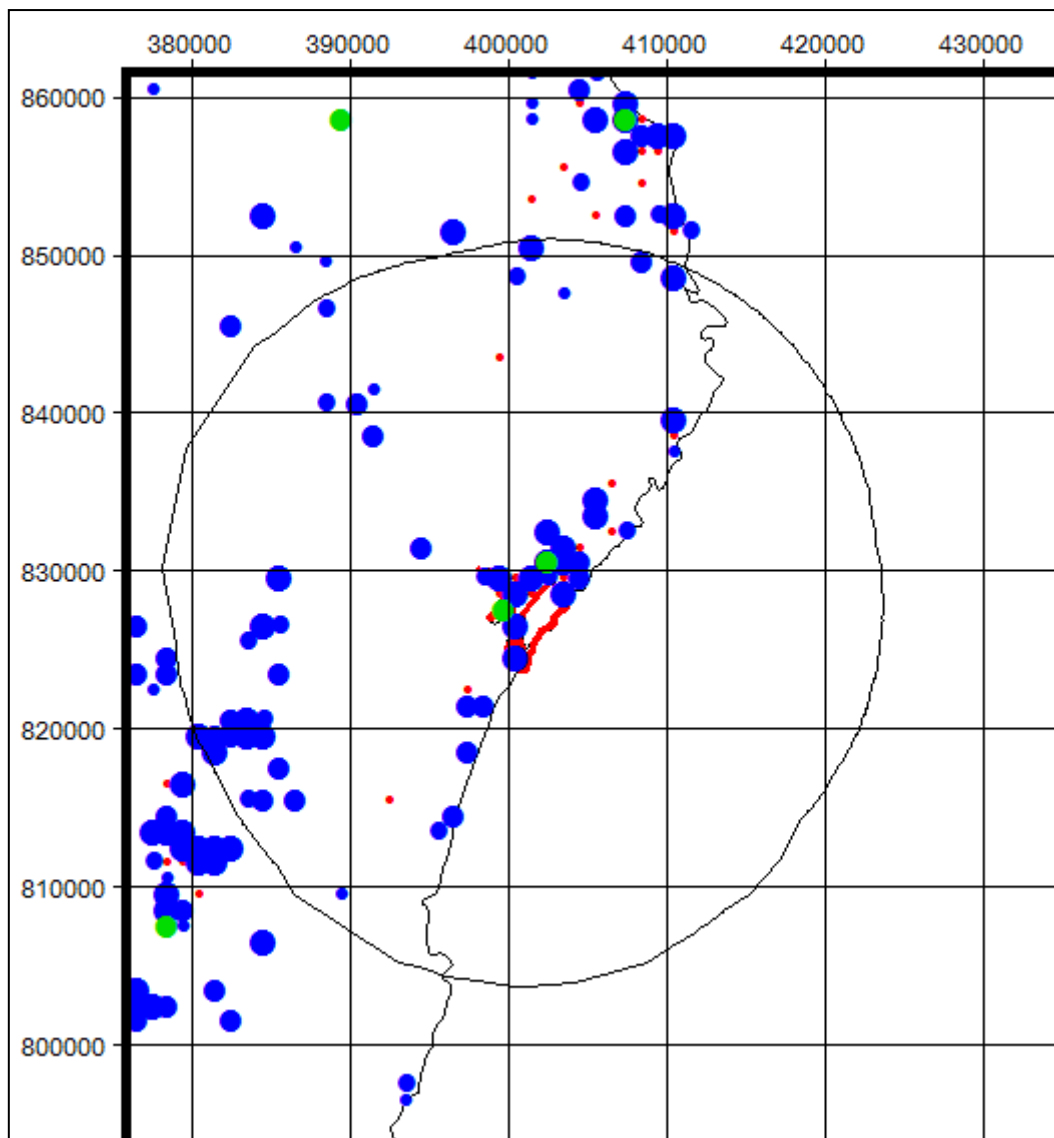


Figure 38. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Ythan Estuary, Sands of Forvie and Meikle Loch SPA. For key see page 35.

The feeding areas are thought to remain broadly similar to previously, although there are fewer records especially in NJ92.

11. Loch of Skene (UK9002261): Greylag Goose

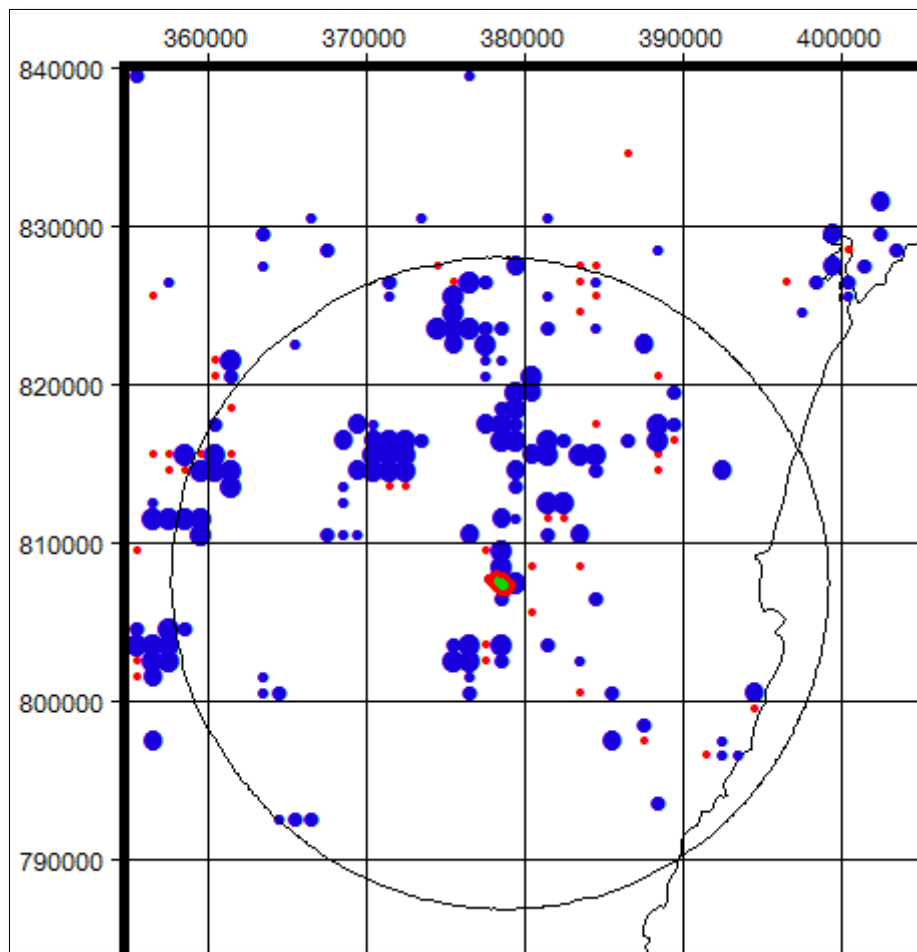


Figure 39. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Loch of Skene SPA. For key see page 35.

Roost locations and feeding distribution

The first record of Iceland Greylag Geese at Loch of Skene was a count of 150 birds in November 1964. Counts in the hundreds throughout the 1960s were followed by thousands in the 1970s. Numbers steadily increased and in the 1990s, numbers fluctuated from 5,000 to 15,000 birds. Most fed to the north and north west, towards lower Donside, where they were thought to overlap with birds from the Muir of Dinnet (see below). Compared to other areas of Aberdeenshire, the feeding distribution of geese around Loch of Skene was patchier because of the greater hectareage of woodland and shelter belts. The median distance of feeding Greylag Geese from the loch was 5.8km (Bell 1988), although at times the birds had been recorded flying up to 37km from the roost, to join birds from the roost at Haddo House Lakes.

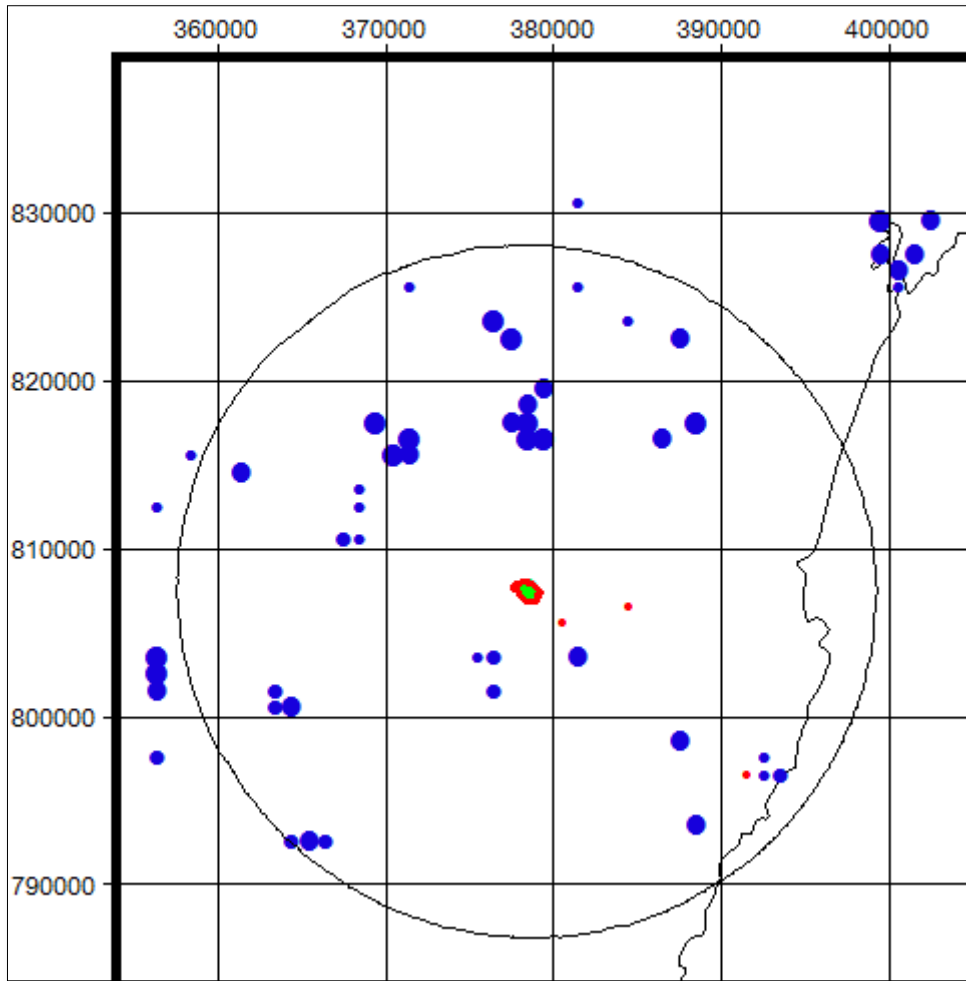


Figure 40. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Loch of Skene SPA. For key see page 35.

There are far fewer records in the most recent period mostly due there being far fewer birds roosting at Loch of Skene (Mitchell & Hall 2012). This is part of a trend of near abandonment of key roost sites in north east Scotland (e.g. Loch of Strathbeg and Muir of Dinnet) as birds have started to winter in ever greater numbers on Orkney.

12. Muir of Dinnet (UK9002791): Greylag Goose

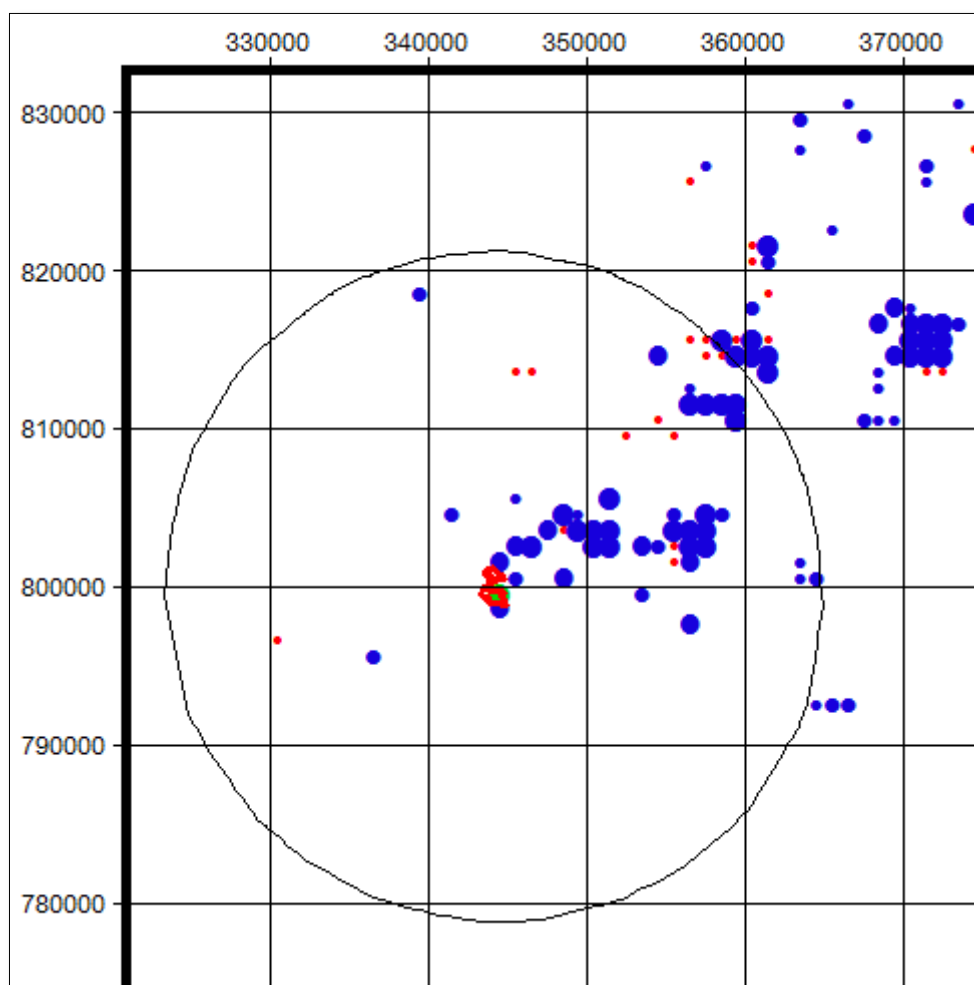


Figure 41. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Muir of Dinnet SPA. For key see page 35.

Roost locations and feeding distribution

Iceland Greylag Geese did not appear to use the Muir of Dinnet in any number until the late 1970s, when 500 were counted roosting on Loch Kinord. Numbers continued to increase through the 1980s and 1990s to a maximum of 36,525 counted in October 1996 (Hearn & Mitchell 2004). Numbers began to decline from the late 1990s onwards. The main feeding areas tended to be in the Howe of Alford although birds feeding here could switch roost to the Loch of Skene (see above). Bell (1988) found that the feeding areas could be a considerable distance away, with most birds feeding 10-22km to the north east, although they were concentrated in a relatively small area. The Howe of Tarland, 5 km to the north east, was used, often in the spring, and at other times, birds dispersed north to feed in Donside and east to south Deeside.

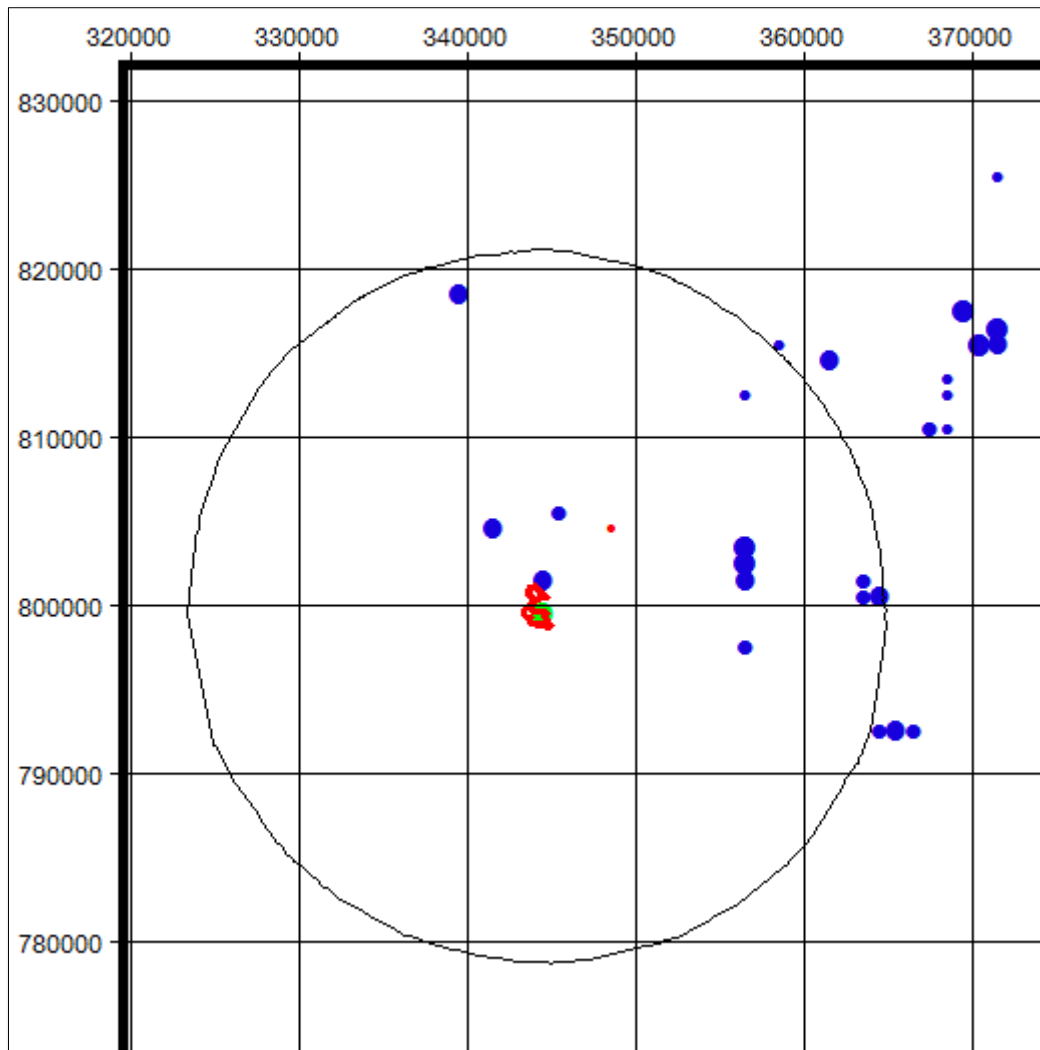


Figure 42. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Muir of Dinnet SPA. For key see page 35.

As Iceland Greylag Geese have shifted wintering area north, especially to Orkney, large parts of Aberdeenshire are now abandoned as a wintering area. This is well demonstrated at Muir of Dinnet SPA where numbers roosting there have fallen from over 36,000 in 1996 to just a few hundred birds in the late 2000s. Correspondingly, the feeding areas have also been largely abandoned although small numbers are occasionally encountered.

13. Loch Ken and River Dee Marshes (UK9003111): Greylag Goose

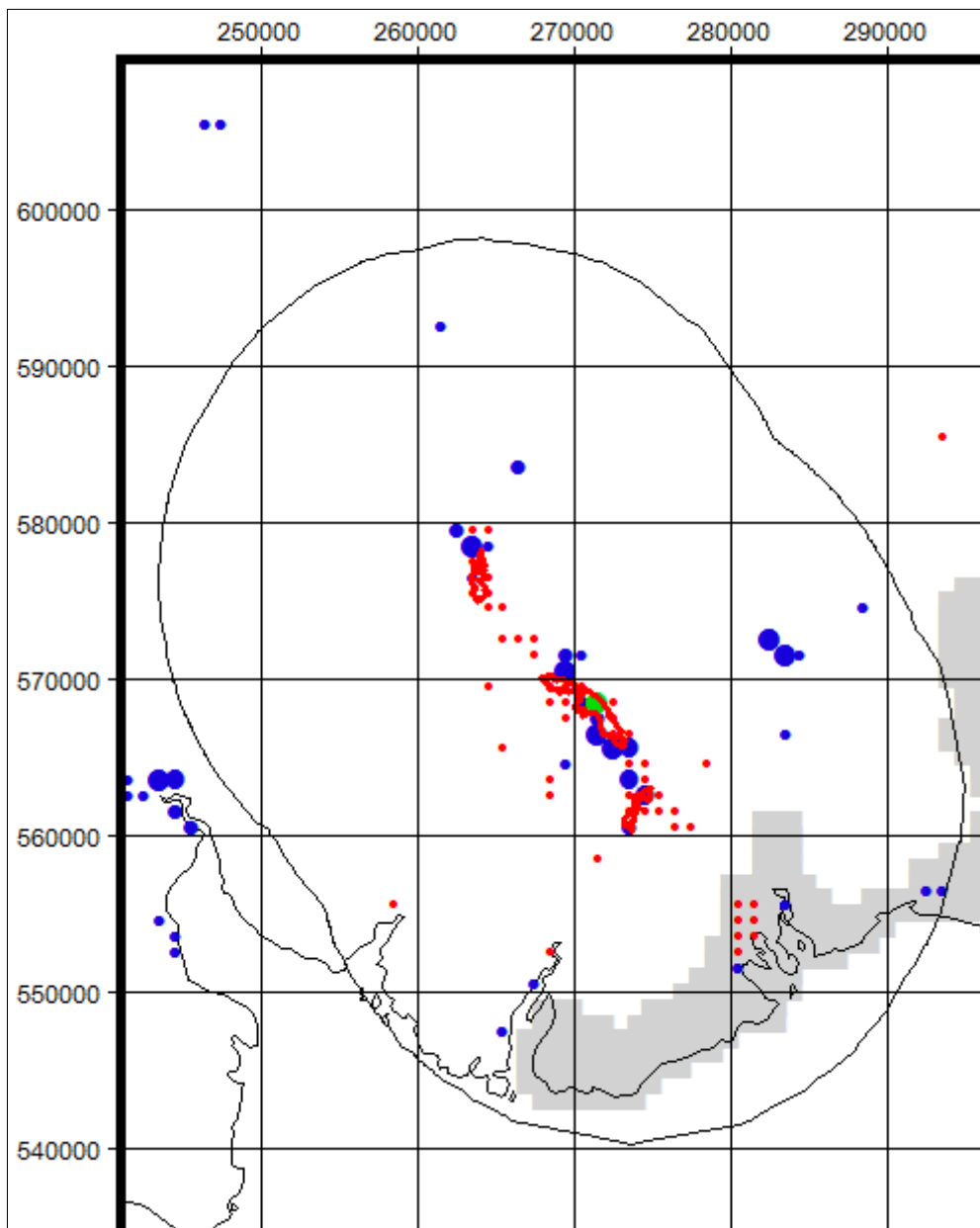


Figure 43. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Loch Ken and River Dee Marshes SPA. For key see page 35.

