
Review of the potential impacts of offshore
wind farms on migrating and overwintering
swans and geese in the SEA 5 area

CORK ♦ ECOLOGY

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Non-technical Summary

Introduction

A review of the coastal distribution and abundance of swans and geese in the SEA 5 area, including migration routes, key feeding areas and roosting areas was carried out by Cork Ecology at the request of the Department of Trade and Industry as part of the SEA 5 process. A review of the potential impacts of offshore wind farms on swans and geese was also conducted

The study area was defined as the east coast of Scotland from the English border north to John O' Groats, including Orkney and Shetland, and the offshore waters in the SEA 5 area. The review considered nine species: mute swan, Bewick's swan, whooper swan, bean goose, pink-footed goose, white-fronted goose, greylag goose, barnacle goose and brent goose.

Methodology

Counts and figures for the SEA 5 area from the Wetland Bird Survey (WeBS) Annual reports from 1991/92 to 2000/01 and relevant bird reports were included in this review. In general data from 1991 onward were considered with the aim of presenting the most recent estimates for the important sites.

Sites that regularly hold more than 1 % of the national population of a species are deemed to be nationally important, and sites with more than 1 % of the biogeographic population are internationally important.

Potential impacts of offshore wind farms on swans and geese

Offshore wind farms may impact birds directly by mortality from collisions or indirectly by displacement from migratory flyways or local flight paths. At present there are very little data on the effects of offshore wind farms on swans and geese.

Whooper swan, pink-footed goose, European white-fronted goose, barnacle goose and brent goose have been highlighted as potentially sensitive species to wind farms and these species are likely to be focal species for environmental assessment.

Key areas and species

Of the nine species reviewed, five species, whooper swan, mute swan, pink-footed goose, greylag goose and barnacle goose occur in internationally important numbers at coastal sites in the SEA5 area. Greenland white-fronted goose occur in nationally important numbers.

Orkney

The Loch of Harray holds internationally important concentrations of mute swan between October and December. Greylag geese winter throughout Orkney in internationally important numbers, and barnacle geese from Greenland winter on Switha and in the South Walls area.

Caithness

The Caithness Lochs SPA is internationally important in winter for greylag geese from Iceland and nationally important for whooper swans and Greenland white-fronted geese. The Loch of Wester, Loch Heilen and Loch Calder make up the SPA.

Moray Firth

Several sites in the Moray Firth area hold internationally significant numbers of swans and geese in winter. The Inner Moray Firth holds internationally important numbers of mute swans between October and December. The Dornoch Firth and Loch Fleet are internationally important for greylag geese while both greylag and pink footed geese occur in internationally important numbers in Findhorn Bay, Loch Eye and the Cromarty Firth.

Wintering whooper swans occur in nationally important numbers in the Dornoch Firth, Loch Eye and the Cromarty Firth.

Aberdeenshire coast

The Loch of Strathbeg is internationally important for whooper swans, pink-footed geese and barnacle geese from the Svalbard breeding population in autumn and winter. The area around the Ythan Estuary and Meikle Loch also holds internationally important numbers of pink-footed geese. Several inland sites hold significant numbers of swans and geese in winter.

Angus coast

The Montrose Basin is nationally important for moulting mute swans, with numbers peaking between July and September. Pink-footed geese also occur here in internationally important numbers, particularly in October and November.

Tay & Eden Estuaries

The Tay Estuary is internationally important in winter for pink-footed and greylag geese, while the Eden Estuary supports internationally important numbers of greylag geese.

Firth of Forth

Pink-footed geese roost in internationally important numbers at Aberlady Bay, with peak numbers occurring in October and November. The Firth of Forth also holds nationally important numbers of whooper swans in winter.

Lothian/Berwickshire coast

The Tweed Estuary holds internationally important numbers of moulting mute swans between July and September. Whooper swans occur in nationally important numbers at Tynninghame Estuary in winter.

[Conclusions](#)

Offshore wind farm developments should not be considered where potential adverse effects on designated sites for nature conservation may occur. Several coastal sites within the SEA 5 Area have been designated as SPAs for swans and geese on passage and in winter, including Caithness Lochs, the Moray Firth, Loch of Strathbeg, Montrose Basin, Tay and Eden Estuaries, and the Firth of Forth.

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1. Introduction

Strategic Environmental Assessment (SEA) is a process of appraisal through which environmental protection and sustainable development may be considered, and factored into national and local decisions regarding government (and other) policies, plans and programmes.

The UK Department of Trade and Industry (DTI) is the principal regulator of the offshore oil and gas industry in the UK and has taken a proactive stance on the use of SEA as a means of striking a balance between promoting economic development of the UK's offshore oil and gas resources and effective environmental protection.

A review of the potential impacts of offshore wind farms on swans and geese migrating and overwintering in the SEA 5 area was carried out by Cork Ecology at the request of the Department of Trade and Industry as part of the production of the SEA 5 Consultation Document.

The objectives of this study were:

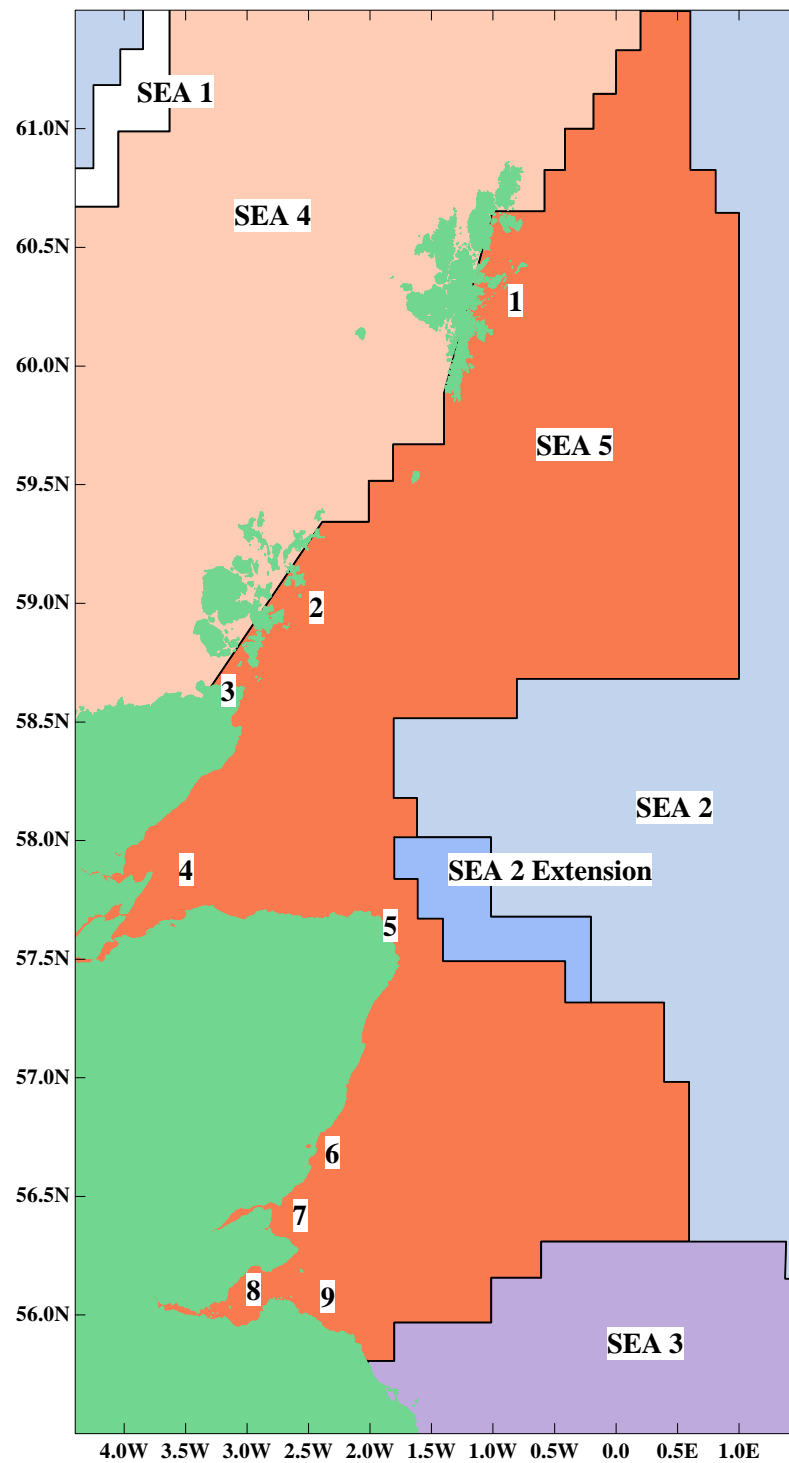
- To conduct a generic review of the potential impacts of offshore wind farms on swans and geese.
- To review the existing knowledge of the distribution and abundance of swans and geese in the SEA 5 area, including information on migration routes and key feeding and roosting areas.

1.1 Background to the SEA process

In 1999 the DTI began a sequence of sectoral SEAs considering the implications of further licensing of the UK continental shelf (UKCS) for oil and gas exploration and production. The SEAs were in line with the UK's "Greening Government" initiative, which included implementing Directive 2001/42/EC (the SEA Directive). Now the SEA process is also considering the implications of renewable energy developments such as wind farms.

SEA 5 is addressing the UKCS east of Orkney and Shetland and the east coast of Scotland, adjacent to SEA areas 2, 3 and 4 (Figure 1).

Figure 1. SEA 5 area, adjacent SEA areas and key areas for swans and geese mentioned in the text



Site Key

- | | | | |
|---|-------------------|---|----------------------------|
| 1 | Shetland | 6 | Montrose Basin |
| 2 | Orkney | 7 | Firth of Tay/Eden Estuary |
| 3 | Caithness Lochs | 8 | Firth of Forth |
| 4 | Moray Firth | 9 | Lothian/Berwickshire coast |
| 5 | Loch of Strathbeg | | |

1.2 Background to swans and geese in the SEA 5 area

Potential impacts of offshore wind farms

Offshore wind farms may have several potential impacts on bird species. There may be direct impacts such as mortality resulting from collisions, or indirect impacts such as the displacement of migratory flyways or local flight paths (Crockford 1992). Increased collision rates may occur during bad weather conditions when visibility is reduced or at night, (Soker *et al* 2000) especially if the turbines have navigational lights which may attract birds to the wind farm (Hiscock *et al* 2002).

Effects will vary between species, season and the location of the wind farm (Langston & Pullan 2002).

Potential impacts of offshore wind farms on migrating and overwintering swans and geese are discussed here.

Numbers, movements and distribution of swans and geese within the SEA 5 area

Apart from the resident mute swan, swans and geese are primarily winter visitors to Britain, arriving in autumn and spending the winter feeding on agricultural land or saltmarshes.

Several of these species that overwinter in Britain may pass through the SEA 5 area on migration to and from their breeding grounds in spring and autumn. Many parts of Scotland are important wintering areas for these species (e.g. Thom 1986).

This review collates existing sources of information, to provide a current picture of the numbers, movements and distribution of swans and geese within the SEA 5 area.

2. Potential impacts of offshore wind farms on swans and geese

The available evidence suggests that appropriately positioned wind farms do not pose a significant hazard for birds (RSPB 2004). However, developments must be sited, designed and managed carefully to ensure that problems do not arise.

2.1 Potential impacts

In general, the main potential hazards to birds from offshore wind farms are:

- Mortality following collision with turbines
- Loss of habitat - birds traditionally using an area may be disturbed and may move elsewhere
- Turbines may be a barrier between feeding and/or roosting areas and migration routes

These and other potential impacts may arise during specific phases of the development of an offshore windfarm. These are: (Hiscock *et al* 2002)

- Pre-installation exploration
- Construction, including cable installation
- Operation
- Maintenance
- De-commissioning

All of these phases may have impacts on bird species in the surrounding area. For this report, only those activities likely to impact on swans and geese are considered.

2.1.1 Pre-installation exploration

Prior to any construction and cable laying, potential sites would require further study to obtain detailed information concerning depth contours, sediment types and suitability for the proposed foundation techniques (Hiscock *et al* 2002). Potential impacts arising from these activities are not thought likely to affect swans and geese.

2.1.2 Construction

The construction period would involve increased vessel activity in a development area, transporting materials to the site and carrying out installation of the foundations and turbines. In addition, cable installation between turbines and to the shore would also be carried out. Potential impacts on bird populations in the area are listed below: (Hiscock *et al* 2002)

- Disturbance to bird feeding sites in the vicinity of construction site from noise, physical presence etc

- Disturbance to migration routes
- Indirect effects from changes to food sources

2.1.3 Cable Installation

Cables between offshore turbines and an onshore electricity substation would be laid during the construction period. It is likely that cables would be buried for protection and to reduce the possibility of being caught in fishing gear (Metoc 2000).

Typical cable laying operations for an offshore windfarm would involve the cutting of a trench for the cable using a water jet or plough. The cable would then be laid approximately 1 metre below the seabed surface. Offshore cable laying operations would be likely to disturb a strip of seabed on both sides of the trench and cause re-suspension of seabed material in the water column.

The installation of under-sea cables could potentially cause the following impacts:

- Disturbance to bird feeding sites in the vicinity of cable laying route
- Indirect effects from changes to food sources
- Disturbance to onshore roosting & feeding sites where the cable comes ashore

Potential impacts on swans and geese arising from the construction phase of an offshore wind farm would be temporary and limited. Construction operations likely to cause disturbance should be conducted at times of year when impacts would be minimised. Concentrations of swans and geese are predominantly found in coastal areas during the autumn and winter, although other species would also have to be considered when choosing the most appropriate time of year.

2.1.4 Operation

Once an offshore wind farm is in operation there are several potential impacts on bird populations in the area:

- Collision of birds with turbines, including risks of attracting birds to the turbines, particularly at night if the structures are lit for navigation/aircraft warning purposes
- Potential habitat loss due to presence of turbines
- Disturbance to flight patterns
- Disturbance to bird feeding sites in the vicinity of wind turbines

Collision risk

The presence of an operational windfarm in an area may result in birds colliding with turbines and rotor blades, although most studies suggest that bird mortality from such collisions is not sufficiently great to present a threat to local populations (Galvin 2001).