Roost locations and feeding distribution

Iceland Greylag Geese used to occur in the Loch Ken/Dee Marshes area from near New Galloway in the north to near Threave in the south with as many as 1,742 birds counted as recently as December 1999 (see Hearn & Mitchell 2004). The feeding areas were primarily along the valley, notably at Threave Mains.

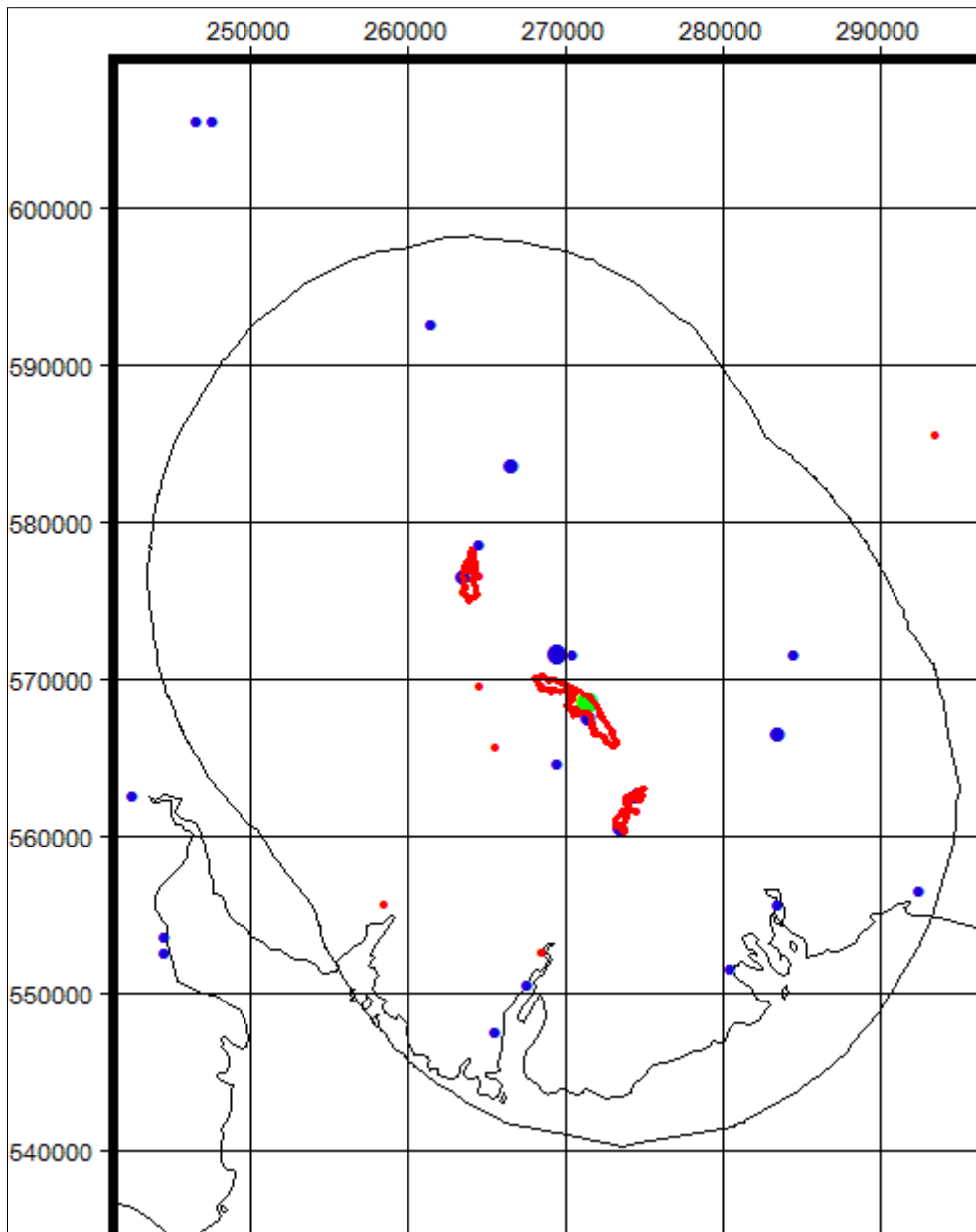


Figure 44. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Loch Ken and River Dee Marshes SPA. For key see page 35.

Since the shift in winter distribution north to Orkney, numbers of Iceland Greylags Geese now using the area are greatly diminished. Small numbers occasionally occur, probably annually (as evidenced by sightings of colour-marked individuals) although several hundred British Greylag Geese now also occur here year round, making an assessment of the number of winter migrants involved hard to determine.

14. Castle Loch, Lochmaben (UK9003191): Pink-footed Goose

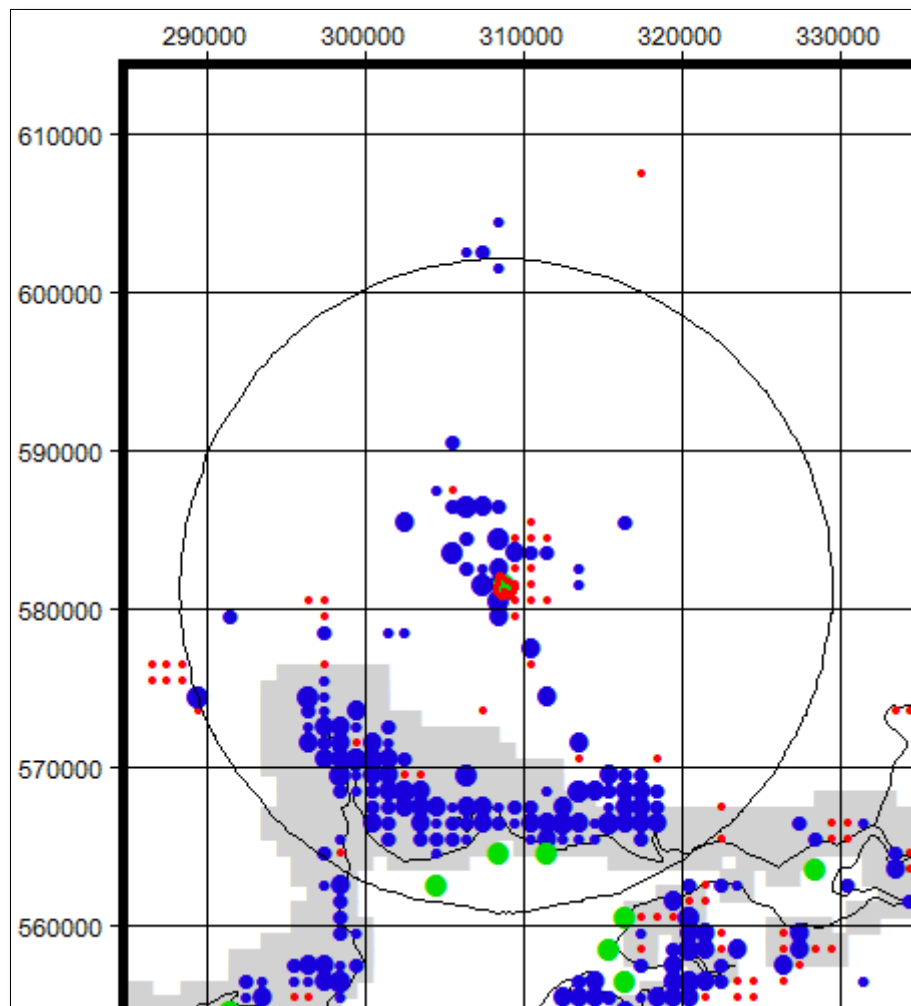


Figure 45. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Castle Loch, Lochmanben SPA. For key see page 35.

Roost locations and feeding distribution

Few Pink-footed Geese tend to use Castle Loch until after the hunting season has ended (see Mitchell & Hearn 2004). Small numbers were present during the 1960s and 1970s, gradually building to a peak of 16,380 in February 1991. The feeding areas used to be in the Annan Valley often up to 10km from the roost. Others fed relatively close to the roost especially to the north and west in NY08 and to the east of the roost both areas associated with grass fields along the low ground of the Waters of Ae. The vast majority of birds feeding along the north shore of the Inner Solway Firth (between Dumfries and Annan) roost on the Solway although there is probably some interchange between the roosts, especially in the spring.

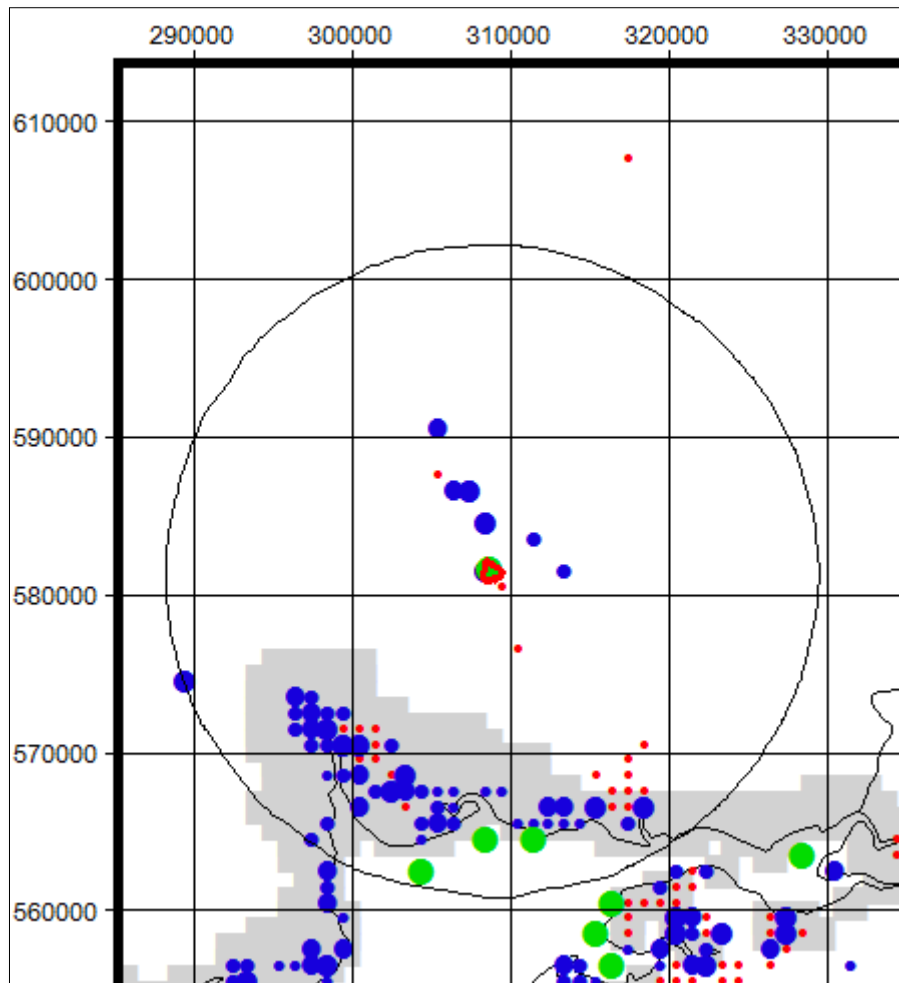


Figure 46. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Castle Loch, Lochmaben SPA. For key see page 35.

There are fewer feeding records near Castle Loch in the most recent period, partly a reflection of smaller numbers using the roost (Mitchell & Hall 2012).

15a. Montrose Basin (UK9004031): Greylag Goose

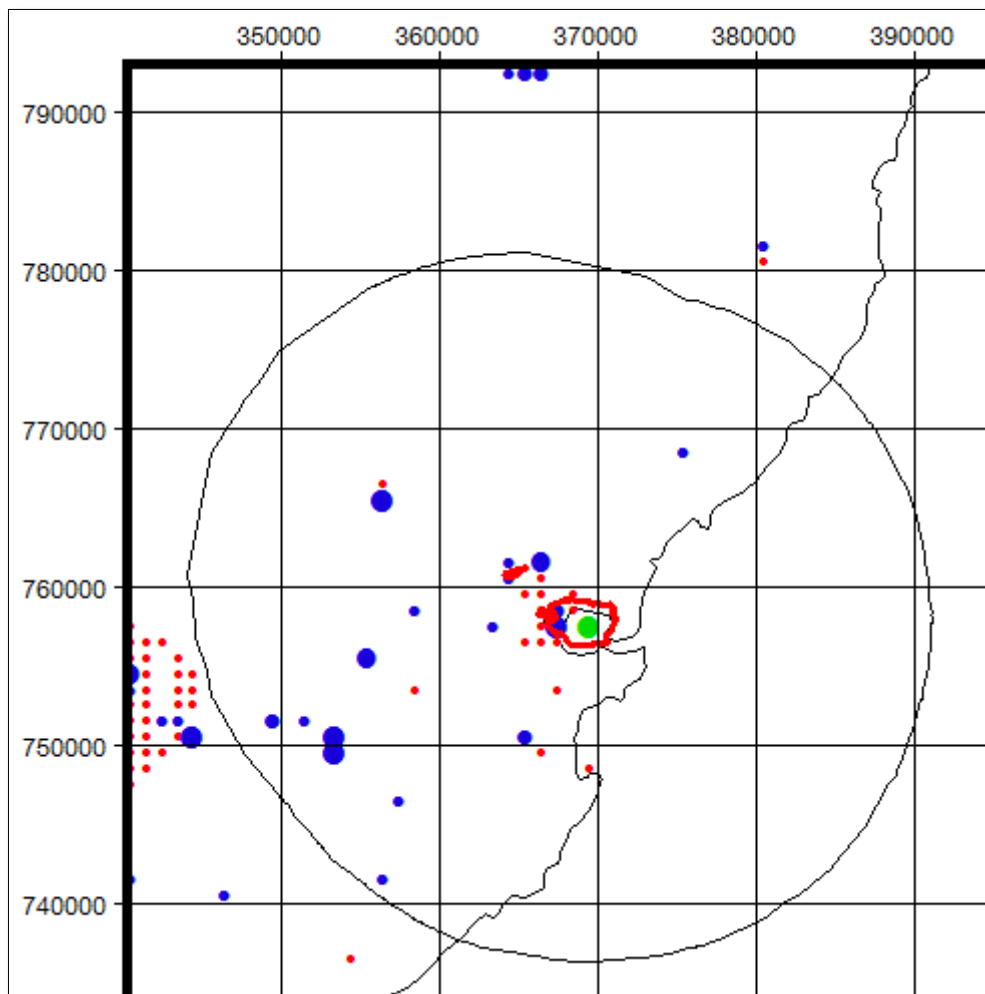


Figure 47. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Montrose Basin SPA. For key see page 35.

Roost locations and feeding distribution

Since the 1960s, Montrose Basin held variable number of Iceland Greylag Geese with a notable increase occurring after 1981, when the site became a Local Nature Reserve, although numbers did not continue to increase like those of its congener, the Pink-footed Goose (see below). The maximum count was of 2,100 in February 1991 and numbers using the roost have decreased since then. The feeding areas were not well documented although thought to be the farmland to the south and west of the estuary.

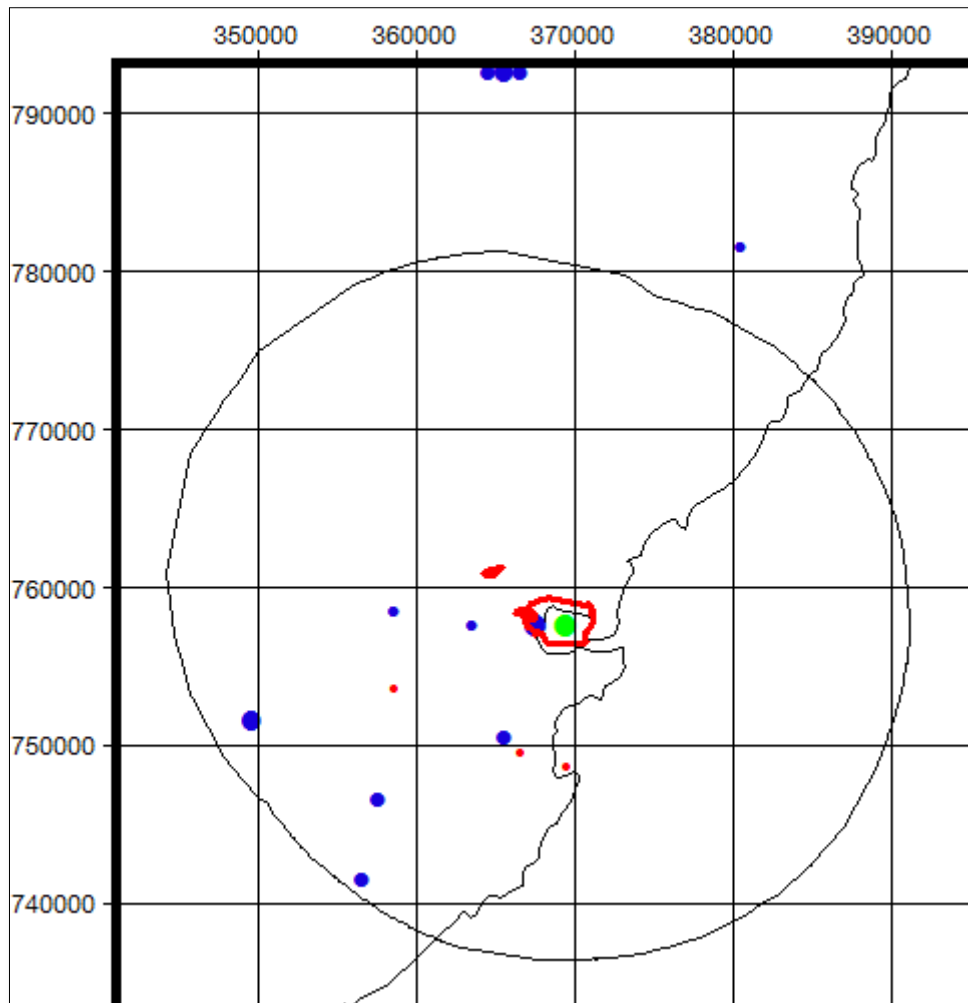


Figure 48. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Montrose Basin SPA. For key see page 35.

The few feeding records from Montrose Basin are a reflection of a decline in the number of Iceland Greylag Geese using the site.

15b. Montrose Basin (UK9004031): Pink-footed Goose

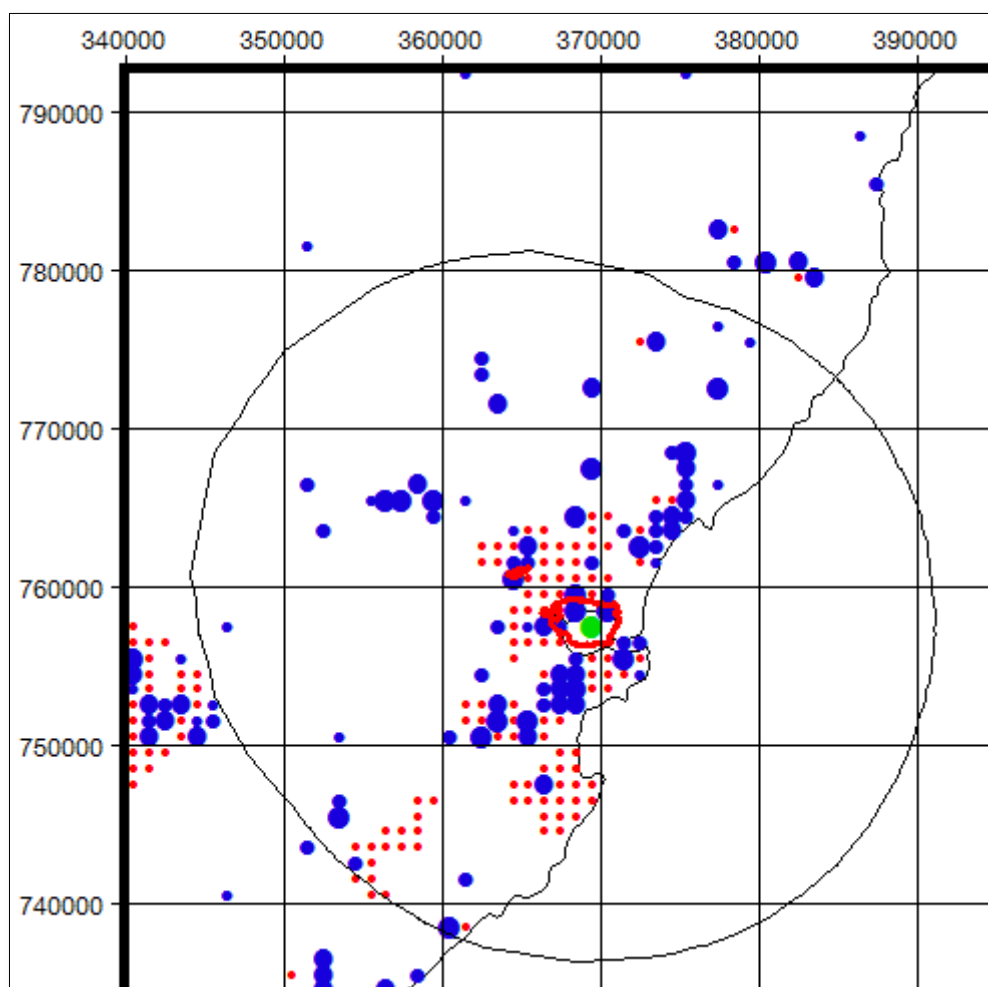


Figure 49. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Montrose Basin SPA. For key see page 35.

Roost locations and feeding distribution

Montrose Basin is one of the most important Pink-footed Goose roosts in the UK. Throughout the 1960s and 1970s, the basin was badly disturbed, first by military aircraft, then by excessive wildfowling. In 1981, a Local Nature Reserve was created. After the designation of the site, numbers steadily rose from the low thousands to a peak of 35,000 birds in November 1987. Numbers declined somewhat in the early 1990s, although increased again subsequently. Birds feed on farmland close to the basin, to the south and south west towards Chapleton/Inverkeilor and to the north in NO76. Pink-footed Geese also seek stubbles in the autumn to the west of the basin in NO67 and NO56.