Whooper swan, pink-footed goose, European white-fronted goose, barnacle goose and brent goose have been highlighted as potentially sensitive species to wind farms (Langstone and Pullan 2002). Mute swans have been recorded as collision victims at an onshore wind farm in the Netherlands (Crockford 1992). Data for collisions at offshore wind farms is minimal (Langstone and Pullan 2002).

Impacts of collisions with turbines are likely to be influenced by several factors:

Height of flight: Swans and geese tend to fly at great height on migration and at lower altitudes on local journeys (Snow & Perrins 1998). Rader studies in the German Bight during spring migration of three species of geese showed that the birds flew at heights of 1,500m to 2,100m (Jellmann 1977). The highest recorded height of whooper swan was a flock flying at 8850 m arriving over Northern Ireland, recorded on a plane's radar and visually identified by the pilot (Ehrlich *et al* 1994). The risk to migrants is principally during take-off and landing, especially in species which gain or lose height gradually e.g. swans (Langstone and Pullan 2002).

Time of day: Conclusions from collision studies at wind farms in the Netherlands, Denmark, Sweden and Britain are that the chance of bird collisions in daylight, with good visibility is negligible (Crockford 1992). However, increased collision rates may occur at night (Soker *et al* 2000), although nocturnal migrants migrate at higher altitudes than diurnal migrants (Evans Ogden 1996). Some species undergo local movements to and from roosting and feeding areas at different times of day and night.

Weather conditions: Increased collision rates may occur during bad weather conditions when visibility is reduced (Soker *et al* 2000). Air pressure, temperature, wind direction and wind speed also influence flight height and direction (OWE 2002).

Turbine size: It is believed that larger turbines reduce collision risk as they are more visible (OWE 2002).

Breeding productivity: Swans and geese are long lived, raising two or three young in a breeding season. The consequences of collisions could therefore be potentially more significant than they would be for short lived species with higher breeding productivity (Langston & Pullan 2002).

Avoidance behaviour: Avoidance behaviour varies between species and the degree of avoidance behaviour may reduce through time, as birds become habituated to the new structures. Studies have shown that migrating swans and geese changed their course at a greater distance from wind farms than other species (Crockford 1992). There is a need for further studies on avoidance behaviour in different species.

Numbers of birds in the area: Bird numbers in an area will vary on a daily and seasonal basis. Migration movements tend to peak in spring and autumn. Migration times vary between species for example greylag goose movements in Britain from Iceland tend to peak in November, whereas the main movement of pink-footed geese occurs in October (Meek 2003).

Distance from shore: Some species such as brent geese follow the coast on migration, therefore an inshore wind farm might have greater impacts on migrating birds. Many species of waterfowl show a preference for shallow water for feeding.

Operating strategies: Short term turbine shutdown in low visibility conditions is an option to avoid excessive bird mortality.

Colour/lighting of turbine: Navigational lights on turbines may attract birds to the wind farm, which may lead to increased collision rates (Hiscock *et al* 2002). Brightly painted turbines may be more visible to birds although this may lead to increased human objection on visual grounds.

Noise/movement of turbines: It is expected that offshore wind farms will produce more noise than onshore models. This may increase disturbance to birds in the area resulting in a reduced number of collisions (OWE 2002).

Habitat Loss and disturbance

The amount of space or “footprint” occupied by each wind turbine is a small fraction of the total area of a wind farm therefore direct habitat loss to birds in the area would be negligible. However, if birds avoid a site completely following construction then the loss of available habitat and disturbance to feeding sites would be considerable.

Disturbance and or displacement arising from onshore wind turbines has been highlighted as a potentially significant impact on whooper swan, pink-footed goose, European white-fronted goose, barnacle goose and brent goose. Observed flight reactions to turbines showed that brent geese reacted 200 – 500m from the turbines, and that flock formation was disrupted (Langstone and Pullan 2002).

Impacts arising from habitat loss and disturbance will also be influenced by several factors:

Habituation: The degree of avoidance shown by birds could change over time as they become habituated to the presence of turbines (Crockford 1992).

Scale & layout of wind farm: Flight patterns of migrating birds may be affected by offshore wind farms, particularly if there are long lines of turbines perpendicular to the general flight direction of birds (Soker *et al* 2000). Rather than fly between turbines, birds may fly around the outside of the cluster. If there are several large scale offshore wind farms in an area, the cumulative effects of this displacement may be considerable (Langston & Pullan 2002). Careful planning of turbine layout may alleviate any such barrier effect.

Feeding areas: Studies have shown that whooper swans, pink-footed geese and white-fronted geese show avoidance behaviour when feeding in the vicinity of onshore wind turbines (Langston & Pullan 2002). However, since most wintering swans and geese feed in estuaries and on farmland, offshore wind farms would not cause such an impact.

2.1.5 Maintenance

Routine maintenance vessel activity from a supporting harbour to an offshore wind farm is unlikely to cause any significant ecological effects on swans and geese provided standard operating procedures for vessels are followed.

2.1.6 De-commissioning

Existing offshore wind farms have a design life of approximately 20 years (Metoc 2000). Decommissioning would involve the removal of the foundations, towers, turbines, blades and associated cabling. These activities would be likely to have similar or reduced impacts on swans and geese to those predicted for the construction phase.

2.2 Beneficial impacts

The UK has a commitment to meet EU targets for renewable energy arising from the Kyoto Agreement by 2010. Offshore wind farms could make an important contribution to these targets.

Wind farms do not emit chemical by-products such as carbon dioxide, nitrogen oxide, acid or radioactive waste and therefore do not have the negative environmental impacts associated with fossil fuel or nuclear power stations (Galvin 2001).

In addition, there may be the following benefits to the local environment:

- In time, seaduck and other species may be attracted to feed on mussels growing on turbine foundations
- Presence of turbine foundations, together with no-fishing zones around turbines may provide shelter for fish species resulting in an increased food source for birds

3. Use of SEA 5 area by migrating and overwintering swans and geese

3.1 Introduction

Study area

Figure 1 shows the SEA 5 area. The study area was defined as the east coast of Scotland from the English border north to John O' Groats and included all of Orkney and Shetland. Although only the east coasts of Orkney and Shetland are part of the SEA 5 area, it was felt that an all island review would be more meaningful.

Species reviewed

Three species of swans and six species of geese were considered in this review, based on previous knowledge of species composition of the SEA 5 area (Table 1). A brief overview of the most important areas for each species group is included along with individual species accounts detailing distribution and abundance, habitat use and a discussion of trends and changes in species distribution.

Table 1. Species of swans and geese included in SEA 5 review

Species	Latin Name
Mute Swan	<i>Cygnus olor</i>
Bewick's Swan	<i>Cygnus columbianus</i>
Whooper Swan	<i>Cygnus cygnus</i>
Bean Goose	<i>Anser fabilis</i>
Pink-footed Goose	<i>Anser brachyrhynchus</i>
White-fronted Goose	<i>Anser albifrons</i>
Greylag Goose	<i>Anser anser</i>
Barnacle Goose	<i>Branta canadensis</i>
Brent Goose	<i>Branta bernicla</i>

3.2 Data sources

Several sources of data were included in this review. The aim was to include as much recent data from the SEA 5 area as possible from a variety of sources to allow as complete a review as possible to be carried out. Data from the following sources was included in this review.