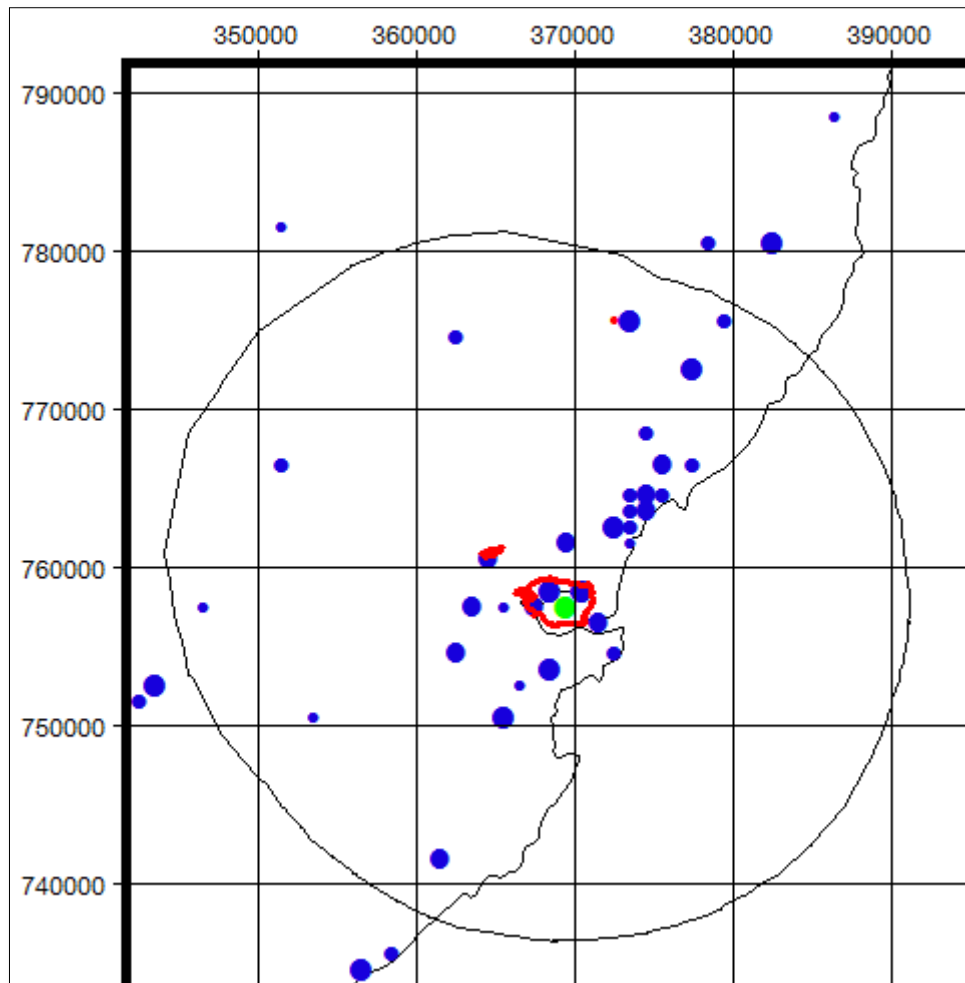


Figure 50. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Montrose Basin SPA. For key see page 35.

There are far fewer recent feeding records compared to Figure 49. The numbers of Pink-footed Geese using the basin have increased in recent years, with 65,060 counted in October 2010 (Mitchell 2011) and the core feeding areas are not thought to have altered much. Thus, this is a good example of an area where a lack of recent records underestimates the current feeding distribution of Pink-footed Geese. The area is a good candidate for a systematic survey.

16a. Loch of Kinnordy (UK9004051): Greylag Goose

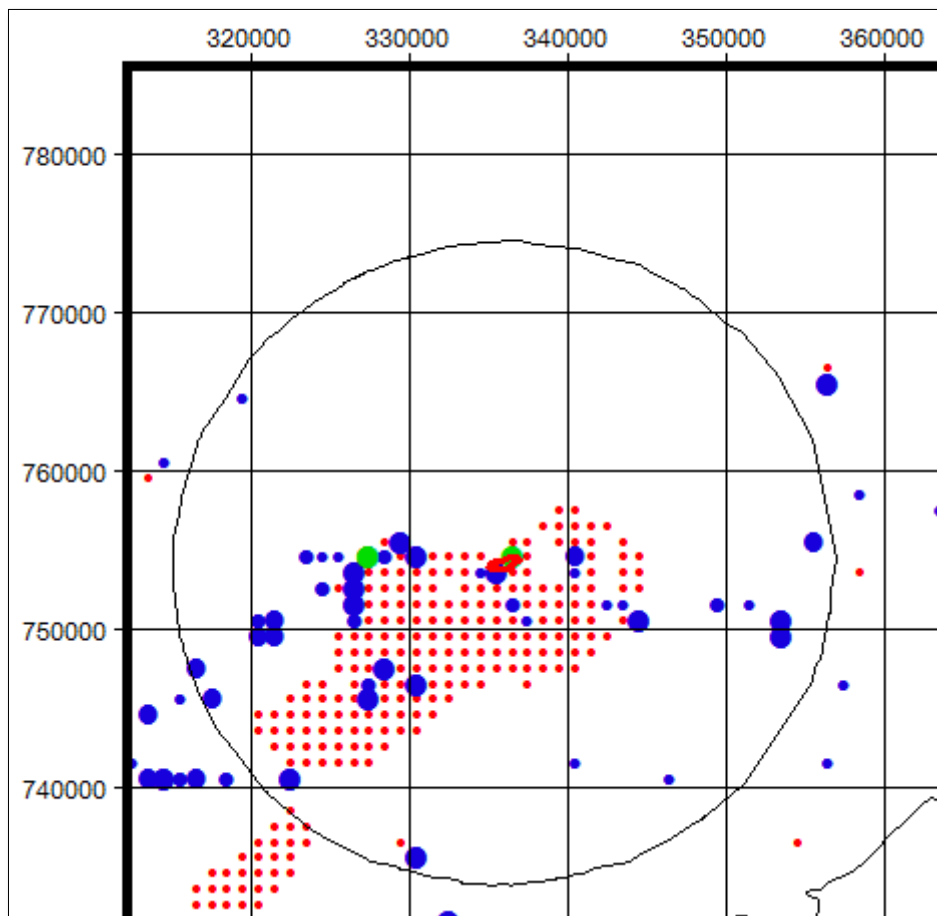


Figure 51. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Loch of Kinnordy SPA. For key see page 35.

Roost locations and feeding distribution

Loch of Kinnordy was an important roost for Iceland Greylag Geese from the 1960s to the late 1980s, typically supporting up to 5,000 birds each autumn. There was always much interchange with the nearby Loch of Lintrathen. The feeding areas were not well documented although data provided for the 2004/05 WWT SPA feeding distribution study suggested feeding areas in Strathmore, especially to the south and south west of the loch.

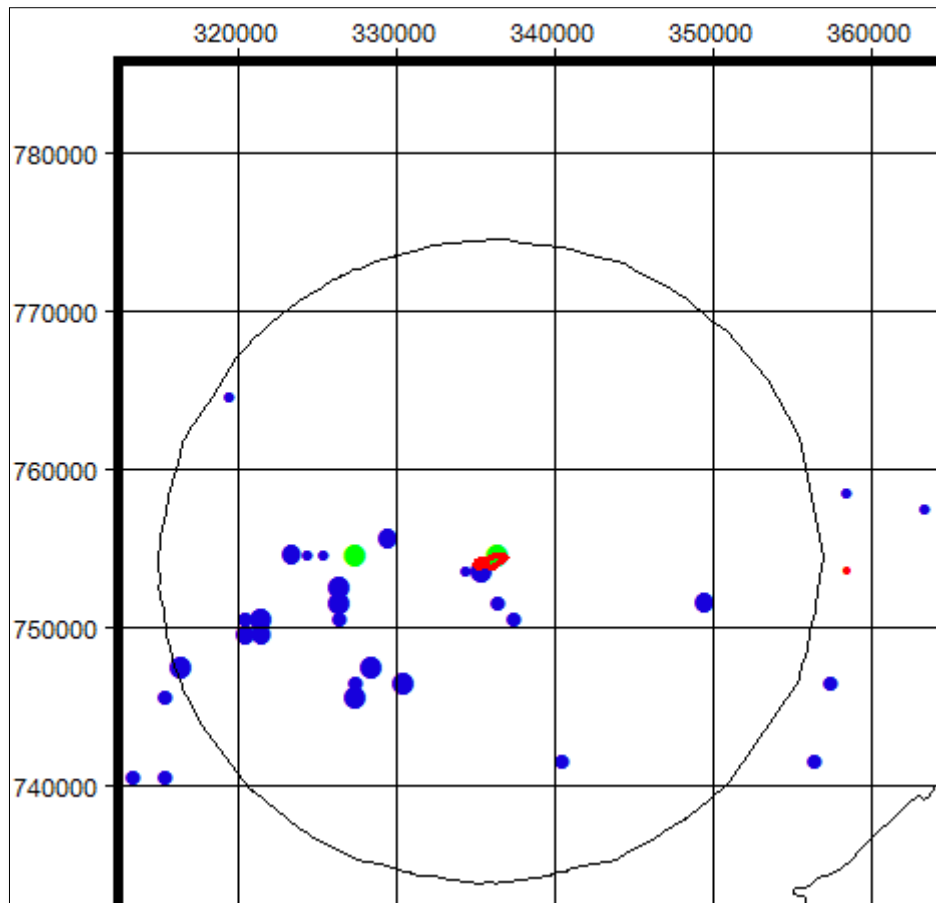


Figure 52. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Loch of Kinnordy SPA. For key see page 35.

Few Iceland Greylag Geese now roost at the site (Mitchell & Hall 2012) and correspondingly there are few feeding records.

16b. Loch of Kinnordy (UK9004051): Pink-footed Goose

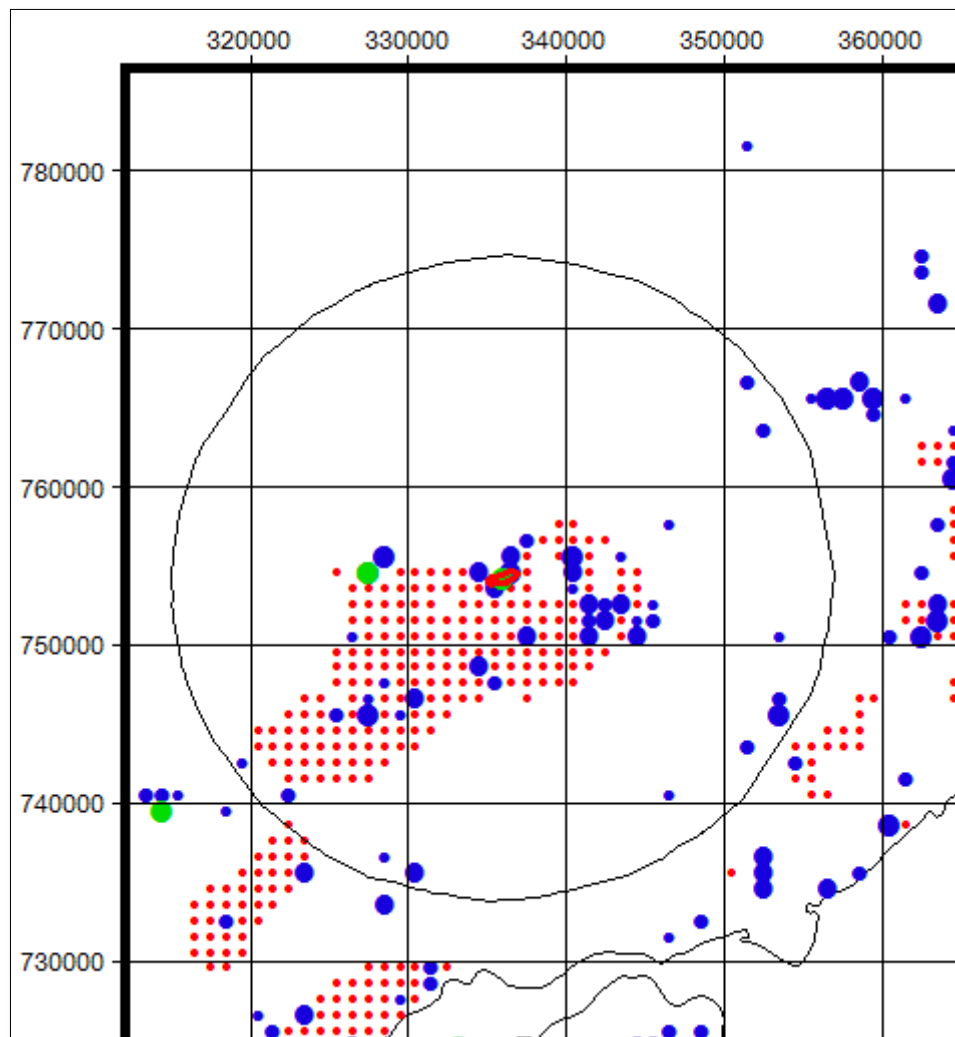


Figure 53. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Loch of Kinnordy SPA. For key see page 35.

Roost locations and feeding distribution

Throughout the 1970s, numbers of roosting Pink-footed Geese were low, but after 1987/88, roost counts of over 5,000 birds were regular, especially in the autumn. Numbers have declined again and birds have probably switched to Loch of Lintrathen, 10km to the west. The feeding areas were not well documented, although data provided for the 2004/05 WWT SPA feeding distribution study suggested feeding areas in Strathmore, especially to the south and south west of the loch.

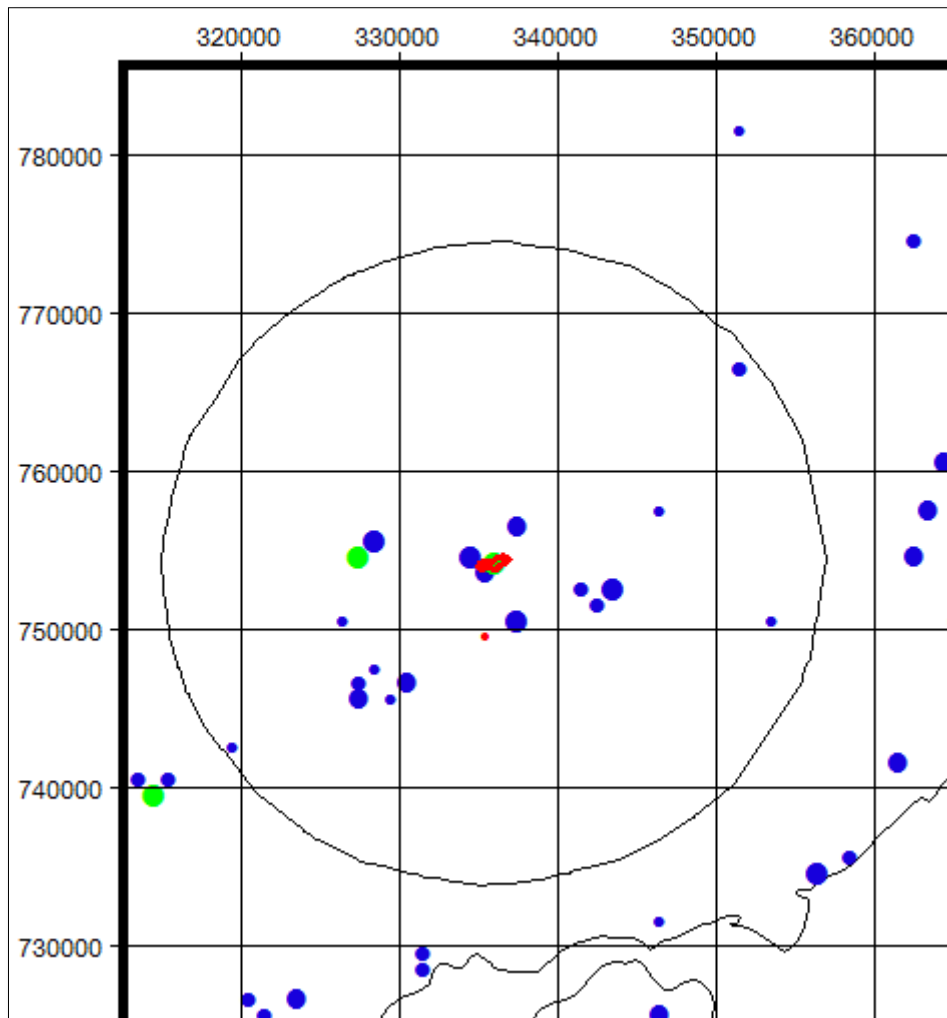


Figure 54. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Loch of Kinnordy SPA. For key see page 35.

Few, if any, Pink-footed Geese now roost at Loch of Kinnordy, the birds having switched to Loch of Lintrathen (Appendix 3 and Mitchell & Hall 2012). The records of birds feeding close to Loch of Kinnordy probably relate to birds that roost at Loch of Lintrathen.

17. Loch of Lintrathen (UK9004061): Greylag Goose

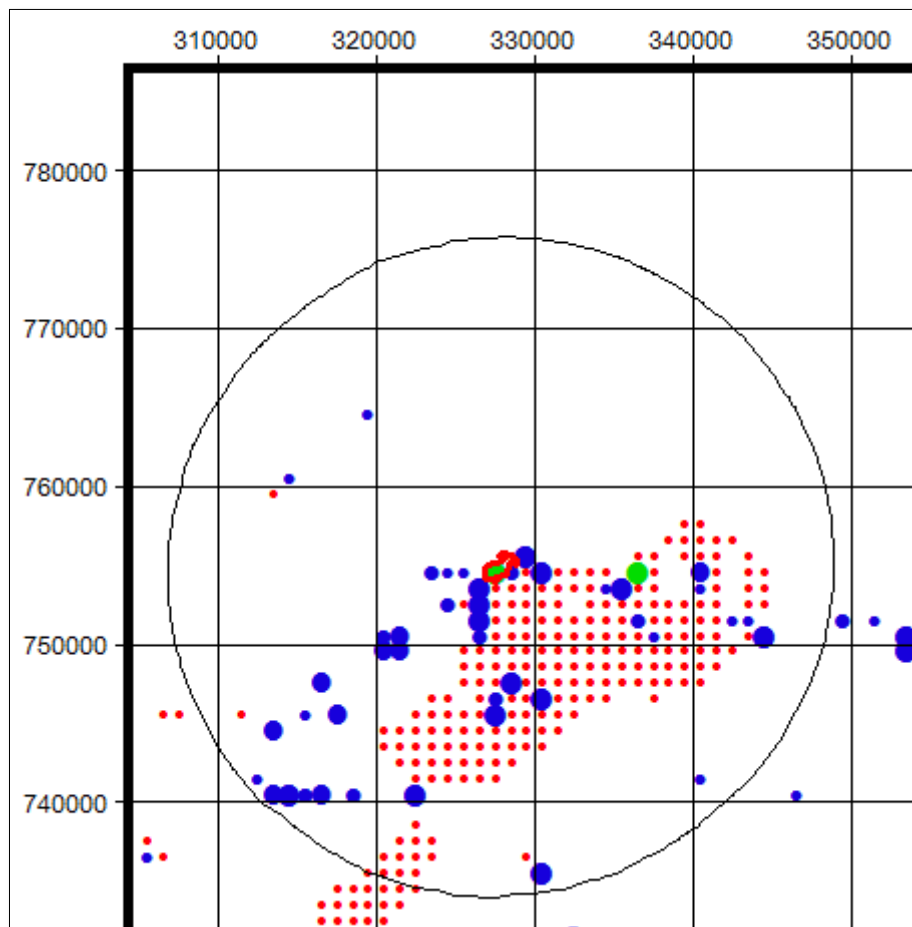


Figure 55. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Loch of Lintrathen SPA. For key see page 35.

Roost locations and feeding distribution

Several thousand Iceland Greylag Geese roosted at Loch of Lintrathen during the 1960s, with a peak count of 12,000 birds in November 1970. Since then the numbers were more variable, ranging from several hundred to 7,200 birds counted in November 1997. Little information was available on the feeding distribution, although data provided for the 2004/05 WWT SPA feeding distribution study suggested feeding areas in Strathmore, to the south and east of the loch, particularly around Incheoch, Torrax and Easter Peel.

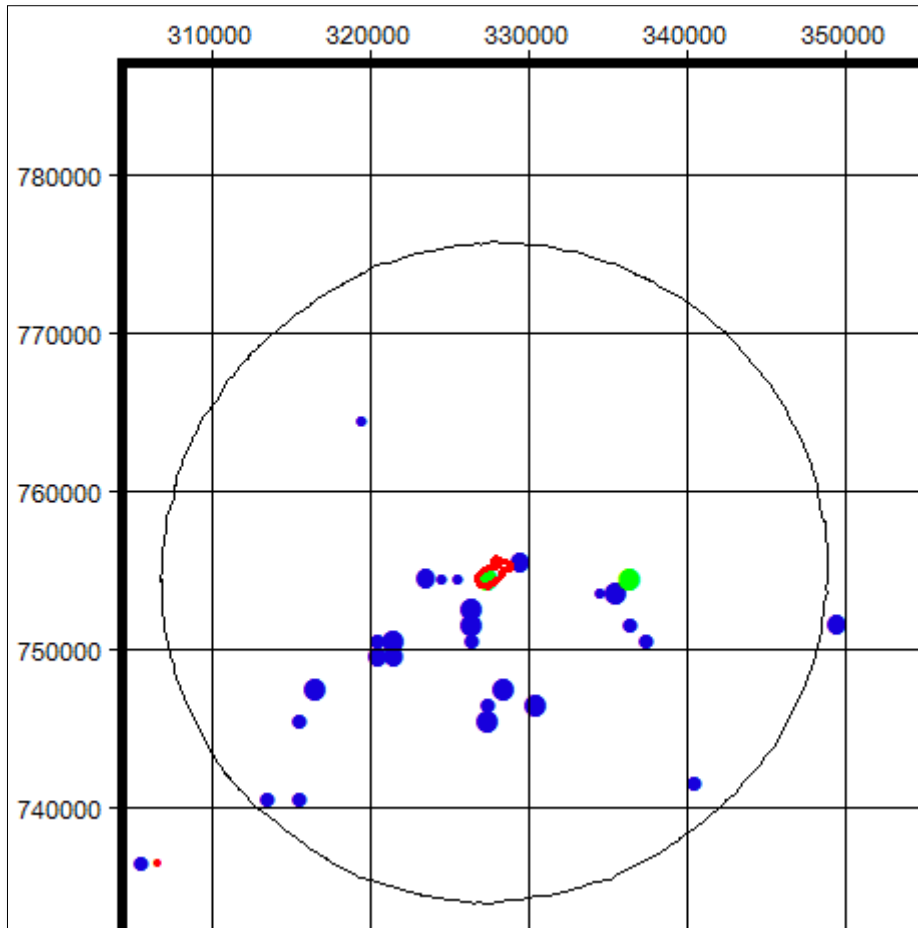


Figure 56. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Loch of Lintrathen SPA. For key see page 35.

Fewer than 1,000 Iceland Greylag Geese now roost at Loch of Lintrathen (Appendix 3 and Mitchell & Hall 2012), and as a consequence, there are fewer feeding records with most coming from the south and south west.