WeBS data

Counts and figures for the SEA 5 area from the Wetland Bird Survey (WeBS) Annual reports from 1991/92 to 2000/01 were included in this review (Cranswick *et al* 1992, Cranswick *et al* 1995, Waters *et al* 1996, Cranswick *et al* 1997, Cranswick *et al* 1999, Pollit *et al* 2000, Musgrove *et al* 2001 & Pollit *et al* 2003).

Bird Reports

Several bird reports were reviewed for relevant counts and records extracted for the SEA 5 area. These included:

- Scottish Bird Reports 1992 – 2000 (SOC 2003)
- North East Scotland Bird Reports 1991 to 2002 (Webb 1992 & 1993, Reeves 1994, 1995, 1997, Phillips & Francis 1999, Thorpe *et al* 2000 & 2002, Baxter 2003)
- Highland Bird Report 2002 (McNee 2003)
- Orkney Bird Report 2001 & 2002 (Williams 2002 & 2003)
- Angus & Dundee Bird Report 2001 & 2002 (Carmichael 2002 & 2003)
- Fife Bird Report 2001 (Dickson 2002)
- Moray & Nairn Bird Report 2001 & 2002 (Cook 2002 & 2003)

Literature Review

A review of available relevant literature was also carried out.

Reference was made to Prater (1981), Thom (1986), Lack (1986), Pennington *et al* (2004), Snow & Perrins (1998) and Wernham *et al* (2002) for historic population and distribution trends, along with information on habitat, biology and migration.

UK Conservation measures

Information on current UK SPA designations is included in the individual species accounts and is based on sites selected for the UK's terrestrial SPA network, which includes sites that extend partly into marine or intertidal areas, for example, estuaries but not the wholly offshore environment (Stroud *et al* 2001).

3.3 Data analysis

Relevant data from all sources were added to an Excel spreadsheet. The WeBS season for wildfowl species runs from June to May and has been adopted in this report.

Maximum monthly counts from relevant bird reports and other sources e.g. WeBS annual reports were compared. For each species, the maximum count for each site was calculated for each season..

Five year means were calculated from the maximum seasonal counts, for the principal sites for each species, where available. Incomplete counts were generally not used to calculate 5 year means.

Sites that regularly hold more than 1 % of the national population of a species are deemed to be nationally important, and sites with more than 1 % of the biogeographic population are internationally important.

3.4 Species Accounts

The following species accounts give a brief outline of population and distribution within the SEA 5 area for the nine species considered in this report, along with a description of habitat use, population trends and current UK conservation measures.

Mute Swan

Population and distribution

Although more commonly found on fresh water, mute swans do also occur in estuaries, primarily in winter. Birds breeding in Britain are very sedentary although some movement from the continent to south-eastern Britain does occur in cold winters when there may also be localised movements to coastal waters (Wernham *et al* 2002). In July, non-breeding birds gather on lochs and tidal waters to moult, often in areas where there are organic waste discharges or distilleries (Thom 1986).

The population of mute swans in Britain has been estimated at 37,500 individuals (Kershaw & Cranswick 2003).

SEA 5 Area population

In the SEA 5 area, major concentrations noted in the mid 1980's involved several hundred birds moulting at the mouth of the Tweed, and approximately 200 birds at Inverness on the Beaully Firth and Udale Bay in the Cromarty Firth (Thom 1986).

Recent peak counts for the most important coastal sites for mute swans in the SEA 5 area are shown in Table 2. The figures shown are taken from WeBS counts, other dedicated surveys and bird reports.

Table 2. Recent peak counts at main coastal sites for mute swans in SEA 5 area

Site	97-98	98-99	99-00	00-01	01-02	02-03	Mean ¹	Mean ²
Tweed Estuary	544	615	580	575	-	-	596	555
Loch of Harray	413	441	495	597	597	577	541	273
Inner Moray Firth	322	400	356	381	489	315	388	334
Montrose Basin	315	304	343	327	246	-	378	277
Loch of Strathbeg	-	149	352	179	150	182	202	197

¹ Mean of most recent 5 years, where available. A more detailed breakdown of data and data sources is shown in Appendix A

² Mean of previous 5 years, where available

The Tweed estuary, the Loch of Harray on Orkney and the Inner Moray Firth regularly hold internationally important numbers of mute swans (> 380 birds – Delaney & Scott 2002), while the five year mean for the Montrose Basin is just below this threshold but is nationally important (> 375 birds – Kershaw & Cranswick 2003). Both the Tweed estuary and the Montrose Basin are traditional moult sites, with numbers showing a peak between July and September. Peak counts for the Loch of Harray and the Inner Moray Firth are between October and December. Numbers at the Loch of Strathbeg are below the nationally important threshold and show a peak in July/August.

Elsewhere in the SEA 5 area, mute swans occur in lower numbers. On Shetland, mute swans are very scarce breeding residents, with low numbers present throughout the year, peaking in May (Pennington *et al* 2004). In Moray and Nairn, mute swans are a scarce resident breeding species, but are common in winter (Cook 2002).

A survey of breeding mute swans in Highland region in 2002 found 72 breeding pairs, mostly in the east of the region (McNee 2003). A complete survey of breeding mute swans on Orkney was also carried out between April and June 2002. A total of 128 breeding pairs and 412 non-breeding birds were counted, which represented a decrease of 21.5% of breeding pairs and 23% of non-breeding birds when compared to the 1983 census (Corse 2003).

Migration

Most movement by mute swans in Britain is localised. Juvenile birds tend to disperse short distances from their nest areas (< 30 km) with most movement in early winter.

Non-breeding mute swans may also move to traditional moulting sites, from mid-May until mid-June, with the return movement mostly in September. Breeding birds moult on their territories, while raising their young. Ringing studies at Berwick and the Montrose Basin have shown that birds tend to follow the coastal plain or the Tweed and Forth valleys, and avoid movements inland over the hills (Wernham *et al* 2002).

Ringing recoveries following periods of very cold weather have shown movements from the Netherlands and Denmark to south-east England, and also between France and the south coast of England (Wernham *et al* 2002).

UK Conservation measures

No terrestrial SPAs were selected for mute swans in the recent review of terrestrial SPAs in the UK (Stroud *et al* 2001).

Bewick's Swan

Population and distribution

Bewick's swans breed in Russian arctic tundra and winter in lowland areas of northern Europe including Denmark, the Low Countries, France, Britain and Ireland (Stroud *et al* 2001). An estimated 8,070 birds winter in Britain each year, mainly in England (Kershaw & Cranswick 2003).