18. Loch Leven (UK9004111): Pink-footed Goose

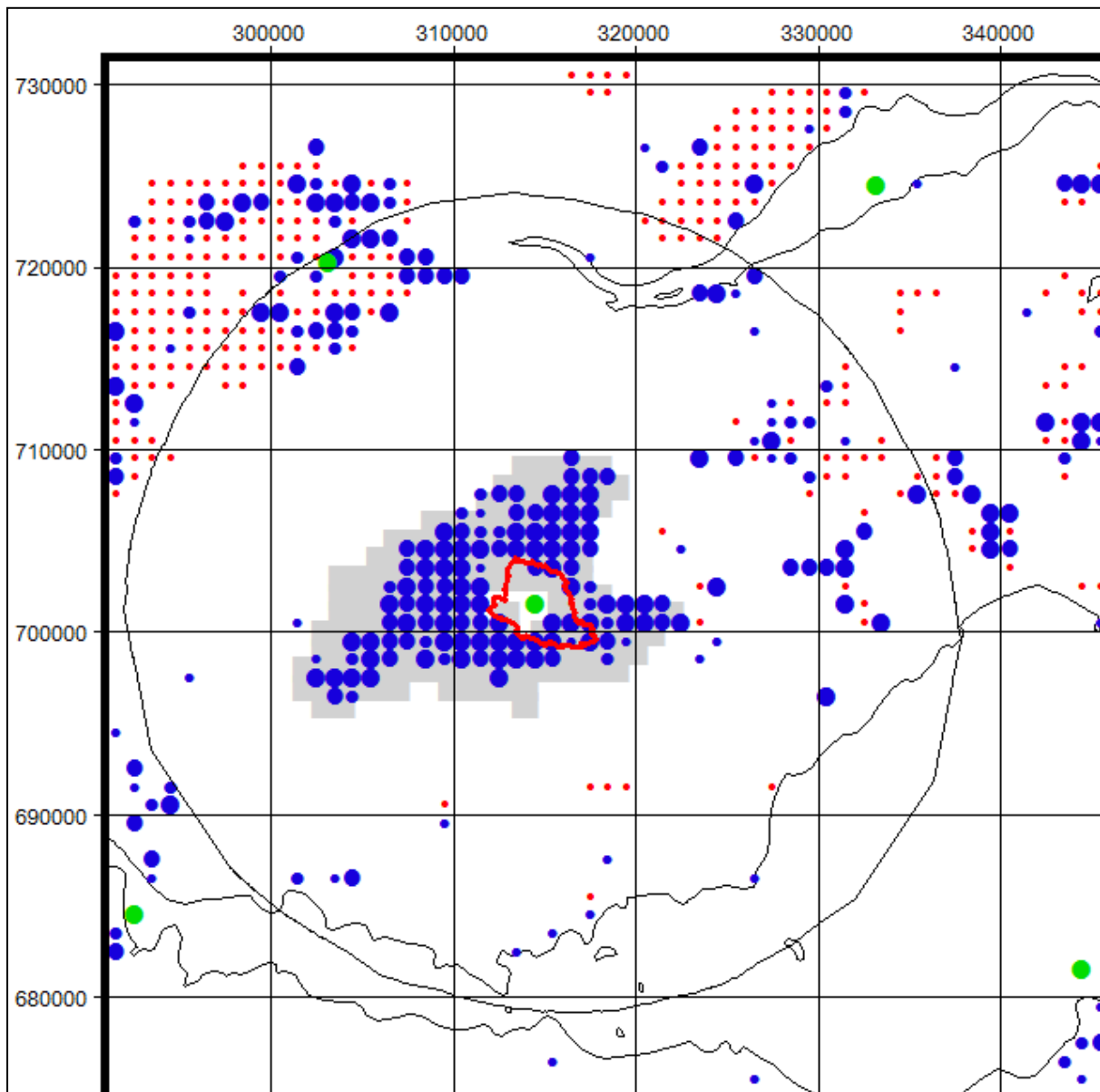


Figure 57. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Loch Leven SPA. For key see page 35.

Roost locations and feeding distribution

The loch provides an important arrival point for Pink-footed Geese and in most years counts are highest in the autumn. Numbers did not reach 10,000 birds until winter 1979/80, after which the average peak count was closer to 17,000 birds. A peak count of 23,070 geese was made in October 1992, although numbers decreased in the late 1990s. Farmland surrounding Loch Leven has been subject to intensive standardised surveys in the late 1960s/early 1970s (Newton & Campbell 1973) and the mid 1990s (Hearn & Mitchell 1995). In addition, several hundred Pink-footed Geese were caught and marked at the site in the 1990s leading to a large number of res-sightings. As a consequence, the feeding areas in relation to the roost are well known. The geese are highly selective of certain fields. Of 1,492 fields checked several times each week between December 1994 and April 1995, only 14% ever held Pink-footed Geese.

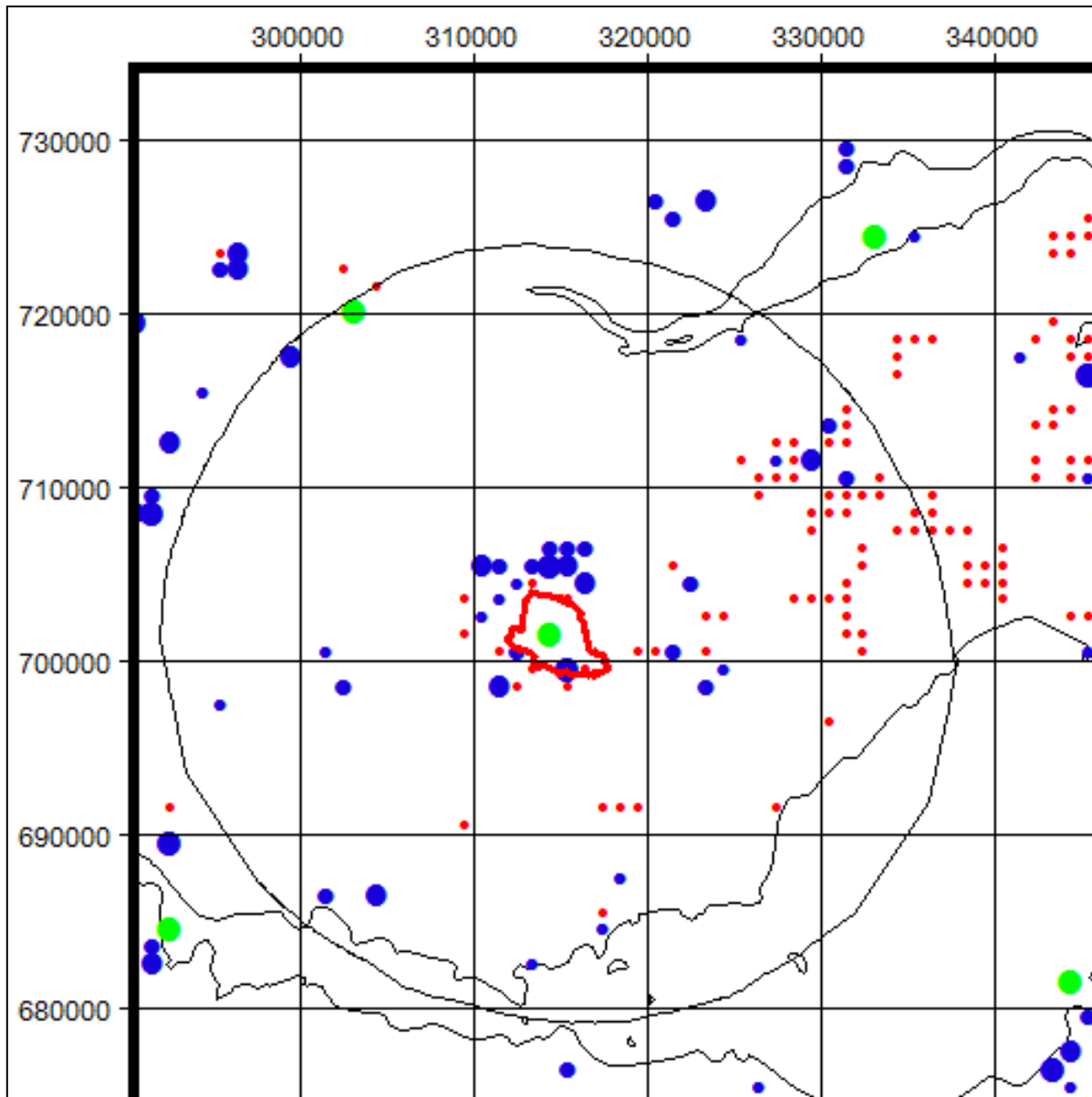


Figure 58. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Loch Leven SPA. For key see page 35.

No standardised feeding surveys were carried out between 2007/08 and 2011/12, and the number of marked individuals has fallen considerably as ringing of Pink-footed Geese declined in the early 2000s. The number of geese roosting at the site has remained high (Appendix 3 and Mitchell & Hall 2012) so it is of note that there are far fewer feeding records for this period. The feeding distribution is generally thought to be similar to previous years (Figure 57) thus this area is another example of the feeding distribution of geese in recent years being under represented by a lack of records.

19a. Firth of Tay & Eden Estuary (UK9004121): Greylag Goose

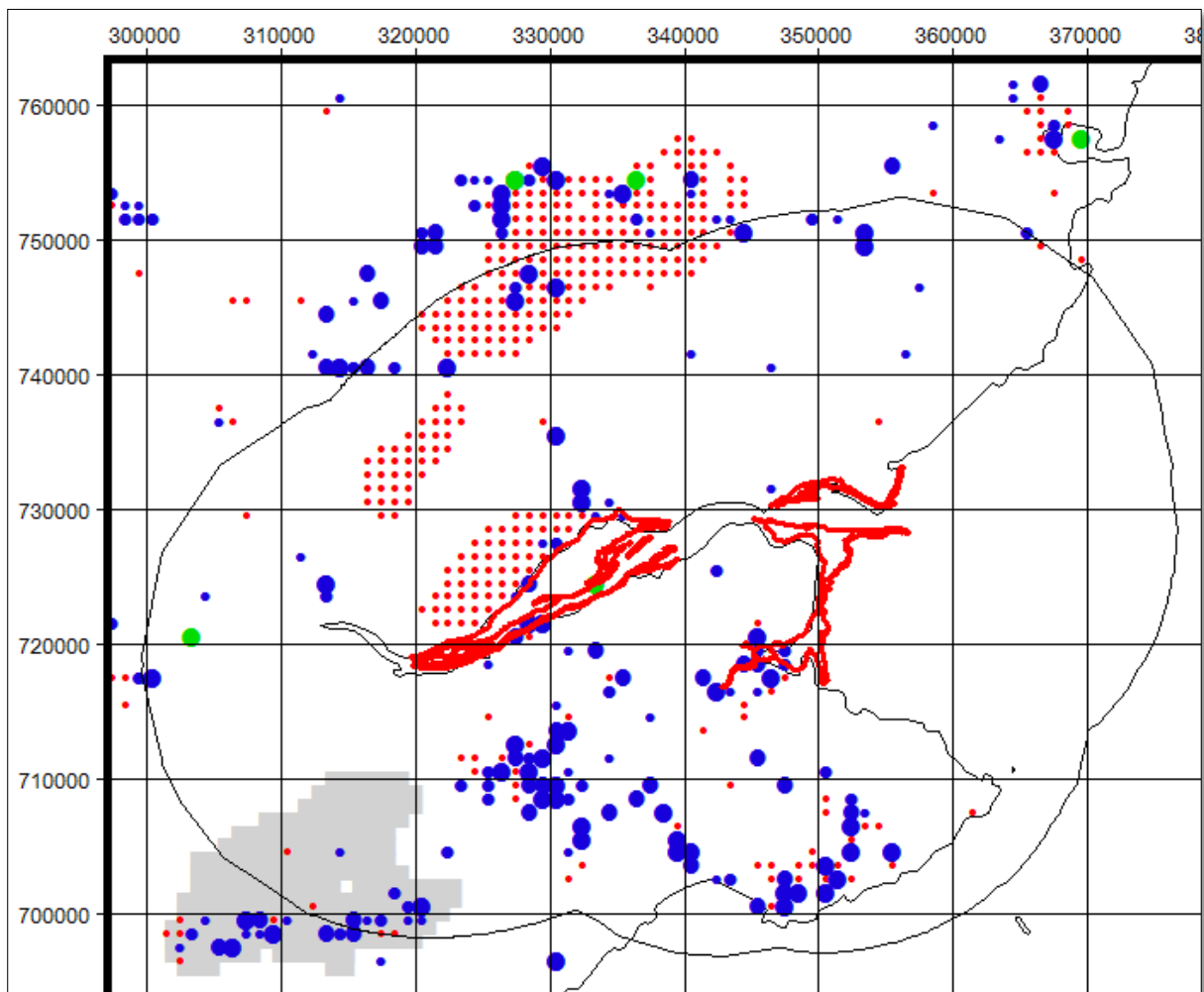


Figure 59. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Firth of Tay & Eden Estuary SPA. For key see page 35.

Roost locations and feeding distribution

Counts of roosting Iceland Greylag Geese were irregular up to 1989/90 and it is difficult to be certain about the numbers using the site during that period, although from the counts that are available it would appear that in most years the winter peak was fewer than 1,000 birds. The second half of the 1990s saw an increase in numbers with 4,350 birds counted in January 1999. Geese roosting on the Firth of Tay typically fed to the north of the site in Southern Angus, often flying over the Sidlaw Hills into Strathmore. During the 1990s, a regular roost of 1,000 to 2,000 birds built up on the Eden Estuary. The bird tended to feed locally to the south and west of the estuary.

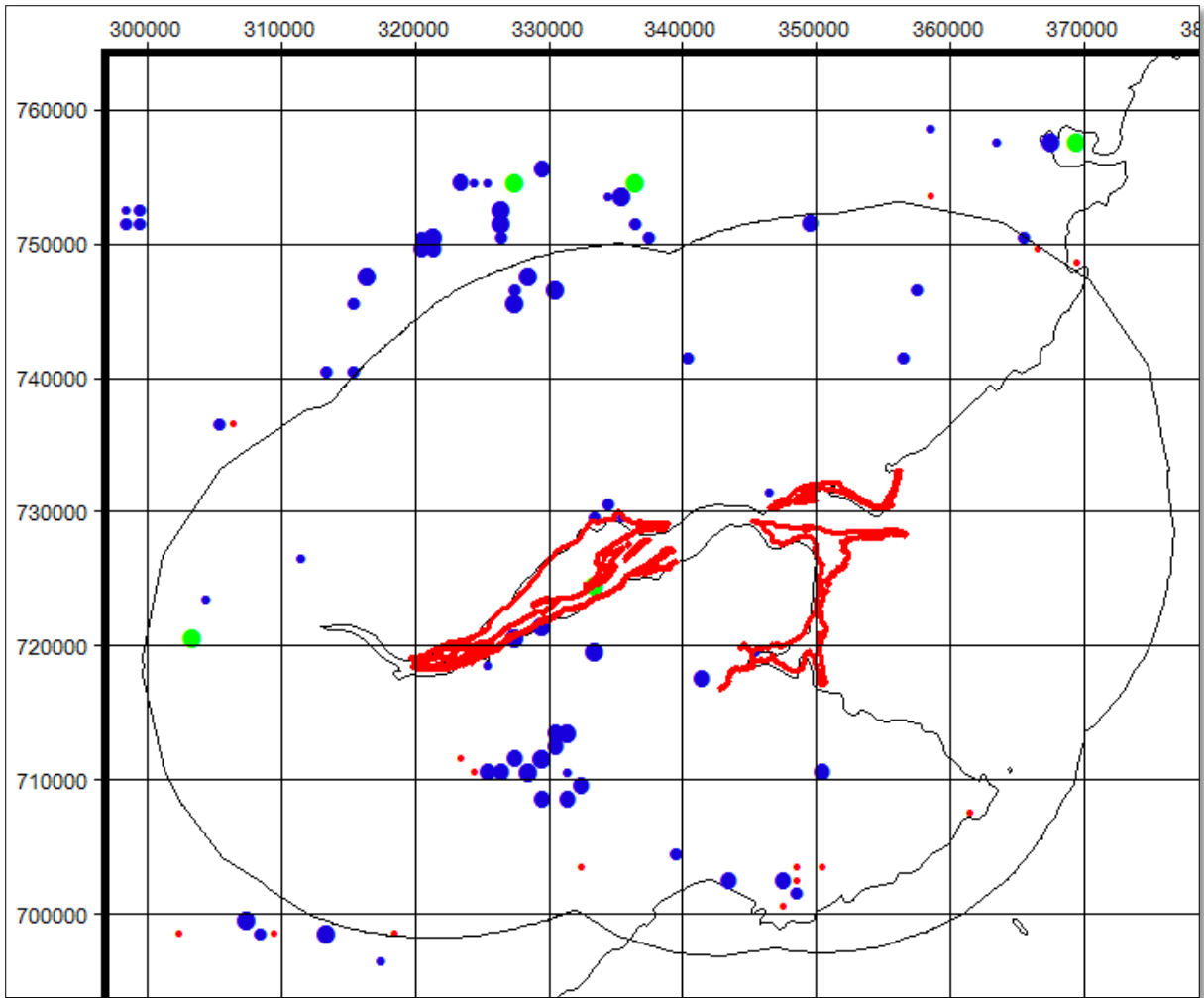


Figure 60. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Firth of Tay & Eden Estuary SPA. For key see page 35.

Counts of Iceland Greylag Geese continued to be irregular in the late 2000s, although fewer birds are counted (Appendix 3) and likewise birds at the Eden Estuary have declined. There has been a similar decline in the number of feeding records.

19b. Firth of Tay & Eden Estuary (UK9004121): Pink-footed Goose

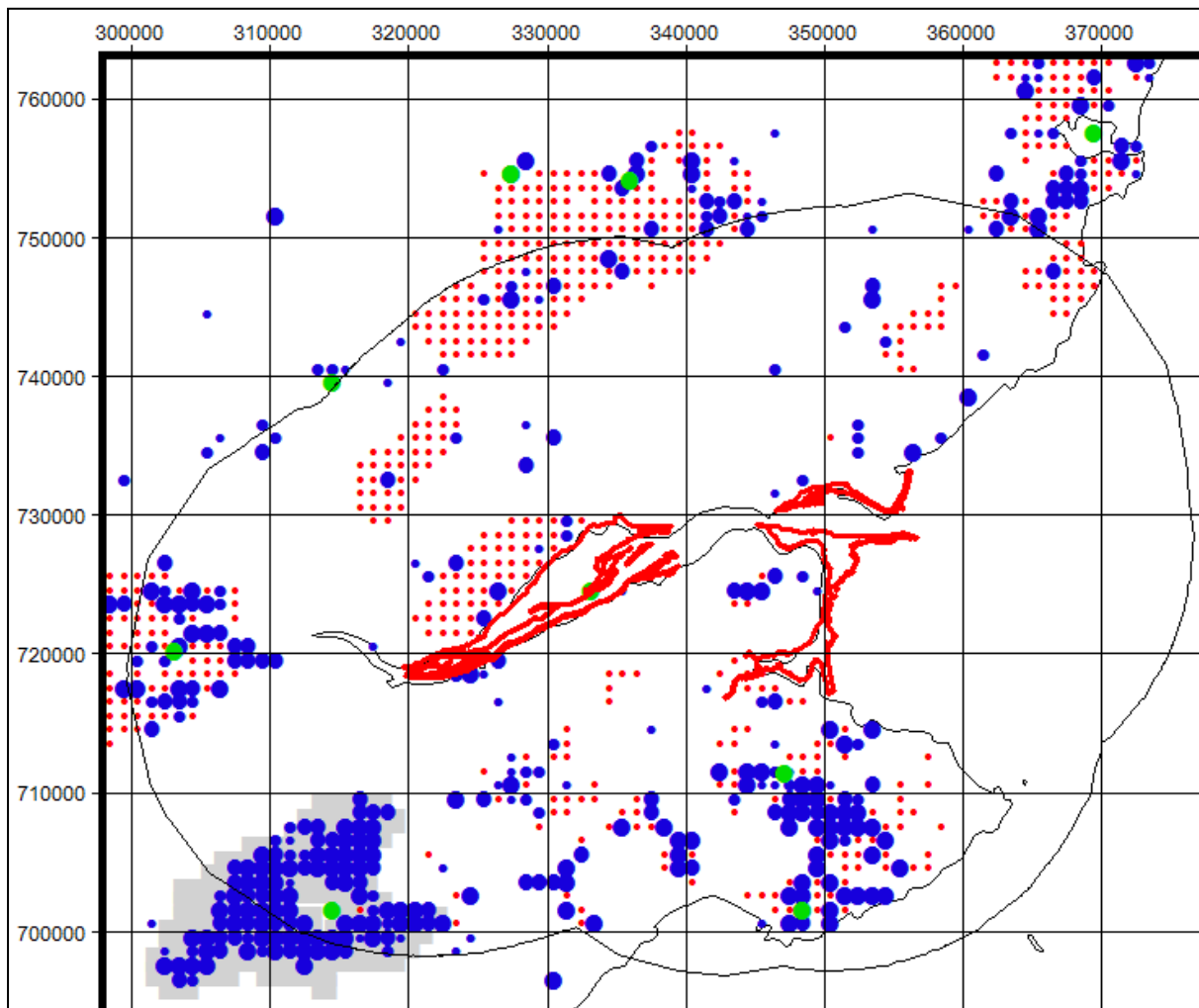


Figure 61. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Firth of Tay & Eden Estuary SPA. For key see page 35.

Roost locations and feeding distribution

In the 1950s and 1960s large numbers of Pink-footed Geese used the inner firth as a roost. The firth was largely abandoned during the 1970s and 1980s, the geese preferring the greater security of inland water. During the 1990s, however, more regular use as a roost began again, with several thousand present in most years with a peak of 8,897 birds in 1996/97. The geese fed on farmland on the north shore or often flew over the Sidlaw Hills to the Wolfhill/Pitcur area, whilst others occasionally used the Rhynd peninsula mainly in the area bounded by Inverarity, Letham, Arbirlot and Monikie. The number of Pink-footed Geese roosting at the Eden Estuary was low in the mid 1980s (100 to 300 birds) although more regular use was established in the 1990s with a maximum of 2,500 birds in November 1993. The geese fed locally often in the Craigie Fram area, 3km to the north.

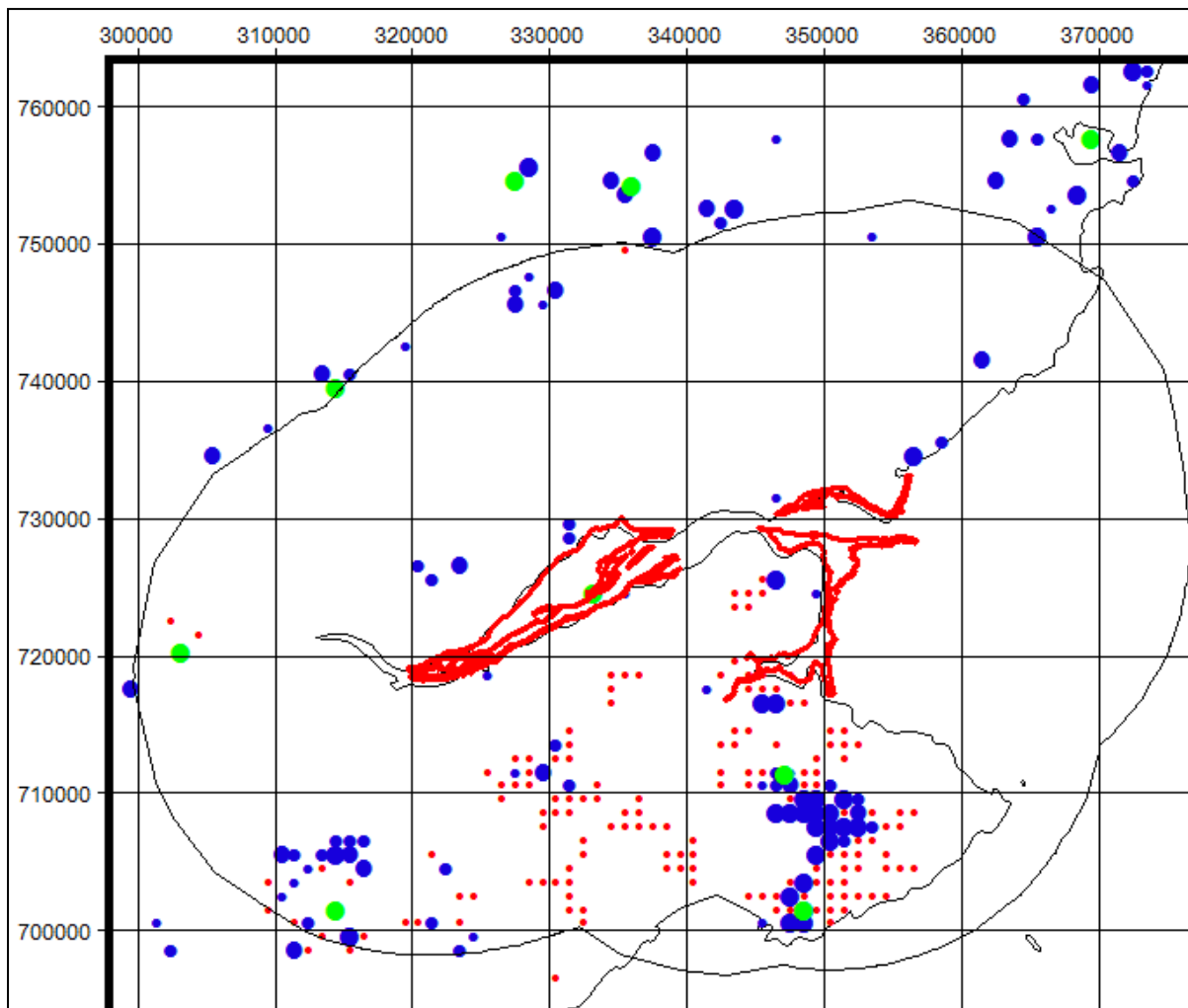


Figure 62. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Firth of Tay & Eden Estuary SPA. For key see page 35.

Whilst the number of Pink-footed Geese using the Firth of Tay and the Eden Estuary have undoubtedly declined, there has been a larger decline in the number of feeding records. This area, particularly to the north of the Firth, is another example of the feeding distribution of geese in recent years being under represented by a lack of records.

20. Cameron Reservoir (UK9004131): Pink-footed Goose

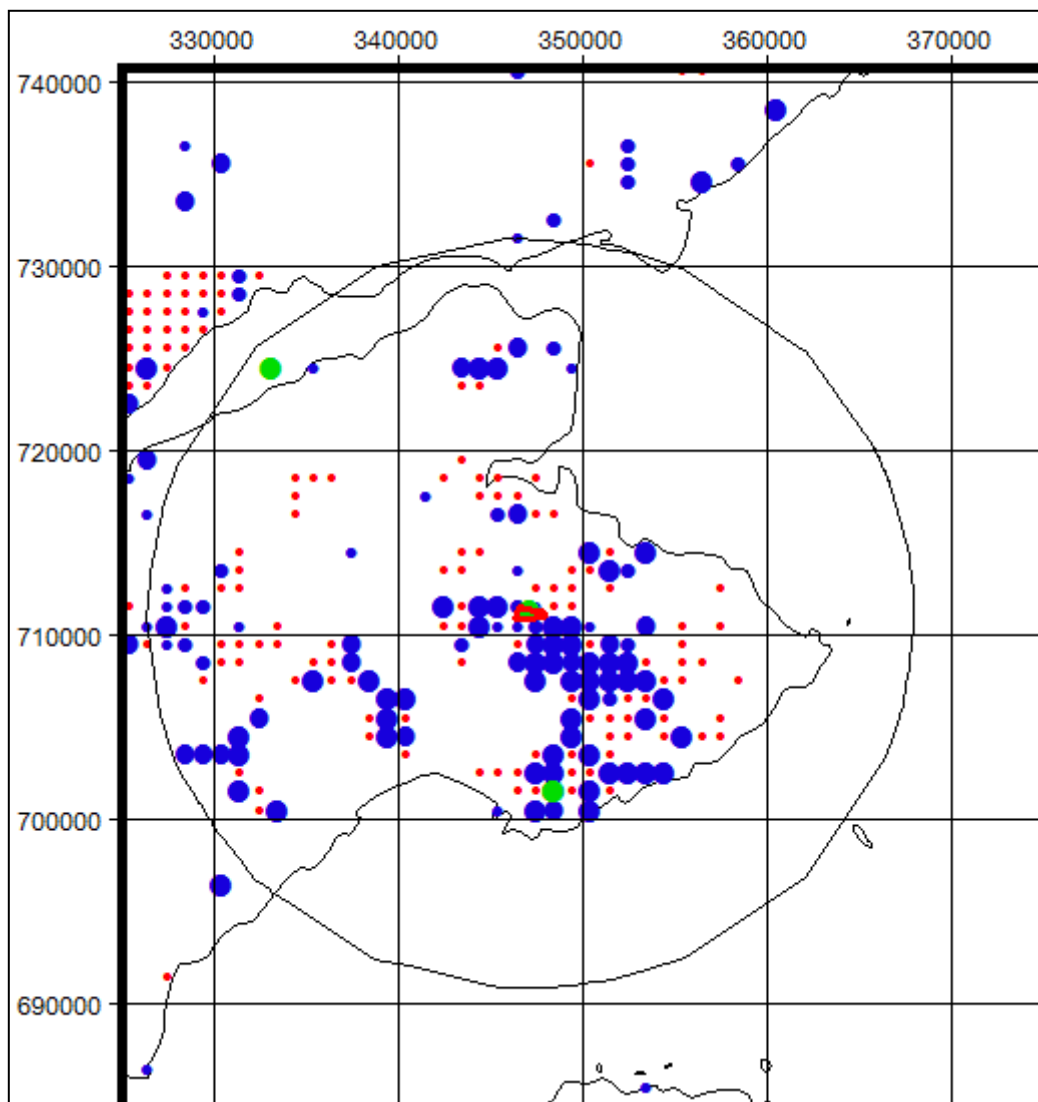


Figure 63. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Cameron Reservoir SPA. For key see page 35.

Roost locations and feeding distribution

Counts from the 1960s to 1980s show regular roosting flocks of over 5,000 birds, with 8,000 to 9,000 often recorded. In the early 1990s, however, there was a sharp increase with 11,000 to 12,000 birds regularly counted and a peak of 27,300 counted in October 1993. Since then numbers have declined. Two regular feeding areas were to the south of the reservoir around Radernie and Northbank Farms and 5km to the south east around Pittarthie and Lochty. Other flocks fed to the east at Boarhills and south of St. Andrews. See also Brown (2009).

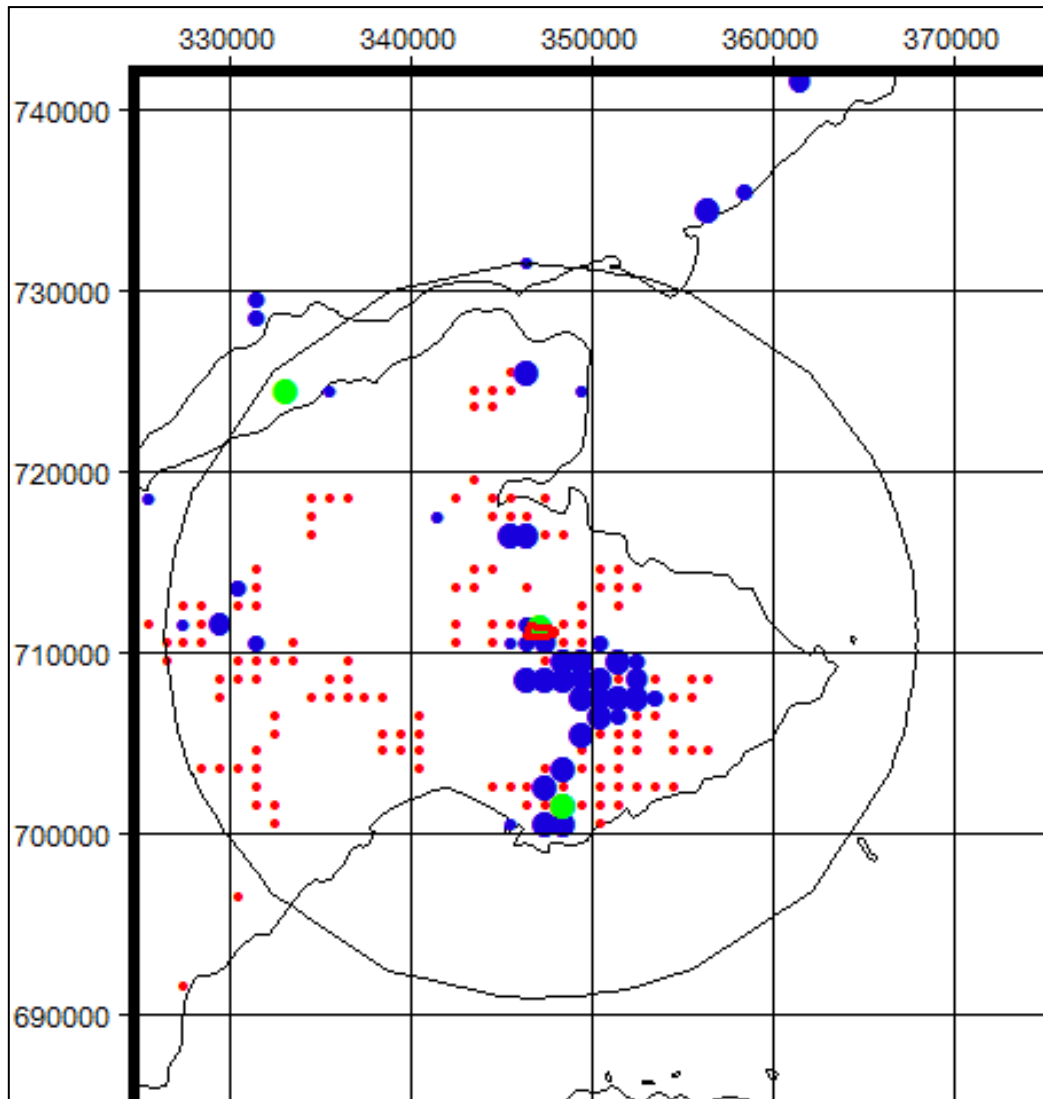


Figure 64. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Cameron Reservoir SPA. For key see page 35.

Although the number of geese using Cameron Reservoir has fallen considerably (often less than 500 birds, Appendix 3 and Mitchell & Hall 2012), the feeding records for the most recent period are in a broadly similar area to that shown in Figure 63. Feeding records from winters 2007/08 and 2008/09 found geese to the south east of the reservoir extending from Brewsterwells to Lochty/Pittarthie and south to Arncroach and Kilconquhar areas. Relatively few birds occurred in the fields adjoining Cameron Reservoir and few were recorded to the east and north east of Cameron or near St. Andrews (Brown 2009).

21. Gladhouse Reservoir (UK9004231): Pink-footed Goose

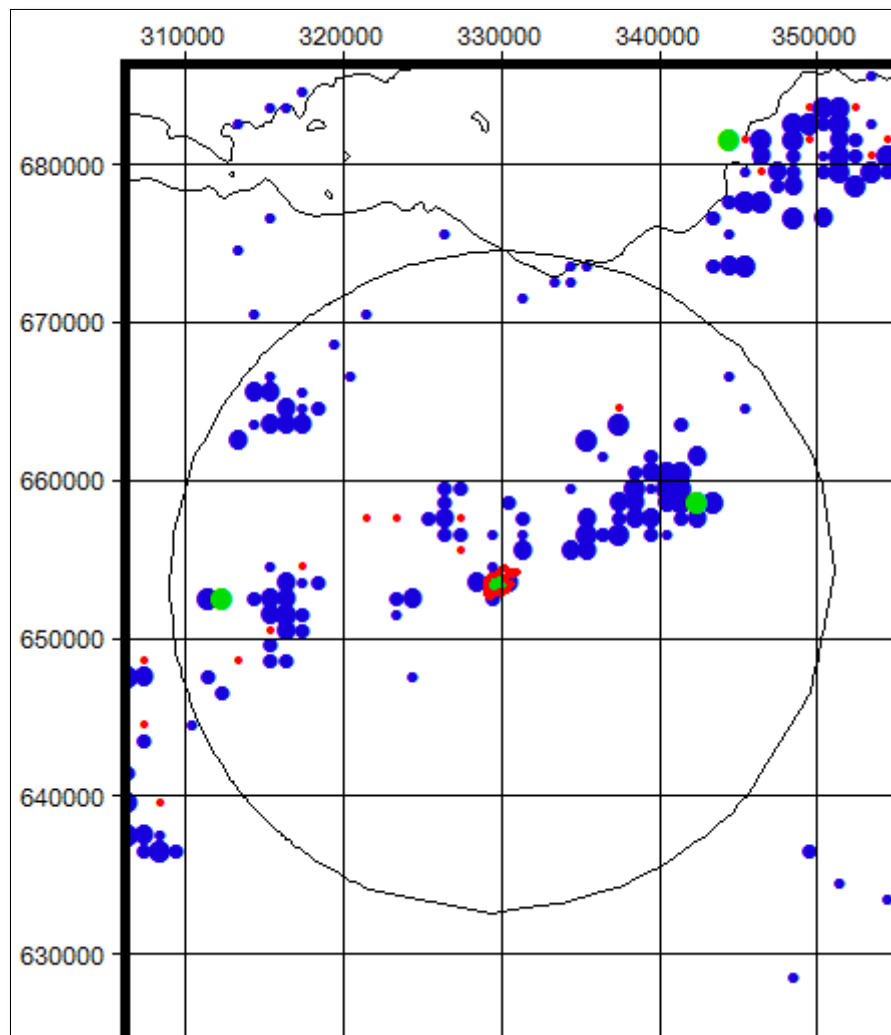


Figure 65. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Gladhouse Reservoir SPA. For key see page 35.

Roost locations and feeding distribution

The reservoir regularly held flocks of over 7,000 birds from the 1960s to the mid 1980s with a peak count of 13,700 birds in October 1982. Fewer geese roosted there in the 1990s with only occasional counts of up to 5,000 birds. Feeding records came from squares NT25 and NT35, often to the north east of the reservoir between Esperton and Blackcastle, although Brown & Brown (2009) reviewed feeding around Gladhouse Reservoir and reported that there were few standardised records.

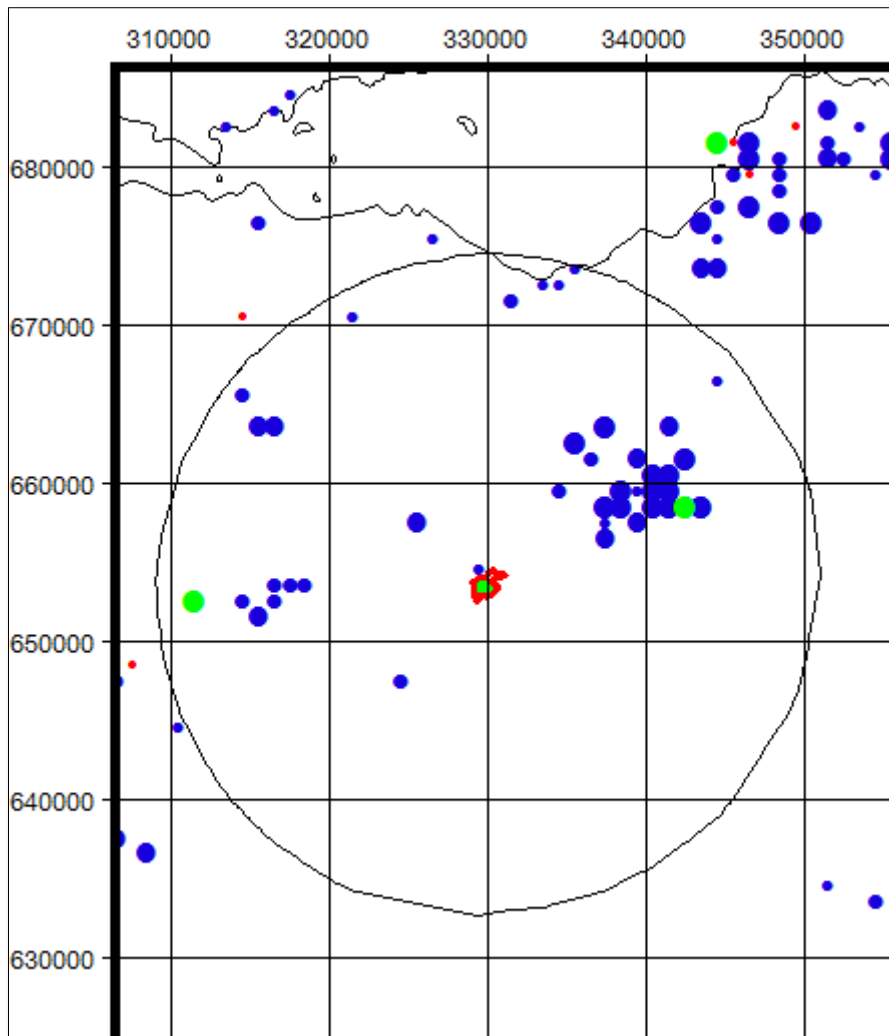


Figure 66. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Gladhouse Reservoir SPA. For key see page 35.

The number of Pink-footed Geese roosting at Gladhouse Reservoir has declined in the most recent period (Appendix 3 and Mitchell & Hall 2012), with nil IGC counts from October and November in 2008 and 2009. There has been a corresponding decline in feeding records too.

22. Fala Flow (UK9004241): Pink-footed Goose

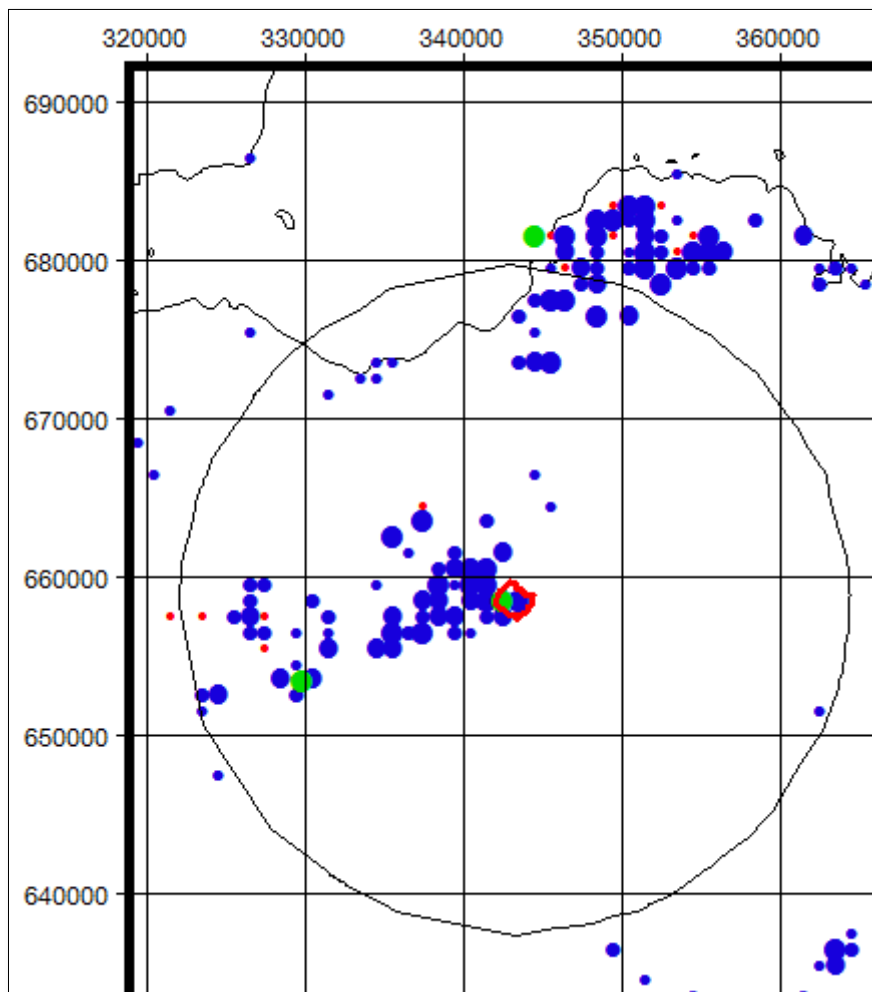


Figure 67. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Fala Flow SPA. For key see page 35.

Roost locations and feeding distribution

Regular counts of Pink-footed Geese at Fala Flow date back to the early 1960s, and roosting flocks of over 3,500 were common throughout the decade. Use of the site appeared to decline in the 1970s, but from the 1980s onwards, much larger flocks were encountered with a peak of 17,000 birds in October 1994. The main feeding area is in the farmland lying between Middleton Mains, 4.5km to the west through to Townhead and Blackcastle to the north west about 3-6km away. See also Brown & Brown (2011) and Brown & Brown (2009).