SEA 5 Area population

Very few Bewick's swans winter along the coast of the SEA 5 area. They are rare vagrants to Shetland, with only 17 recent records (Pennington *et al* 2004). There were no records of Bewick's swans in Orkney, Moray & Nairn or Angus & Dundee in 2001 or 2002 and no records in Highland in 2002 (Williams 2002 & 2003, Cook 2002 & 2003, Carmichael 2002 & 2003, McNee 2003).

Bewick's swans are rare winter visitors to north-east Scotland in most years and regular but scarce winter visitors to Fife (Thorpe, Francis & Schofield 2002, Dickson 2002). No Bewick's swans were recorded in Lothian or Borders in 1999 or 2000 (SOC 2003).

Migration

Bewick's swans tend to follow a relatively narrow migration route to and from their breeding grounds, reaching southern Britain, the Netherlands and Germany from Russia via the coast of the Baltic Sea (Wernham *et al* 2002). Flight speeds of the nominate north American race *C. c. columbianus* have been measured at between 48 – 59km/h and 60 – 90 km/h in separate studies (Petrie & Wilcox 2003).

UK Conservation measures

A total of 15 terrestrial sites have been selected as SPAs for Bewick's swans in the UK, although none of these are within the SEA 5 area (Stroud *et al* 2001).

Whooper Swan

Population and distribution

Whooper swans breed in northern parts of Eurasia, from Iceland and Scandinavia to eastern Siberia, with almost all birds wintering in Britain arriving from Iceland (Pennington *et al* 2004). An estimated 5,720 whooper swans winter in Britain, with the majority of birds in Scotland (Kershaw & Cranswick 2003). Birds typically arrive in mid-October and stay until mid-April (Lack 1986).

Whooper swans use a wider range of habitats than Bewick's swans and show more of a preference for coastal and marine habitat (Prater 1981). In Scotland, birds feed predominantly on farmland (Lack 1986).

SEA 5 Area population

Recent peak counts for the most important coastal sites for whooper swans in the SEA 5 area are shown in Table 3. The figures shown are taken from WeBS counts, other dedicated surveys and bird reports.

The Loch of Strathbeg regularly holds internationally important numbers of whooper swans (>210 birds - Delaney & Scott 2002). Birds are also present in smaller numbers at other sites in north-east Scotland in winter.

Whooper swans are a common migrant and winter visitor to Moray and Nairn, with flocks present at 15 sites in November 2001 and 12 sites in autumn 2002 (Cook 2002 & 2003). The species has bred in Highland region, and is common on passage and in winter, mainly in the east. The Dornoch Firth, Loch Eye and Cromarty Firth all regularly hold nationally important numbers (>57 birds - Kershaw & Cranswick 2003). In November 2002, there were sizable scattered flocks involving a few hundred birds around the Inner Moray Firth area (McNee 2003).

In Caithness, large numbers of whooper swan occur at Loch of Wester, Loch Heilen and Loch Calder. These lochs make up the Caithness Lochs SPA and held at least 4.5% of the British wintering whooper swan population between 1991/2 – 1995/6, based on the five-year peak mean (JNCC 2001).

Table 3. Recent peak counts at main coastal sites for whooper swans in SEA 5 area

Site	97-98	98-99	99-00	00-01	01-02	02-03	Mean ¹	Mean ²
Loch of Strathbeg	310	476	413	424	503	342	432	218
Dornoch Firth	73	89	84	307	-	-	113	52
Loch of Wester	114	123	45	86	-	-	93	118
Forth Estuary	-	79	-	95	-	-	87	-
Loch Eye/ Cromarty Firth	52	28	126	39	-	-	73	216
Tynninghame Estuary	44	113	76	15	-	-	63	31
Loch Heilen	99	38	33	-	-	-	54	52
Inner Moray Firth	-	74	-	-	-	-	54	90

¹ Mean of most recent 5 years, where available. A more detailed breakdown of data and data sources is shown in Appendix A

² Mean of previous 5 years, where available

Recent five year means for both the Forth Estuary and Tynninghame Estuary were above the nationally important threshold, although there is considerable variation in numbers between winters.

In Shetland, the total wintering population of whooper swans has probably been less than 60 birds in most years since the beginning of the 1990's. Three pairs bred in 2000 and 2001 (Pennington *et al* 2004). Whooper swans are fairly common winter visitors and passage migrants in Orkney. Several flocks of up to 100 birds were seen in 2001 and 2002 (Williams 2002 & 2003).

Migration

Satellite tracking studies have shown that Icelandic whooper swans fly direct from Iceland to Britain and Ireland in autumn, returning in spring. No satellite-tracked birds flew via the Faeroe Islands. Landfall points in Britain and Ireland included Donegal Bay, the Western Isles and Skye (Wernham *et al* 2002).

Ringed studies have also shown that some whooper swans from the Fennoscandian and north-west Russian population also occur in Britain and Ireland in winter, mainly in south-east England, although numbers may be influenced by weather conditions. There is also considerable movement of whooper swans between Britain and Ireland within a winter season (Wernham *et al* 2002).

UK Conservation measures

A total of 20 terrestrial sites have been selected as SPAs for whooper swans in the non-breeding season in the UK. Of these, seven are located in counties bordering the SEA 5 area although only four of these are coastal sites: Loch Eye, the Cromarty Firth, Loch of Strathbeg and the Lochs of Spiggie and Brow on Shetland. These seven sites are estimated to support 20.6% of the national wintering population (Stroud *et al* 2001).

Bean goose

Population and distribution

Two populations of bean goose occur in Britain in winter. Taiga bean geese *A. f. fabilis* breed in the taiga zone of Scandinavia and Russia, and most of this population winters in the Netherlands. Two small groups winter in Britain, primarily in Norfolk and the Slamannan Plateau in Stirling (Pollit *et al* 2003). Tundra bean geese *A. f. rossicus* breed further north and winter further south than taiga bean geese, although a few birds winter in Britain each year. Up to 400 taiga bean geese and 100 tundra bean geese are estimated to winter in Britain (Kershaw & Cranswick 2003).

SEA 5 Area population

Very few bean geese winter in counties bordering the SEA 5 area. There were no records in Moray & Nairn, Fife or Angus & Dundee in 2001 or 2002 and only two records from Highland region in 2002; 1 bird of the *A. f. rossicus* race and a flock of 10 in flight near Brora in October (Cook 2002 & 2003, Dickson 2002, Carmichael 2002 & 2003, McNee 2003). Both subspecies of bean geese are rare vagrants to Orkney and Shetland (Williams 2002, Pennington *et al* 2004). Bean geese are rare winter visitors and passage migrants in north-east Scotland, with 2 birds of the *A. f. fabilis* race in 2001 and 1 bird of the *A. f. rossicus* race in 2002 (Thorpe, Francis & Schofield 2002, Baxter 2003). No bean geese were recorded in Lothian or Borders in 1999 or 2000 (SOC 2003).

Migration

Very little information exists about bean goose movements in Britain from ringing and colour-marking studies (Wernham *et al* 2002). Occasional influxes of birds from continental Europe may occur during severe winters.

UK Conservation measures

One terrestrial site (in Norfolk) has been selected as an SPA for wintering bean geese in the UK, although this is not within the SEA 5 area (Stroud *et al* 2001).

Pink-footed goose

Population and distribution

More than 75% of the world population of pink-footed goose winters in Britain, arriving in autumn from their breeding grounds in Iceland and eastern Greenland (Lack 1986). A separate population breeds in Svalbard, and these birds winter predominantly in the Netherlands, Denmark and Belgium (Prater 1981). Numbers wintering in Britain are estimated to be around 241,000 birds, with up to three quarters of these in Scotland (Kershaw & Cranswick 2003, Lack 1986).

SEA 5 Area population

Recent peak counts for the most important coastal sites for pink-footed goose in the SEA 5 area are shown in Table 4. The figures shown are taken from WeBS counts, other dedicated surveys and bird reports.

Table 4. Recent peak counts at main coastal sites for pink-footed goose in SEA 5 area

Site	97-98	98-99	99-00	00-01	01-02	02-03	Mean ¹	Mean ²
Loch of Strathbeg	33,556	37,078	31,031	42,615	35,272	39,900	37,179	44,035
Montrose Basin	35,000	33,012	18,480	29,922	38,669	12,500	26,517	29,572
Ythan/Meikle Loch	12,200	16,400	15,500	23,500	30,000	8,000	18,680	20,214
Aberlady Bay	6,540	13,260	4,840	16,750	-	-	9,208	12,013
Findhorn Bay	-	-	-	-	5,500	8,500	7,000	-
Tay Estuary	3,765	5,355	4,630	8,930	-	-	6,315	3,273
Loch Eye/ Cromarty Firth	465	295	12,000	126	-	-	2,891	4,828
Skinflats	-	-	-	2,750	-	-	2,155	2,394

¹ Mean of most recent 5 years, where available. A more detailed breakdown of data and data sources is shown in Appendix A

² Mean of previous 5 years, where available

All the sites in Table 4, with the exception of Skinflats, hold internationally important numbers of pink-footed geese (>2,400 birds - Delaney & Scott 2002). The Loch of Strathbeg is the most important site in Britain for pink-footed geese, particularly in autumn (Pollit *et al* 2003). The Montrose Basin in Angus and the Ythan/Meikle Loch area in north-east Scotland also regularly hold large numbers, with peak numbers in October.

Pink-footed geese are common migrants in Moray and Nairn, with numbers increasing in winter (Cook 2002). The Loch Eye/Cromarty Firth area is more important for birds in spring than autumn although count effort is higher in autumn. The low numbers for the site in Table 4 are autumn counts while the count of 12,000 birds for 1999-2000 was made in April (Pollit *et al* 2003).

In Shetland, pink-footed geese are fairly common passage migrants, with most records in September and October (Pennington *et al* 2004). Recent years in Orkney have seen an influx of a few hundred birds in March and April. Autumn passage involved hundreds of birds in 2001 and several thousand in late September/early October 2002 (Williams 2002 & 2003).

Migration

Pink-footed geese breeding in east Greenland move to Iceland in late August to join the breeding/moulting population there before arriving in Britain in mid to late September. The main areas of arrival are north-east Scotland, particularly the Loch of Strathbeg, eastern Scotland and Lothian and Borders. Peak numbers arrive in mid-October. Birds tend to move southwards in late autumn and early winter to Lancashire and Norfolk, before moving north again in February. Numbers build up again at key sites such as the Loch of Strathbeg, Meikle Loch and the Moray Firth in late March prior to the return migration flight in mid-April (Wernham *et al* 2002).

There have been a few records of ringed birds from the Svalbard breeding population in Britain (Wernham *et al* 2002).

UK Conservation measures

A total of 24 terrestrial sites have been selected as SPAs for the Iceland/Greenland population of pink-footed geese in the non-breeding season in the UK. Of these, 15 sites are located in counties bordering the SEA 5 area although only six of these are coastal sites: the Moray & Nairn coast, Loch of Strathbeg, Ythan Estuary/Sands of Forvie & Meikle Loch, the Montrose Basin, the Firth of Tay & Eden Estuary and the Firth of Forth. These six sites are estimated to support 54.9% of the national wintering population (Stroud *et al* 2001).

Greenland white-fronted goose

Population and distribution

Greenland white-fronted geese (*A. a. flavirostris*) breed in Greenland and winter in Ireland, the west coast of Scotland, Islay and the Inner Hebrides. The nominate subspecies or European white-fronted goose (*A. a. albifrons*) breeds in northern Russia and Siberia and winters in north-west Europe, including southern Britain (Prater 1981, Pennington *et al* 2004). An estimated 20,900 birds of the Greenland race and 5,790 birds of the nominate race of white-fronted geese winter in Britain each year (Kershaw & Cranswick 2003).

SEA 5 Area population

Recent peak counts for the most important coastal sites for Greenland white-fronted goose in the SEA 5 area are shown in Table 5. The figures shown are taken from WeBS counts, other dedicated surveys and bird reports.

Table 5. Recent peak counts at main coastal sites for Greenland white-fronted goose in SEA 5 area

Site	97-98	98-99	99-00	00-01	01-02	02-03	Mean ¹	Mean ²
Caithness Lochs	310	230	280	232	-	-	252	188
Orkney West Mainland	128	125	201	153	112	106	139	127

¹ Mean of most recent 5 years, where available. A more detailed breakdown of data and data sources is shown in Appendix A

² Mean of previous 5 years, where available

In Caithness, the Caithness Lochs SPA is a roost site for two separate flocks of Greenland white-fronted goose (JNCC 2001). The five year-mean between 1996/7 to 2000/01 for this site is 252 birds, which is nationally important (> 209 birds - Kershaw & Cranswick 2003) (Pollit *et al* 2003). The geese feed within the SPA and in the surrounding agricultural land and other wetlands.

In Orkney, the Greenland race is a fairly common passage and winter visitor, with a regular flock of around 100 birds wintering in the west mainland (Williams 2003, Pollit *et al* 2003).

Both subspecies of white-fronted geese are scarce passage migrants to Shetland, although the Greenland subspecies occurs more frequently (Pennington *et al* 2004).

White-fronted geese are scarce winter visitors to Moray and Nairn, with low numbers in most years. Birds are of the Greenland race (Cook 2002, Cook 2003). The species is scarce in the eastern part of Highland region, occurring in small numbers in most years (McNee 2003).

In north-east Scotland the species is an uncommon winter visitor and passage migrant, with both subspecies occurring in low numbers (Baxter 2003). In Angus & Dundee, a few birds of the Greenland race are seen each year, normally associating with other grey geese species (Carmichael 2002 & 2003). Small numbers were recorded in Lothian and Borders in 1999 and 2000 (SOC 2003).

Migration

Satellite studies have shown that migrating Greenland white-fronted geese leave their breeding areas in Greenland in September, staging in Iceland on the way and arriving at their wintering grounds in October (Fox & Stroud 2002). In spring, returning birds leave the wintering areas in mid-April and fly to Iceland, where they may spend up to a month, before onward migration to Greenland (Wernham *et al* 2002).

UK Conservation measures

Twelve terrestrial sites have been selected as SPAs for Greenland white-fronted geese in the UK, although only one site, Caithness Lochs SPA, is located in a county bordering the SEA 5 area. This site has been estimated to hold 1.3% of the national wintering population (Stroud *et al* 2001).