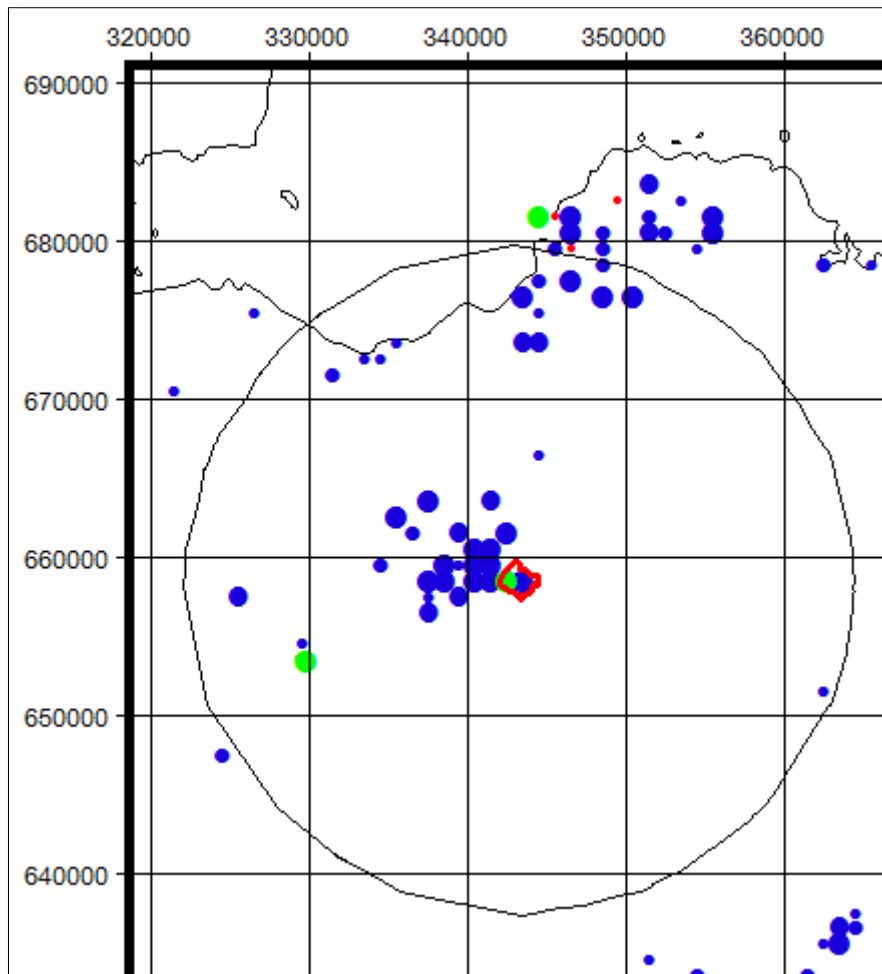


Figure 68. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Fala Flow SPA. For key see page 35.

The most recent IGC counts from Fala Flow have been variable although counts of over 2,000 are frequent (9,000 counted in October 2009). The feeding areas remain similar to those shown in Figure 67.

23. West Water (UK9004251): Pink-footed Goose

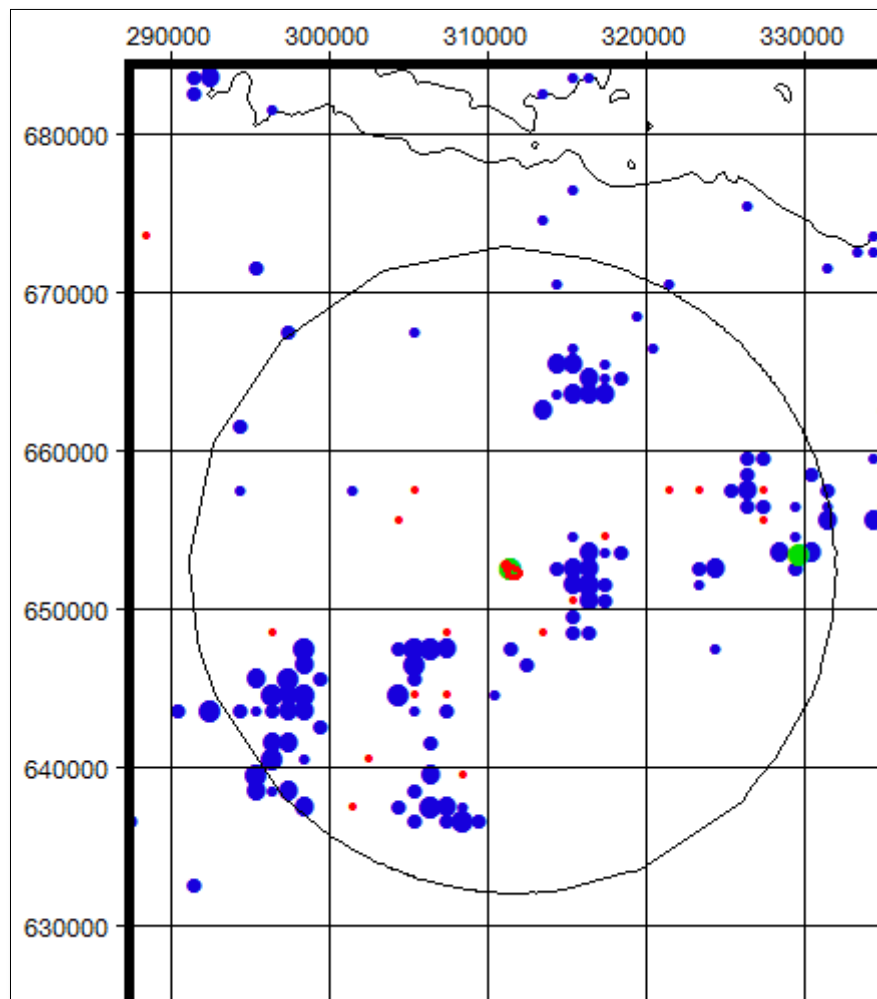


Figure 69. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the West Water SPA. For key see page 35.

Roost locations and feeding distribution

The reservoir has supported roosting Pink-footed Geese since its creation in the mid 1960s and, as of the late 1990s, it became one of the most important sites in the UK. Up to 1980, it held fewer than 7,500 birds, but in December of that year, a count of 18,000 was recorded. Subsequently, counts of over 20,000 have been regular, and 55,000 birds were counted in both October 1995 and 1996. Pink-footed Geese feed in areas to the east at West Linton and to the south west in the Biggar area. See also Brown & Brown (2007) and Brown & Brown (2009).

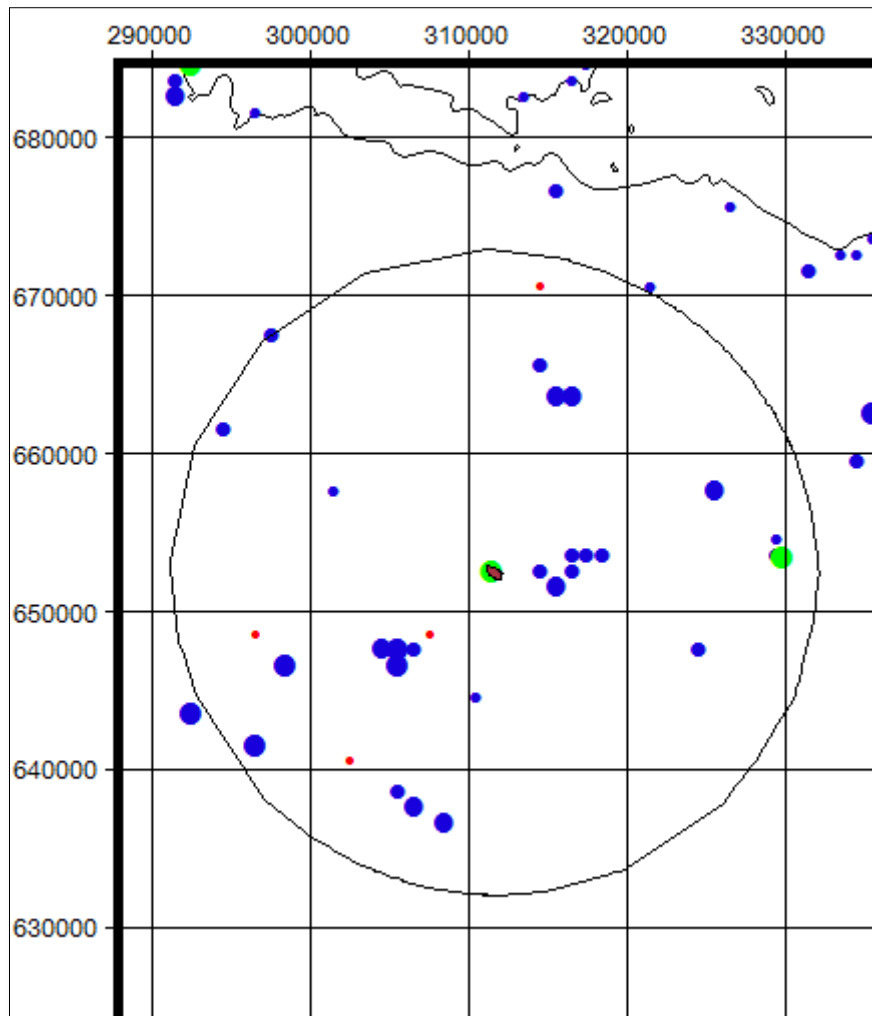


Figure 70. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the West Water SPA. For key see page 35.

Pink-footed Goose IGC counts in the most recent periods have been variable, although often over 10,000 with 47,361 birds being counted in October 2008. Although large numbers continue to roost at the reservoir, there are far fewer feeding records from the most recent period.

24. Greenlaw Moor (UK9004281): Pink-footed Goose

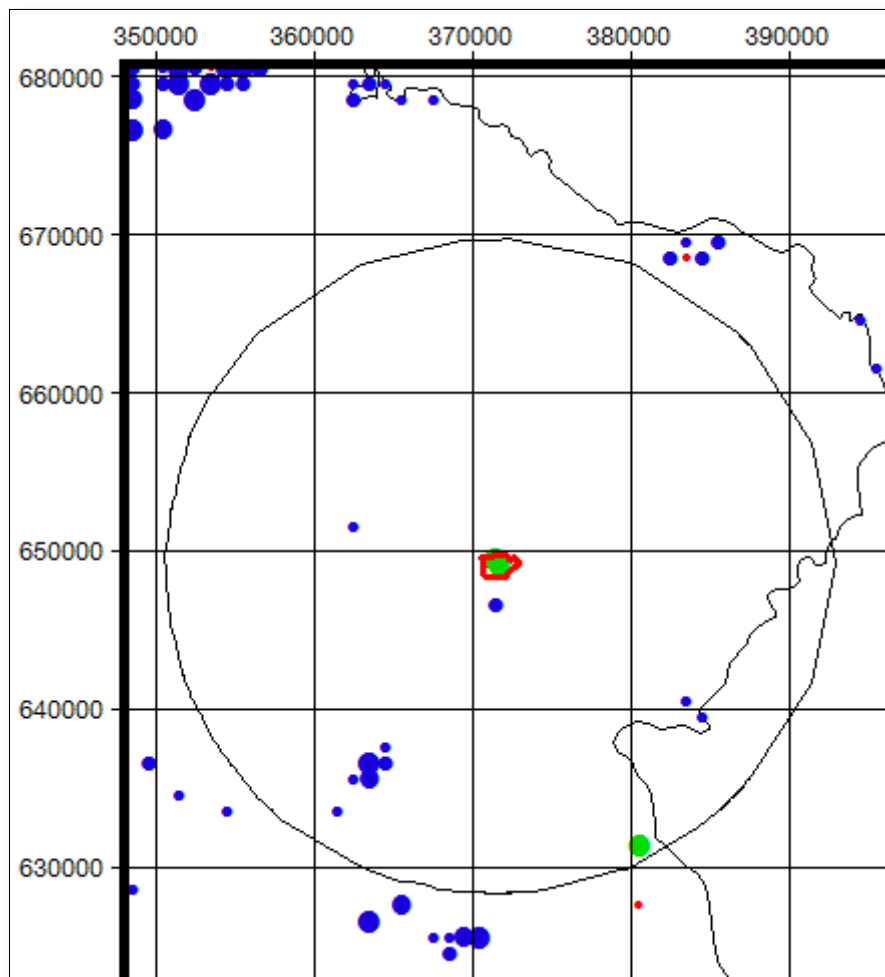


Figure 71. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Greenlaw Moor SPA. For key see page 35.

Roost locations and feeding distribution

Hule Moss (Greenlaw Moor) forms the most important winter roost for Pink-footed Geese in the Tweed Basin, with flocks of up to 5,000 birds recorded regularly between 1960 and 1980. A dramatic increase then took place with a peak of 25,735 counted in October 1989. Pink-footed Geese roosting at Hule Moss were said to feed to the south and south west of the roost, especially around Greenlaw (Mitchell & Hearn 2004) although no details were given. A cluster of records near Smailholm probably refer to Hule Moss geese.

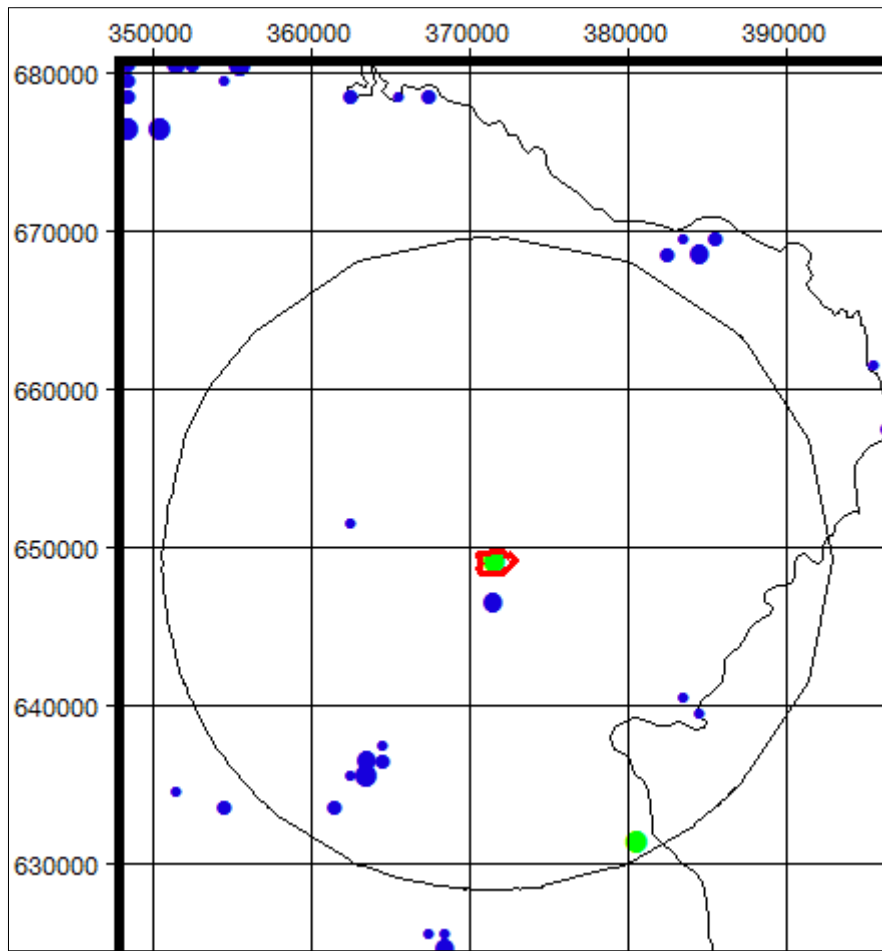


Figure 72. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Greenlaw Moor SPA. For key see page 35.

Counts of between 2,000 and 9,000 birds have been regular at the site in the most recent period. Although large numbers use the loch, there are very few feeding records from the most recent period.

25a. Din Moss – Hoselaw Loch (UK9004291): Greylag Goose

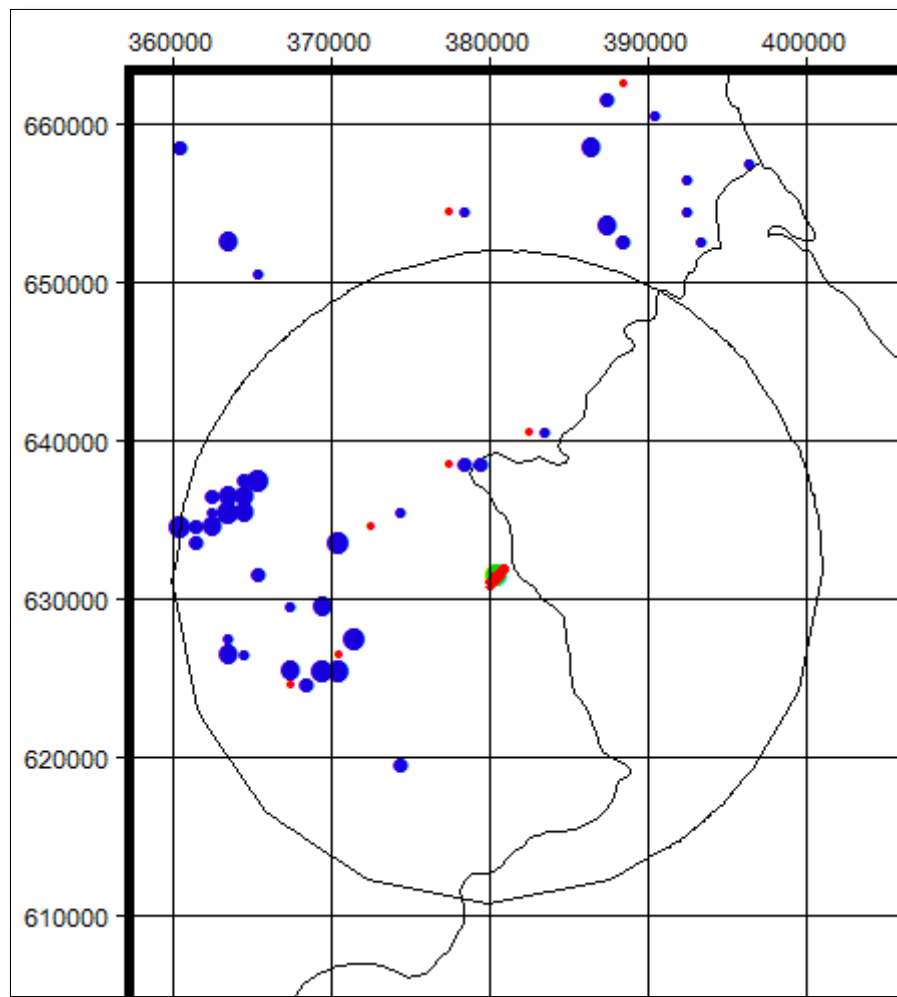


Figure 73. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the Din Moss – Hoselaw Loch SPA. For key see page 35.

Roost locations and feeding distribution

Large numbers of roosting Iceland Greylag Geese used Hoselaw Loch during the 1970s and 1980s (maximum 5,700 in October 1985) but this was followed by a decline in numbers in the 1990s. During the 2000s, very few Greylag Geese roosted at the site (<100, Appendix 3 and Mitchell & Hall 2012), and these may be from the British population. Consequently, the feeding areas of the former flocks were poorly documented. The cluster of records in NT63 may refer to birds roosting at Hule Moss, although it is unknown where the birds feeding to the north east of Jedburgh roost.

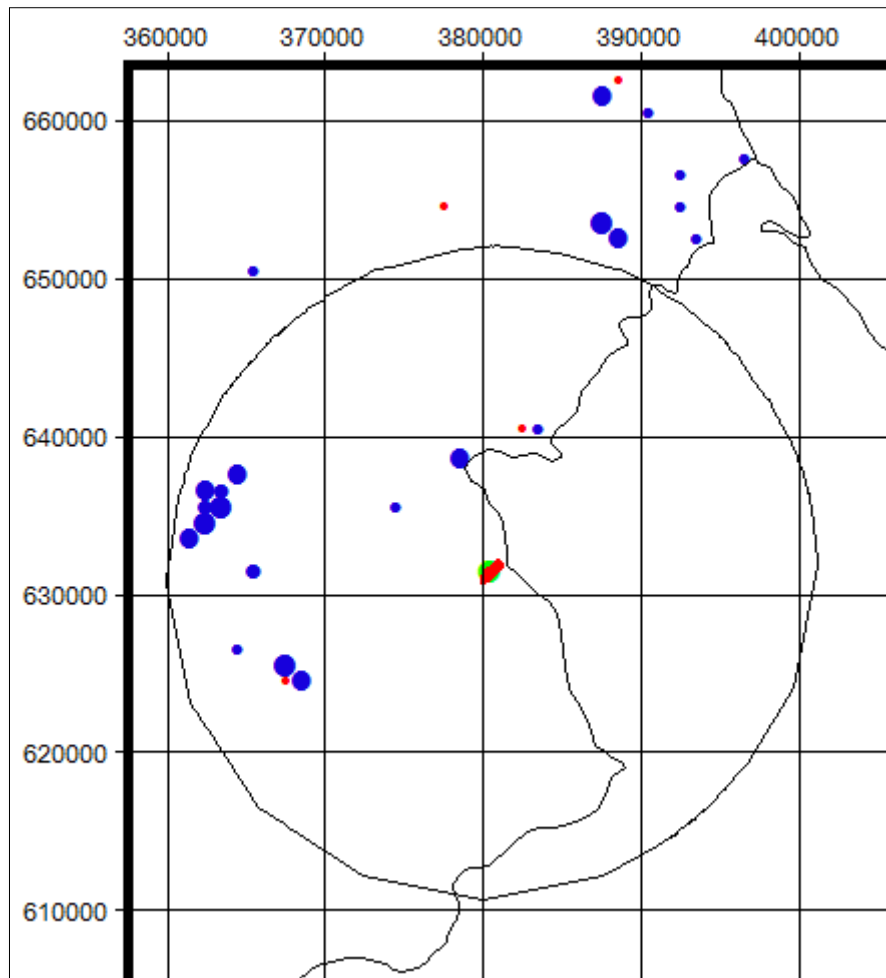


Figure 74. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the Din Moss – Hoselaw Loch SPA. For key see page 35.

Very few Greylag Geese (British or Iceland) were recorded roosting at Hoselaw Loch (<100, Appendix 3 and Mitchell & Hall 2120) in the most recent period and there are very few feeding records.