Greylag goose

Population and distribution

In October, almost the entire breeding population of greylag geese from Iceland arrives in Britain, with Orkney being the most important wintering site (Pollit *et al* 2003). There is also a smaller, mostly sedentary breeding population of greylag geese in north-west Scotland, and a feral population that breeds throughout Britain.

Greylag geese are less dependant on estuaries than other geese, and tend to feed almost exclusively on farmland, roosting on inland lakes and reservoirs. An estimated 81,900 birds of the Iceland population winter in Britain, along with 9,620 birds in the north-west Scotland population and 28,500 feral birds (Kershaw & Cranswick 2003).

SEA 5 Area population

Recent peak counts for the most important coastal sites for greylag goose in the SEA 5 area are shown in Table 6. The figures shown are taken from WeBS counts, other dedicated surveys and bird reports.

All sites in Table 6 hold internationally important numbers of greylag goose except for the Loch of Strathbeg (>1,000 birds - Delaney & Scott 2002). The wintering population in Orkney is considerably higher than anywhere else in Britain, and has increased since the early 1990's. The increase could be due to a combination of mild winters allowing geese to winter further north than in the past, better foraging and reduced shooting pressure compared to wintering sites further south (Meek 2003). A small proportion of this total is likely to be locally breeding birds (Pollit *et al* 2003).

Table 6. Recent peak counts at main coastal sites for greylag goose in SEA 5 area

Site	97-98	98-99	99-00	00-01	01-02	02-03	Mean ¹	Mean ²
Orkney	13,361	18,110	20,475	15,914	23,065	30,126	21,538	8,697
Caithness Lochs	7,200	12,731	10,017	8,326	-	-	8,730	6,878
Loch Eye & Cromarty Firth	5,416	9,181	5,674	6,192	-	7,000	7,012	9,262
Findhorn Bay	2,350	1,760	2,600	620	7,000	-	3,238	3,179
Dornoch Firth	3,211	2,352	3,351	3,339	-	-	2,677	1,543
Tay Estuary	650	4,350	2,221	1,116	-	-	1,883	819
Loch Fleet Complex	843	2,970	980	1,700	-	-	1,539	1,254
Eden Estuary	68	-	1,330	840	-	-	1,207	1,050
Loch of Strathbeg	222	637	513	817	1,454	525	789	1,353

¹ Mean of most recent 5 years, where available. A more detailed breakdown of data and data sources is shown in Appendix A

² Mean of previous 5 years, where available

The Caithness Lochs SPA and Loch Eye & Cromarty Firth also hold large numbers of greylag geese, with numbers peaking in October and November. Elsewhere in the Moray Firth, Findhorn Bay, the Dornoch Firth and Loch Fleet also hold sizeable flocks.

On the east coast of Scotland, the Tay and Eden estuaries are internationally important for greylag geese, although numbers vary considerably between seasons. In Shetland greylag geese are scarce breeding residents and fairly common winter visitors (Pennington *et al* 2004).

Migration

Birds arrive from Iceland between late September and early November, and return from mid-March to late April (Thom 1986). There is considerable within-winter movement, with birds moving predominantly southwards, but also northward. This movement may be in response to changes in food supply, disturbance and periods of snowy weather (Wernham *et al* 2002).

Ringling studies have shown that greylag geese breeding in Britain are fairly sedentary, with birds moving only short distances from breeding and wintering areas (Wernham *et al* 2002).

UK Conservation measures

A total of 22 terrestrial sites have been selected as SPAs for the Icelandic population of greylag goose in the non-breeding season in the UK. Of these, 17 sites are located in counties bordering the SEA 5 area although only eight of these are coastal sites: Cromarty Firth, Dornoch Firth & Loch Fleet, Loch Eye, the Inner Moray Firth, the Moray & Nairn coast, Loch of Strathbeg, the Montrose Basin, the Firth of Tay & Eden Estuary and the Firth of Forth. These eight sites are estimated to support 25.4% of the national wintering population (Stroud *et al* 2001).

Barnacle goose

Population and distribution

Two separate populations of barnacle goose winter in Britain. Birds breeding in Svalbard winter on the Solway Firth, staging in spring in Helgoland and Norway, while breeding birds from Greenland winter on the west coast of Scotland and Ireland, and stop off in Iceland on spring and autumn passage (Pennington *et al* 2004, Wernham *et al* 2002).

An estimated 45,000 birds of the Greenland population and 22,000 birds of the Svalbard population of barnacle geese winter in Britain each year (Kershaw & Cranswick 2003).

SEA 5 Area population

Recent peak counts for the most important coastal sites for barnacle goose in the SEA 5 area are shown in Table 7. The figures shown are taken from WeBS counts, other dedicated surveys and bird reports.

Table 7. Recent peak counts at main coastal sites for barnacle goose in SEA 5 area

Site	97-98	98-99	99-00	00-01	01-02	02-03	Mean ¹	Mean ²
Loch of Strathbeg (Svalbard pop.)	353	6,200	513	3,700	7,900	314	3,725	366
South Walls (Greenland pop.)	1,180	1,140	1,000	600	900	-	964	1,091

¹ Mean of most recent 5 years, where available. A more detailed breakdown of data and data sources is shown in Appendix A

² Mean of previous 5 years, where available

The Loch of Strathbeg is an important autumn staging site for barnacle geese of the Svalbard breeding population, as it is the only site outside the Solway Estuary that regularly holds internationally important numbers (>230 birds - Delaney & Scott 2002) (Pollit *et al* 2003). It is also the first landfall on the flight from the Svalbard breeding areas (Stroud *et al* 2001). Numbers of birds overwintering around the Loch of Strathbeg are increasing (Baxter 2003.)

Around one thousand barnacle geese are present in the South Walls area of Orkney each winter (Williams 2002 & 2003). These birds are thought to be from the Greenland breeding population and numbers here are internationally important (>540 birds - Delaney & Scott 2002) (SOC 2003, Pollit *et al* 2003). Birds feeding in the area roost on Switha, an uninhabited, low-lying grassy island 2 km east of South Walls, which has been designated an SPA as a result (Stroud *et al* 2001).

Barnacle geese are fairly common passage migrants to Shetland, with most birds in September and October. Colour-ringed birds passing through in autumn have been found to be from the Svalbard population, although birds at other times of year could be from either population (Pennington *et al* 2004, SOC 2003).

Barnacle geese are scarce migrants and winter visitors to Moray and Nairn. Numbers seen on autumn passage vary between years, with the record peak movement in a single day being 2,093 on 29th September 2001 (Cook 2002). Birds seen on autumn passage in Aberdeenshire, Angus, Fife and Lothian are thought to be birds of the Svalbard population en route to the Solway Firth.

Small flocks are recorded at a few sites each year (Carmichael 2002 & 2003, SOC 2003). In Highland, there is a scattering of individuals with other goose flocks around the Inner Moray Firth in most years (McNee 2003).