25b. Din Moss – Hoselaw Loch (UK9004291): Pink-footed Goose

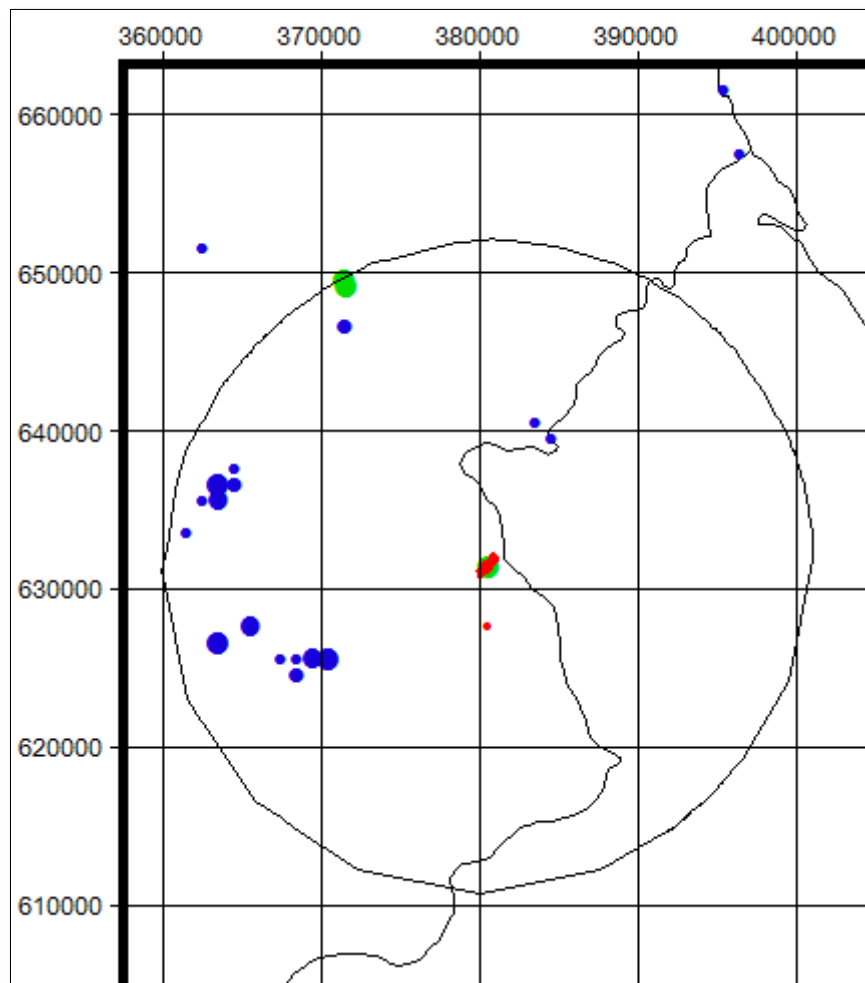


Figure 75. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Din Moss – Hoselaw Loch SPA. For key see page 35.

Roost locations and feeding distribution

Hoselaw Loch has held small numbers of Pink-footed Geese since the early 1980s. Numbers increased to over 3,000 birds (max 12,000 in 1985/86), although they have declined greatly in recent years (Appendix 3 and Mitchell & Hall 2012). Geese were said to feed on farmland up to 6km from the roost in any direction although no details were give (Hearn & Mitchell 2004). Consequently, the feeding areas of the former flocks were poorly documented. The cluster of records in NT62/63 may refer to birds roosting at Hule Moss and others sites.

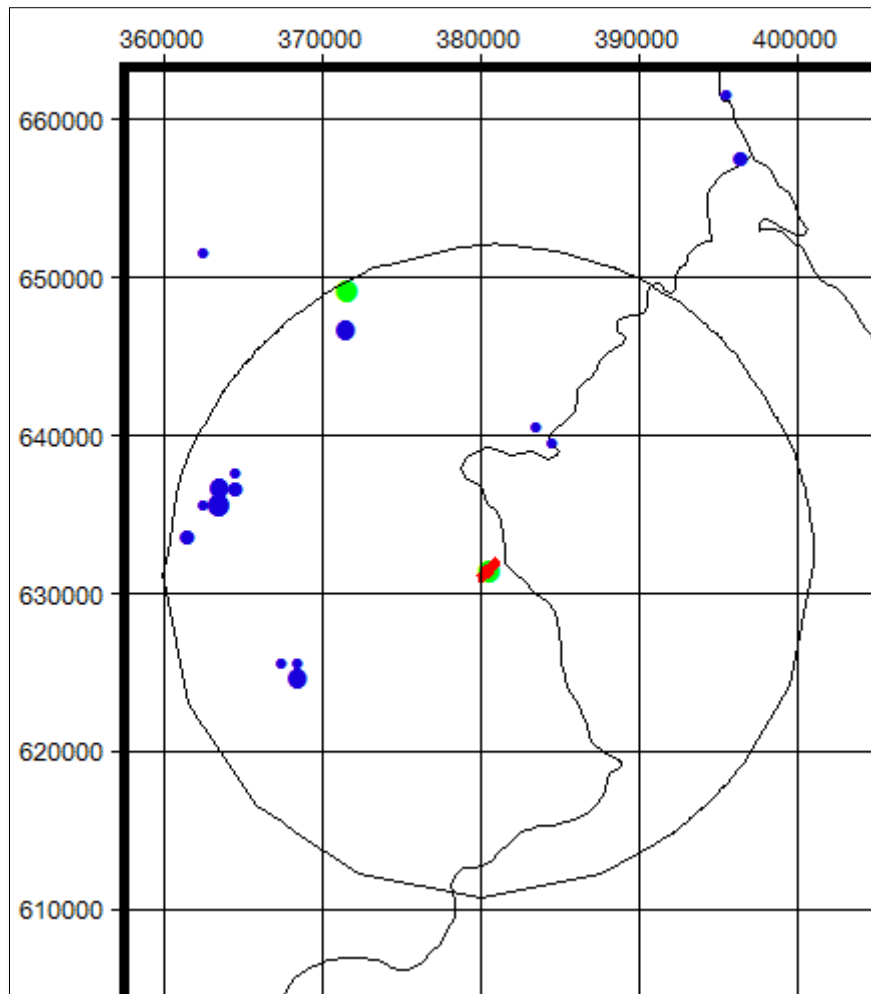


Figure 76. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Din Moss – Hoselaw Loch SPA. For key see page 35.

Very few Pink-footed Geese were recorded roosting at Hoselaw Loch (<100, Appendix 3 and Mitchell & Hall 2012) in the most recent period and there are very few feeding records.

26a. South Tayside Goose Roosts (UK9004401): Greylag Goose

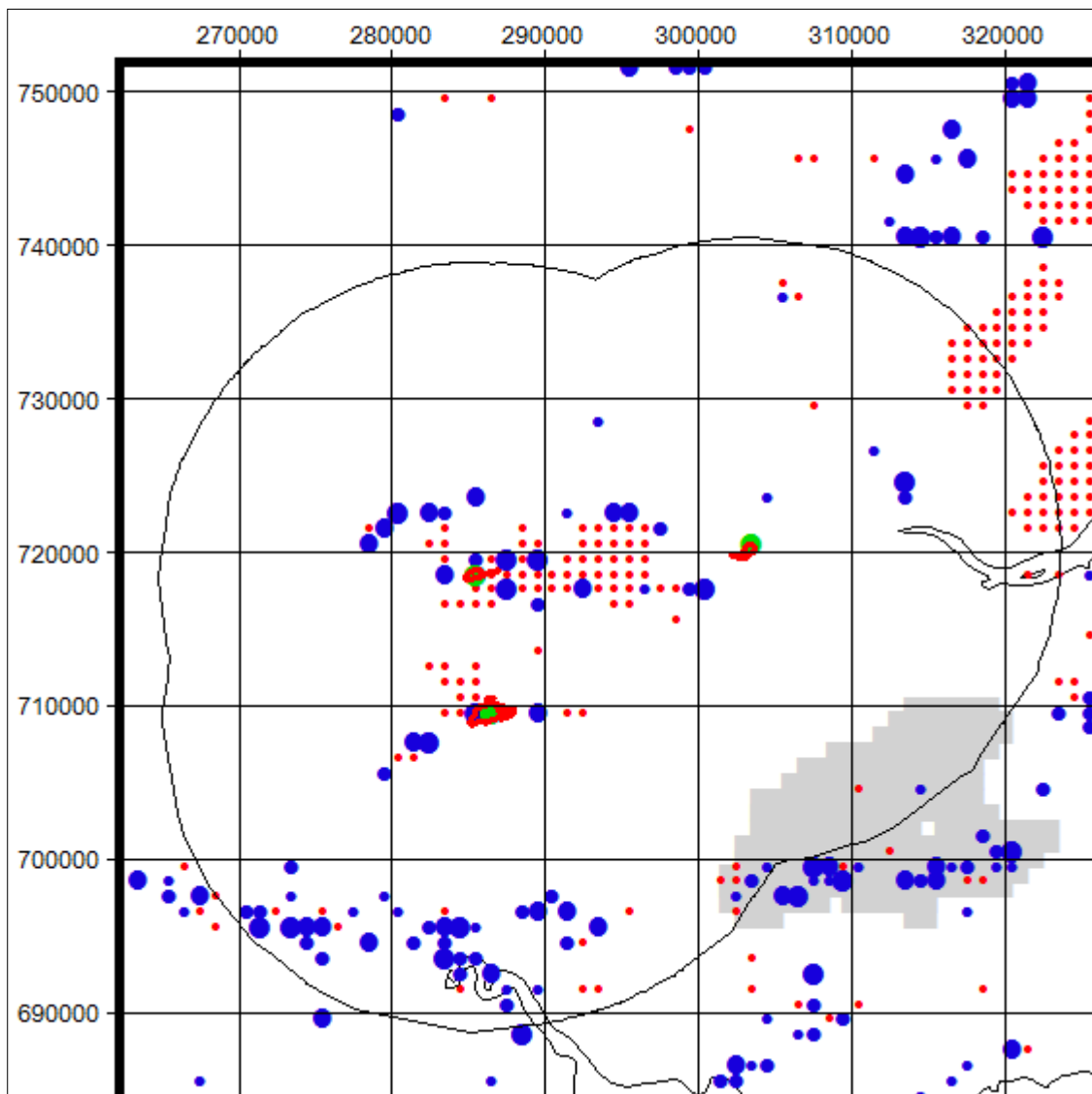


Figure 77. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese in relation to the South Tayside Goose Roosts SPA. For key see page 35.

Roost locations and feeding distribution

Three roost lochs make up the South Tayside Goose Roosts SPA: Dupplin Loch (NO0320), Carsebreck/Rhynd Loch (NN8710) and Drummond Pond (NN8518). During the 1960s and 1970s, Drummond Pond was the largest Greylag Goose roost in Scotland with a peak of 15,000 birds in November 1979, followed by a subsequent decline. Iceland Greylag Geese roosted at Dupplin Lochs from the 1960s to the mid 1980s, where counts of over 1,000 birds were commonplace, however numbers have subsequently declined. Similarly, at Carsebreck/Rhynd Loch, numbers were highest from the 1960s to the late 1980s, where numbers typically ranged from 1,000 to 5,000 birds (maximum of 8,280 in November 1968).

Drummond Pond birds fed along the Earn valley in the patchwork of farmland to the east of the loch as far as Dalroch, and to the north between Crieff and Comrie, whilst birds roosting at Carsebreck/Rhynd Loch tended to feed locally to the north and west.

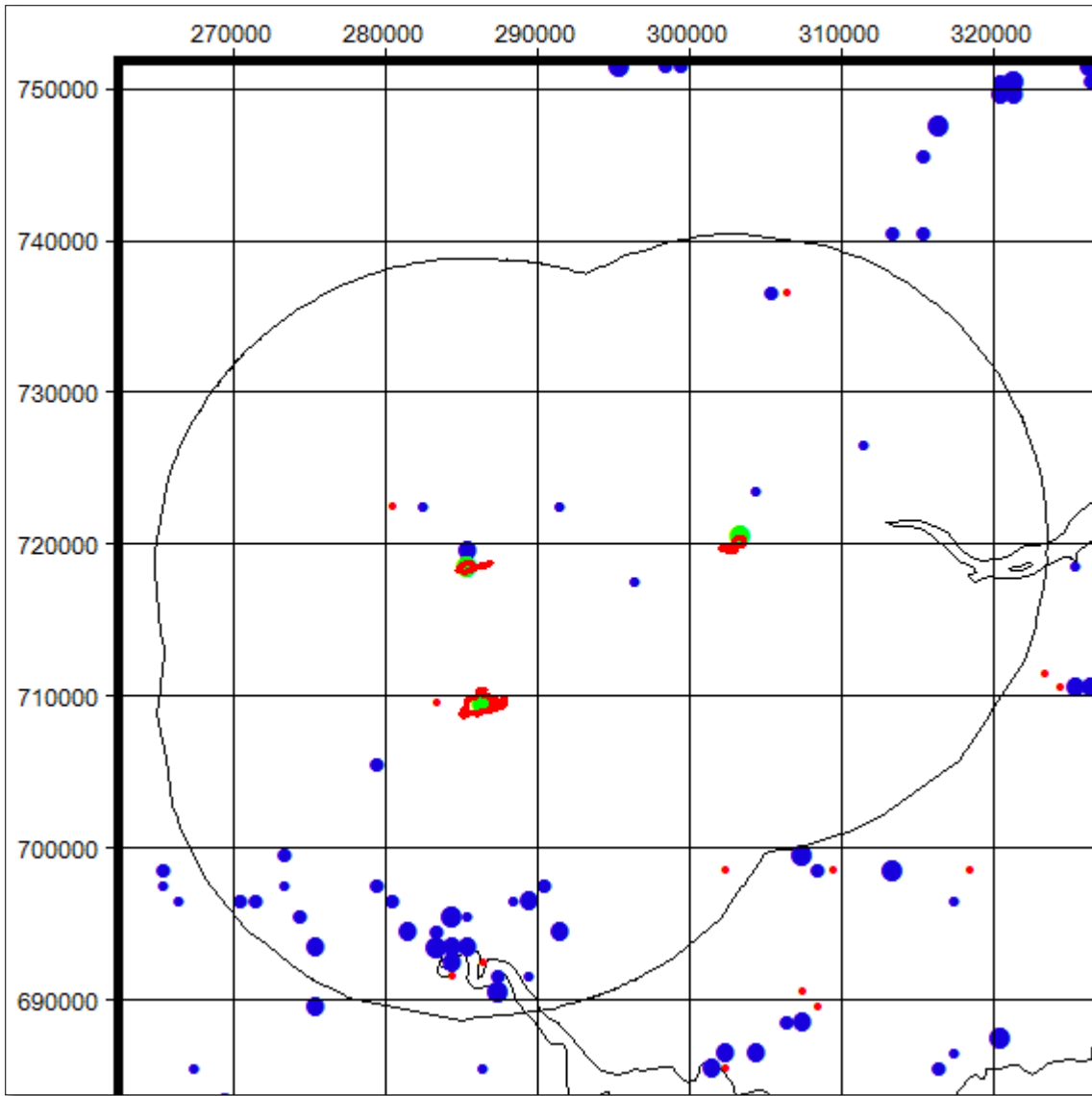


Figure 78. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese in relation to the South Tayside Goose Roosts SPA. For key see page 35.

In the most recent period, very few Iceland Greylag Geese have roosted at any of the three sites – part of the near abandonment of east central Scotland by the Iceland migrants – and as a consequence there are virtually no feeding records. Several hundred Greylag Geese roost at Carsebreck/Rhynd Loch, although some/all of these may be from the British population.

26b. South Tayside Goose Roosts (UK9004401): Pink-footed Goose

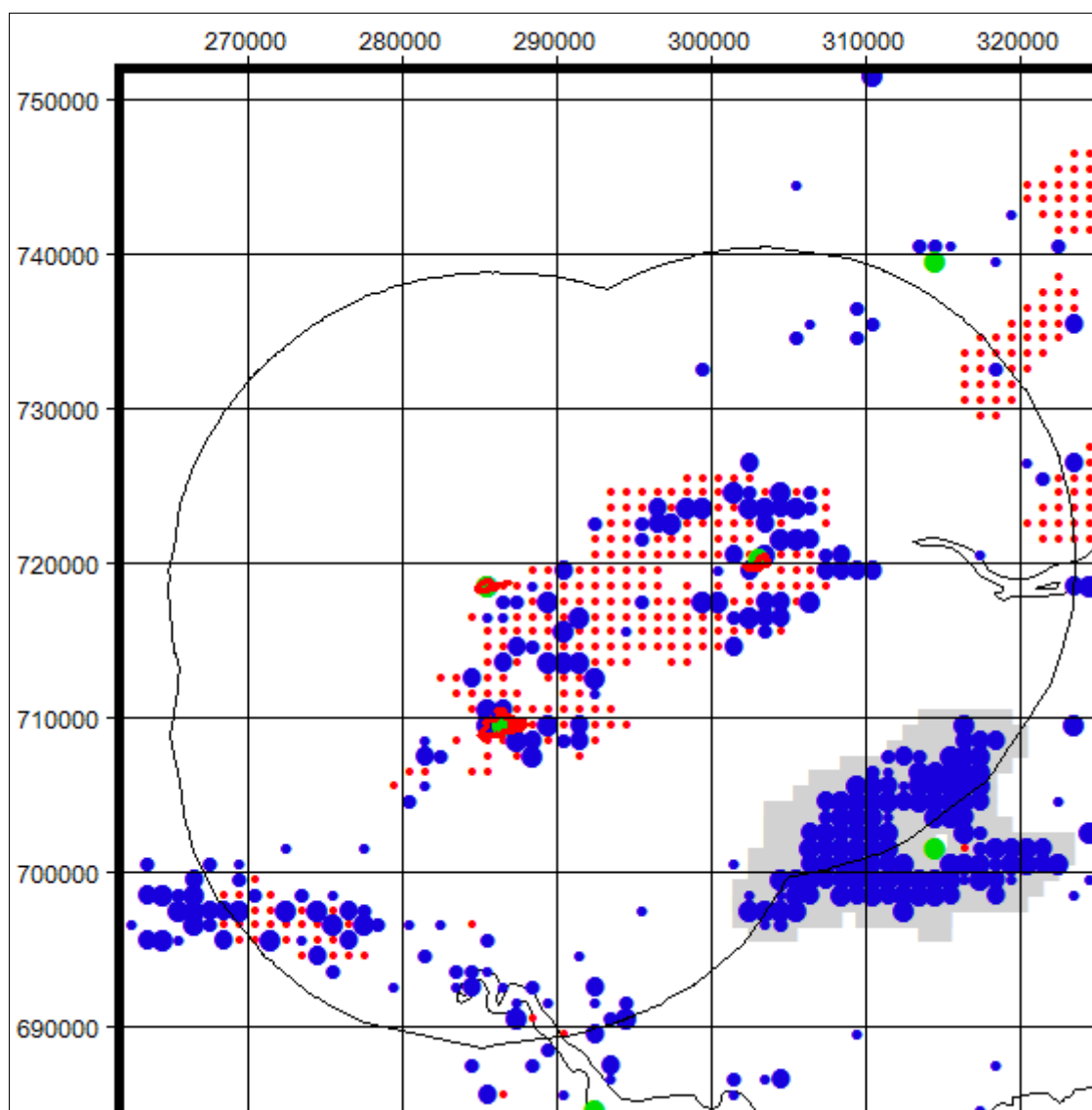


Figure 79. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the South Tayside Goose Roosts SPA. For key see page 35.

Roost locations and feeding distribution

Three roost lochs make up the South Tayside Goose Roosts SPA: Dupplin Loch (NO0320), Carsebreck/Rhynd Loch (NN8710) and Drummond Pond (NN8518). Dupplin Loch was an important roost from the 1960s and this continued well into the 1990s with 62,000 birds being counted in October 1994, however numbers have declined since that time. Numbers at Carsebreck/Rhynd Loch were generally fewer than 7,000 birds up to 1987/88, after which numbers increased, with a peak of 18,500 in October 1998. Drummond Pond was the main Greylag Goose roosting site in the UK in the 1960s and 1970s (see above) and flocks of Pink-footed Geese were first noted there in December 1988. Numbers increased to a peak of 7,000 birds in 1996/97, but has subsequently declined.

The main feeding areas for the Dupplin flocks are in the Earn Valley to the south, Pow Water valley to the north. At times the geese flight south towards Glenfarg, north into Glenalmond. From Carsebreck/Rhynd Loch, birds flight to Strathallan, from Gleneagles to Dunblane, north east into Strathearn and south west into the Forth valley. Birds from Drummond Pond tended to feed on farmland a few kilometres to the south and east.

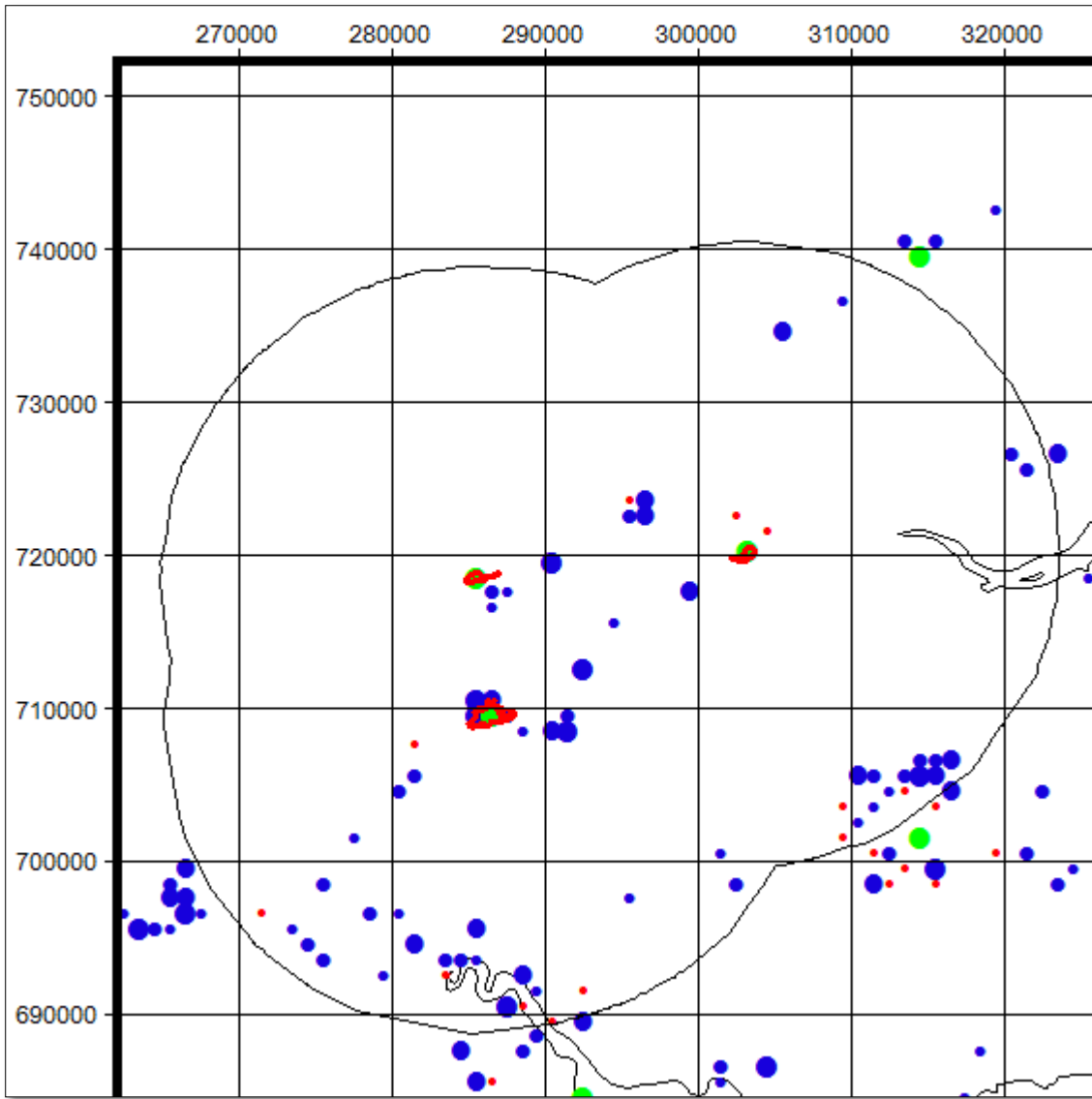


Figure 80. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the South Tayside Goose Roosts SPA. For key see page 35.

Very few Pink-footed Geese now roost at Drummond Pond (although 630 were counted there in November 2009). The decline in numbers of Pink-footed Geese at Dupplin Loch has been dramatic with very few (often nil) roosting there between 2003 and 2009. However, in the most recent winters, numbers have been variable with 18,500 counted there in November 2009. However, numbers at Carsebreck/Rhynd Loch have remained high, often over 10,000 birds. Counts of between 2,000 and 9,000 birds have been regular at the site in the most recent period. Although large numbers still use Strathearn, there are very few feeding records from the most recent period. This area is another example of the feeding distribution of geese in recent years being under represented by a lack of records.

27. Firth of Forth (UK9004411): Pink-footed Goose

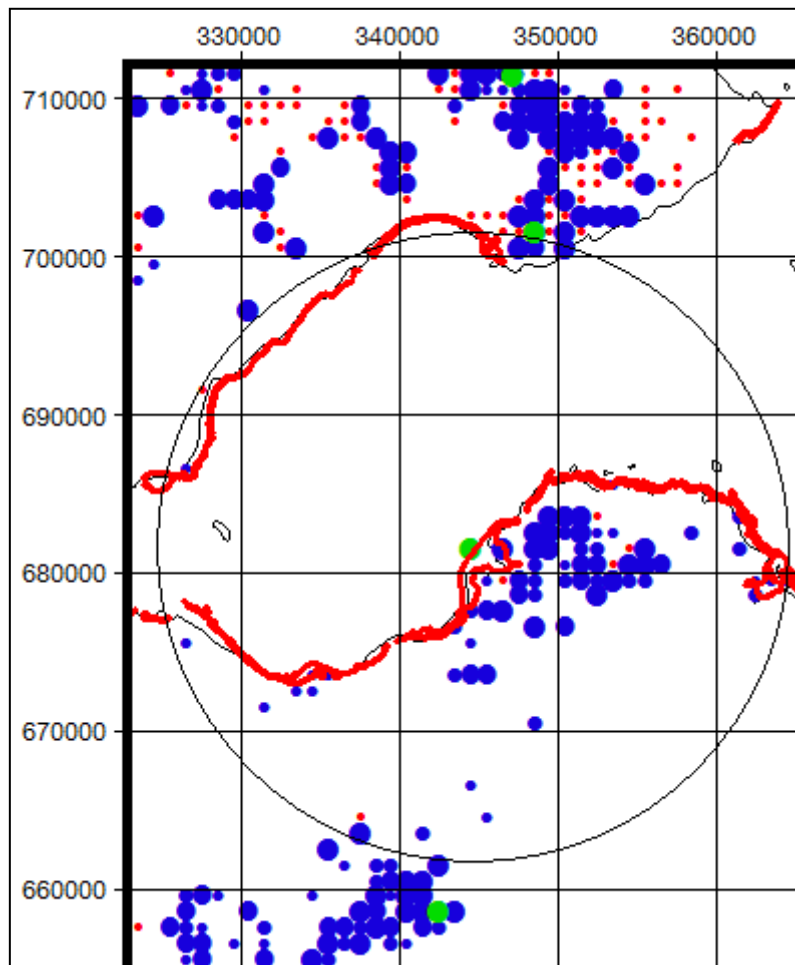


Figure 81. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Firth of Forth (Aberlady Bay roost) SPA. For key see page 35.

Roost locations and feeding distribution

[Rather than show a 20km line around the whole SPA, two feeding distribution areas are shown; one around Aberlady Bay and one around Skinflats].

Aberlady Bay is one of three important Pink-footed Goose roosts on the Firth of Forth (Appendix 3). The bay regularly supported over 1,000 birds during the 1960s, and has increased in importance since then. Roosting flocks often surpass 10,000 birds and occasionally 20,000. The feeding areas are generally to the south and east in the rolling farmland south of Gullane and usually within 10km of the estuary. The area from Spittal to Drem and Dirleton is often used, but occasionally further beyond North Berwick towards Haddington and East Linton. There are regular records of daily movements across the outer Firth of Forth and some Pink-footed Geese roosting at Aberlady Bay feed in south Fife (pers. obs. and G.Brown pers. comm.). See also Brown & Brown (2009).

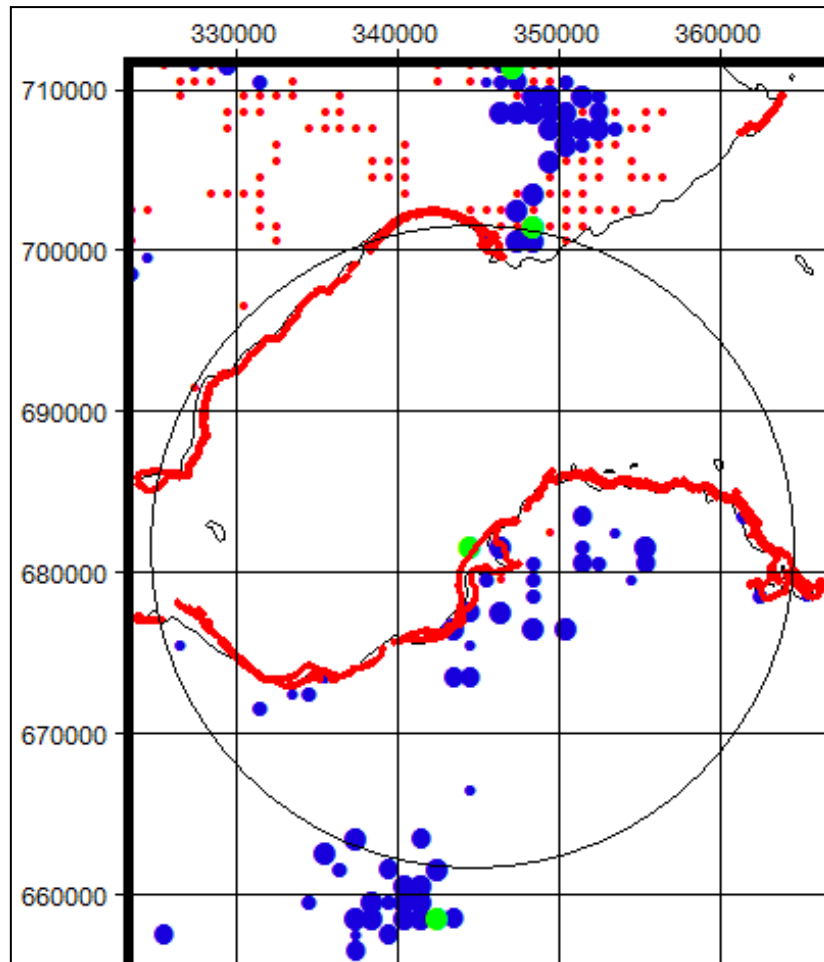


Figure 82. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Firth of Forth (Aberlady Bay roost) SPA. For key see page 35.

The number of Pink-footed Geese roosting at Aberlady Bay has been variable in the most recent period, but often over 10,000 birds have been counted and a peak of 32,244 was counted in October 2008. There are fewer feeding records from the recent period but the distribution is thought to remain similar to previous years.

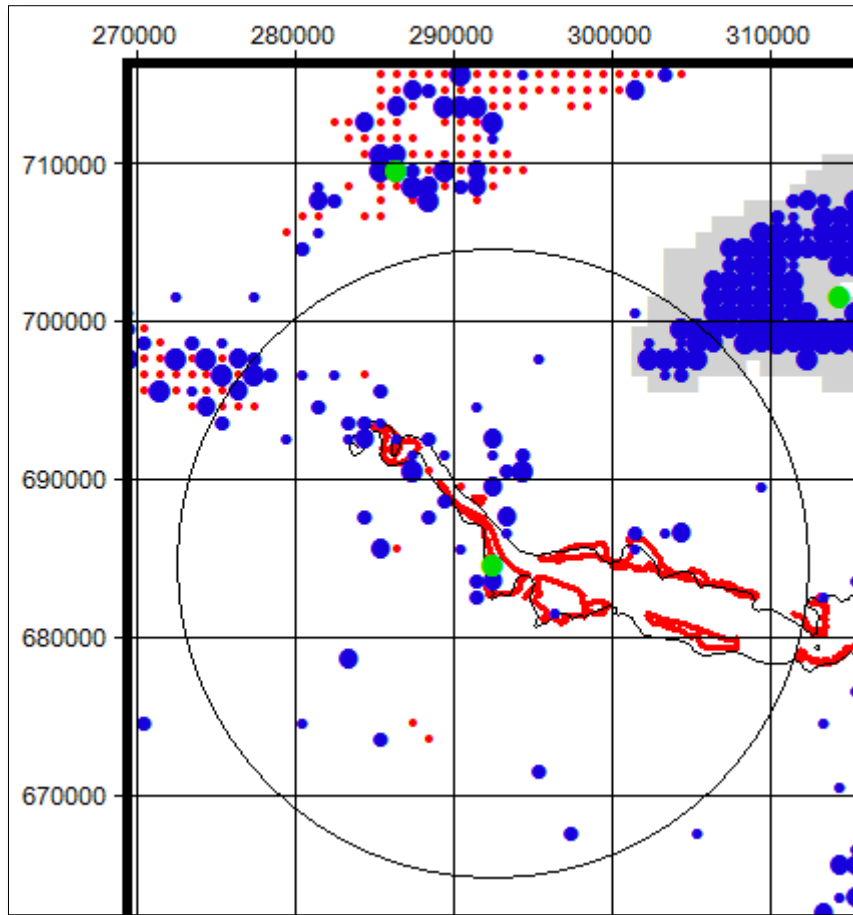


Figure 83. Feeding distribution (1986/87 to 2011/12 – all records) of Pink-footed Geese in relation to the Firth of Forth (Skinflats roost) SPA. For key see page 35.

[Rather than show a 20km line around the whole SPA, two feeding distribution areas are shown; one around Aberlady Bay and one around Skinflats].

The number of wildfowl (including Pink-footed Geese) declined at Skinflats during the 1970s, probably because of excessive wildfowling, and remained low throughout the 1980s. From 1990, however, the number of geese increased and the area regularly supported over 2,000 roosting birds. Feeding was concentrated near the estuary at Skinflats, around Clackmannan and upstream, west towards Stirling.

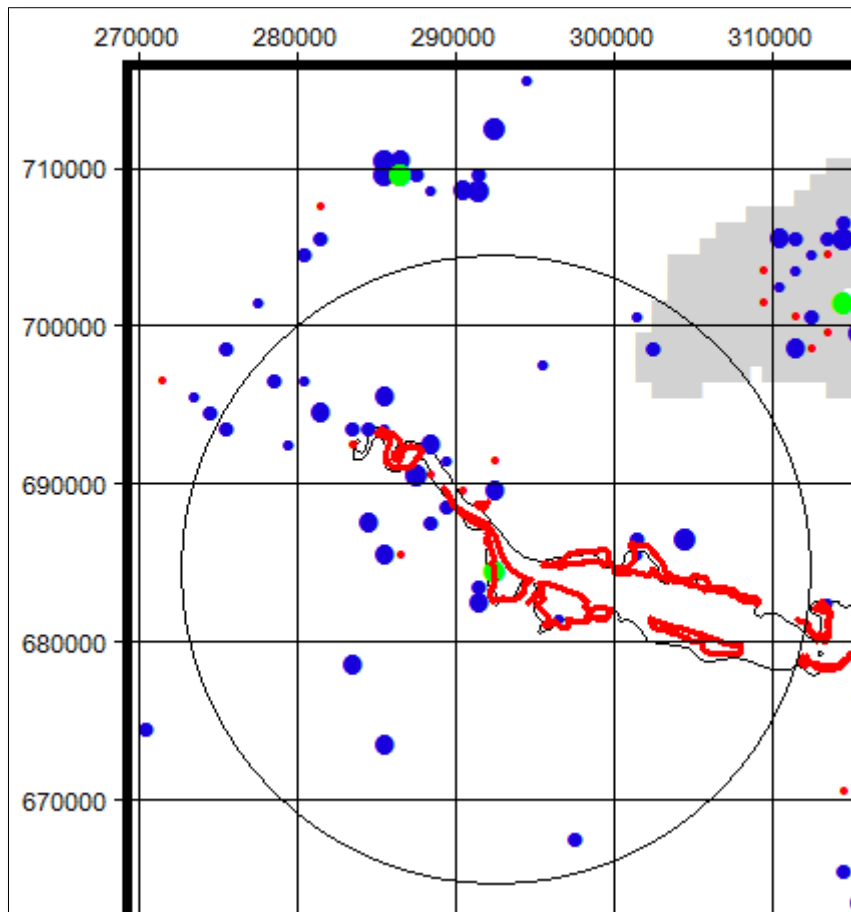


Figure 84. Feeding distribution (2007/08 to 2011/12 – new records) of Pink-footed Geese in relation to the Firth of Forth (Skinflats) SPA. For key see page 35.

The number of Pink-footed Geese counted at Skinflats in the most recent periods has been variable with up to a few thousands in the autumn (maximum 4,463 in November 2008). Despite there being fewer records, the feeding areas are thought to be similar to previous years. This area is another example of the feeding distribution of geese in recent years being under represented by a lack of records.

28. Orkney: Greylag Geese

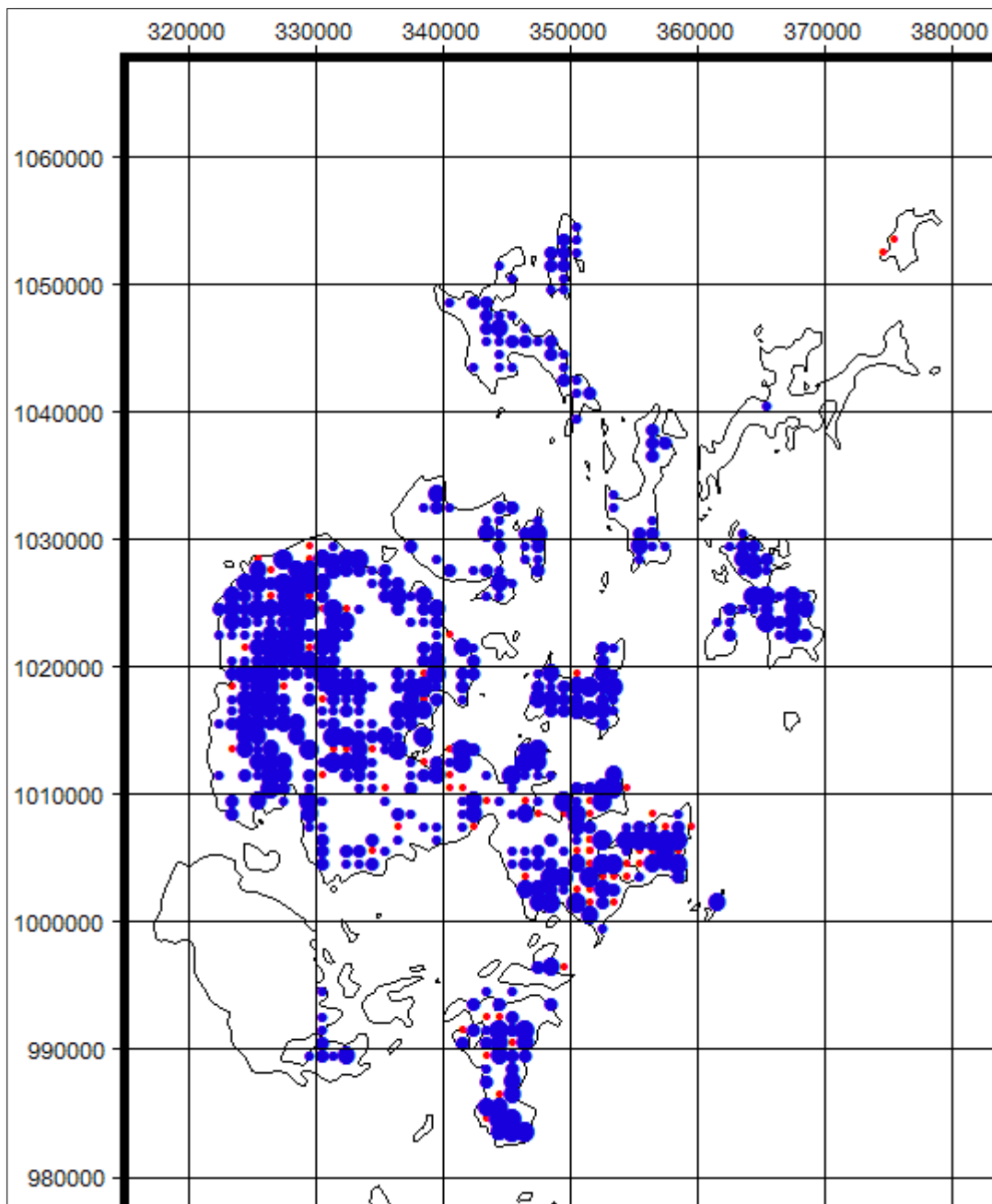


Figure 85. Feeding distribution (1986/87 to 2011/12 – all records) of Greylag Geese on Orkney. For key see page 35.

Roost locations and feeding distribution

[Although there are no SPAs designated on Orkney for either Iceland Greylag or Pink-footed Goose, c.60 to 70% of the Iceland Greylag Goose population now winters there].

In the early part of the 20th century, the Greylag Goose had never been recorded as more than a casual visitor on migration on Orkney (Berry 1939). As recently as the early 1980s, Greylag Geese were still considered as a common passage migrant but only a localised winter resident, occurring in small numbers. During the 1990s, however, the number of wintering birds increased dramatically and more than 20,000 were present in autumn 1999 (Hearn & Mitchell 2004). Large open waterbodies on Orkney provide roosts for Iceland Greylag Geese (e.g. Loch of Swannay, Loch of Hundland, Loch of Boardhouse, Loch

of Harray, Loch of Stenness etc) as well as sheltered coastal bays (e.g. Deer Sound, Widewall Bay etc). Feeding occurs on virtually every island in the archipelago, primarily on grass.

Note however, that both Iceland Greylag Geese (estimated at $\approx 60,000$ birds in the late 2000s) and British Greylag Geese (estimated at $\approx 10,000$ birds) occur on Orkney and, at the time of counting (November and December), it is not possible to distinguish between the two. Thus the feeding distribution maps show the feeding distribution of both populations.

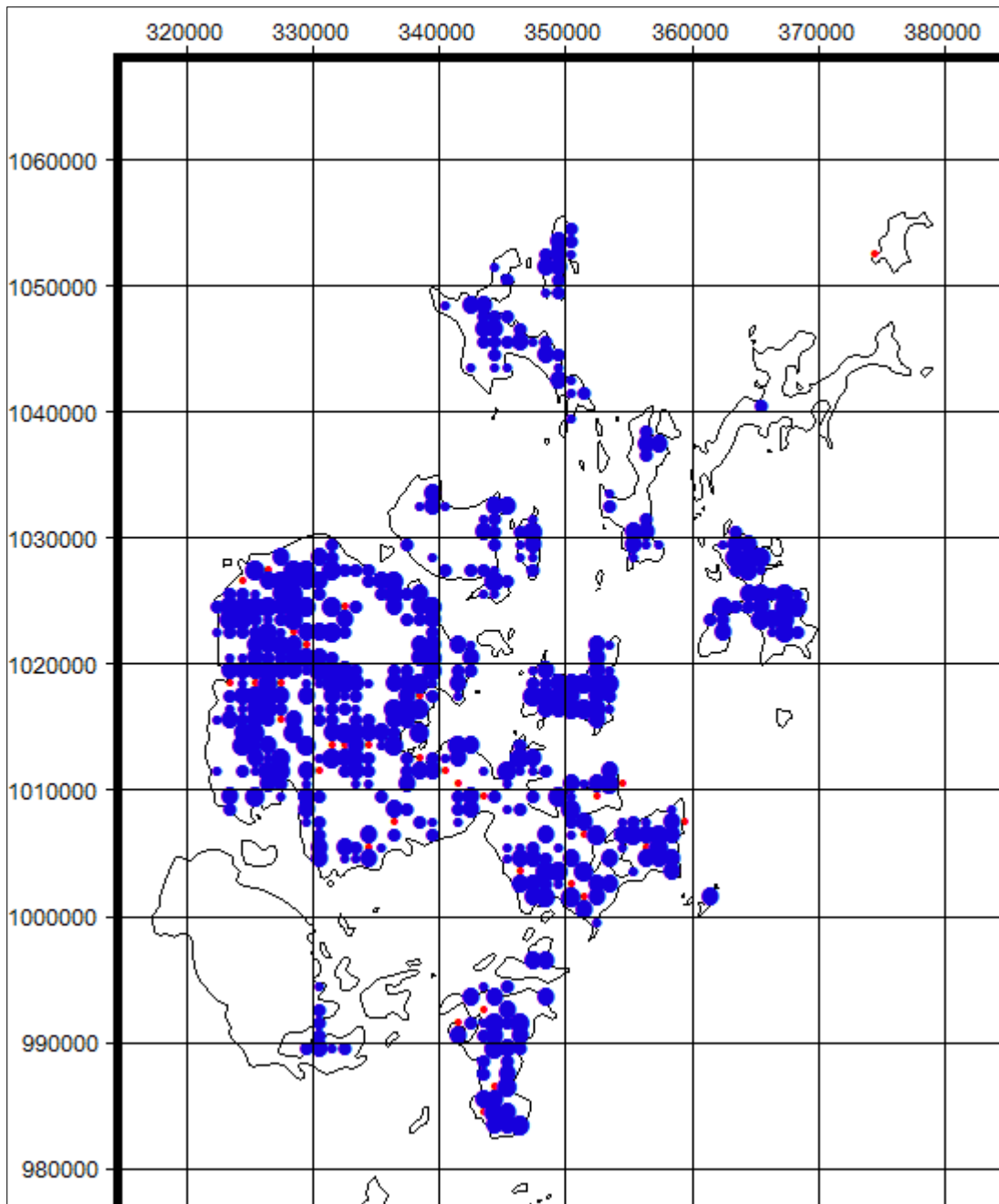


Figure 86. Feeding distribution (2007/08 to 2011/12 – new records) of Greylag Geese on Orkney. For key see page 35.

The most recent estimates suggest that ≈ 60 to 70% of the Iceland population now winter on Orkney and there has been near abandonment of former wintering areas in southern Scotland, east central Scotland and north east Scotland. The recent dramatic rise in numbers on Orkney has led to Greylag Geese feeding on grass on all the islands with human occupation (and associated farming), but especially East and West Mainland, South Ronaldsay, Stronsay, Shapinsay and Sanday.