Migration

Barnacle geese from Svalbard reach Britain across a broad front, from Shetland to Yorkshire. Most birds arrive on the main wintering area of the Solway Firth between mid-September and mid-October. Most birds stay within the Solway area throughout the winter although there may be localised movements within the region. Most birds depart for Svalbard between mid-April and mid-May (Wernham *et al* 2002).

Birds from the Greenland breeding population leave for staging areas in Iceland in late August and September, and most have arrived at their wintering grounds by November. Returning birds leave in mid-April and again stage in Iceland for three to four weeks before arriving back in Greenland in late May (Wernham *et al* 2002).

Migration patterns for barnacle geese have been found to involve flights with short stops during autumn migration from Svalbard to Scotland (Green *et al* 2002).

UK Conservation measures

A total of 11 terrestrial sites have been selected as SPAs for the Greenland population of barnacle goose in the non-breeding season in the UK. Of these, only 1 site, Switha, is within the SEA 5 area. Switha is estimated to support 3.2% of the UK wintering population of Greenland barnacle geese (Stroud *et al* 2001).

Two terrestrial sites have been selected as SPAs for the Svalbard population of barnacle goose in the non-breeding season in the UK. Only one site, the Loch of Strathbeg, is within the SEA 5 area, and is estimated to support 1.3% of the UK wintering population of Svalbard barnacle geese (Stroud *et al* 2001).

Brent goose

Population and distribution

Two subspecies of brent goose winter in Britain. Pale-bellied brent geese *B. b. brota* breed on Svalbard and Franz Josef Land and winter in Denmark and Northumberland. A second population of pale-bellied brent goose breeds in north-east Canada and north-west Greenland and winter in Ireland. Dark-bellied brent geese *B. b. bernicla* breed in Siberia and winter in western Europe. Most birds wintering in Britain occur in south-east England (Pennington *et al* 2004).

An estimated 2,900 pale-bellied brent geese of the Svalbard population and 98,100 dark-bellied brent geese winter in Britain each year (Kershaw & Cranswick 2003).

SEA 5 Area population

Brent geese are scarce passage migrants to the counties bordering the SEA 5 area (e.g. Baxter 2003, Cook 2002 & 2003, Carmichael 2002, McNee 2003, Pennington *et al* 2004, & SOC 2003). Small flocks are seen in most years from Shetland to the Borders, with the pale-bellied subspecies being more common than the dark-bellied subspecies.

Migration

Pale-bellied brent geese from the Svalbard breeding areas arrive at Lindisfarne in Northumberland from September, with numbers peaking between October and December. Birds return to Svalbard via staging grounds in Denmark in March (Wernham *et al* 2002).

Canadian pale-bellied brent geese winter almost exclusively in Ireland. There is no evidence of weather-related movements of Canadian pale-bellied brent geese but both dark-bellied and pale-bellied birds from Svalbard may be pushed south and west from their normal wintering areas by extreme cold weather (Wernham *et al* 2002).

Dark-bellied brent geese leave their breeding grounds in Siberia and reach Denmark, the Netherlands and Germany in large numbers by late September. Numbers in south-east Britain peak in November when a similar number of birds are present in France. Return migration

begins in March and early April, when birds leave the wintering areas in Britain and France and gather in the Wadden Sea (Denmark, the Netherlands and Germany) until late May. Migration is both nocturnal and diurnal and birds tend to migrate over the sea, following the coastline (Wernham *et al* 2002).

Satellite-tagging studies on dark-bellied brent geese migrating between the Wadden Sea and their breeding grounds have shown that birds show a preference to migrate when tailwinds occur. Birds tend to alternate between periods of flight and short stops, resulting in an overall travelling speed of 32 km/h or 763 km/day. Light-bellied brent geese have also been recorded using short stops en route, resulting in overall migration speeds of 32 – 38 km/h on flights between Denmark and Svalbard or Greenland. (Green *et al* 2002).

UK Conservation measures

Lindisfarne is the only terrestrial site that has been selected as an SPA for the Svalbard population of pale-bellied brent goose in the non-breeding season in the UK. The site supports an estimated 75.9% of the UK wintering population (Stroud *et al* 2001).

Six terrestrial sites, all in Northern Ireland, have been selected as SPAs for the Canadian population of pale-bellied brent goose in the non-breeding season in the UK.

13 terrestrial sites, all in England, have been selected as SPAs for dark-bellied brent goose in the non-breeding season in the UK.

3.5 Regional summary

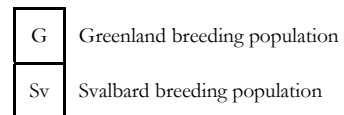
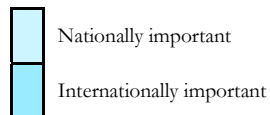
Six species of swans and geese occur in winter in internationally or nationally important numbers in the counties bordering the SEA 5 Area (Table 8).

Table 8. Summary of species wintering in internationally or nationally important numbers at coastal sites in counties bordering the SEA 5 Area

Sites	Species					
	Mute Swan	Whooper Swan	Pink-footed Goose	Greenland white-fronted Goose	Greylag Goose	Barnacle Goose
National threshold ¹	375	57	2,400	209	819	G - 450 Sv - 220
International threshold ²	380	210	2,400	300	1,000	G - 540 Sv - 230
Orkney						Gr
Caithness						
Moray Firth						
Aberdeenshire coast						Sv
Angus coast						Sv
Tay & Eden Estuaries						
Firth of Forth						
Lothian/Berwick shire coast						

1 Kershaw & Cranswick 2003

2 Delaney & Scott 2002



Orkney

The Loch of Harray holds internationally important concentrations of mute swan between October and December. Greylag geese winter throughout Orkney in internationally important numbers, and barnacle geese from Greenland winter on Switha and in the South Walls area. Switha is designated as an SPA for wintering barnacle geese (Stroud *et al* 2001).

Caithness

The Caithness Lochs SPA is internationally important for greylag geese from Iceland and nationally important for wintering whooper swans and Greenland white-fronted geese. The Loch of Wester, Loch Heilen and Loch Calder make up the SPA (Stroud *et al* 2001).

Moray Firth

Several sites in the Moray Firth area hold internationally significant numbers of swans and geese in winter and have been designated as SPAs (Stroud *et al* 2001). The Inner Moray Firth holds internationally important numbers of mute swans between October and December. The Dornoch Firth and Loch Fleet are internationally important for greylag geese while both greylag and pink footed geese occur in internationally important numbers in Findhorn Bay, Loch Eye and the Cromarty Firth.

Wintering whooper swans occur in nationally important numbers in the Dornoch Firth, Loch Eye and the Cromarty Firth.

Aberdeenshire coast

The Loch of Strathbeg is internationally important for whooper swans, pink-footed geese and barnacle geese from the Svalbard breeding population in autumn and winter and has been designated as an SPA for these species (Stroud *et al* 2001). The area around the Ythan Estuary and Meikle Loch also holds internationally important numbers of pink-footed geese and has been designated as an SPA for the species (Stroud *et al* 2001). Several inland sites hold significant numbers of swans and geese in winter.

Angus coast

The Montrose Basin is nationally important for moulting mute swans, with numbers peaking between July and September. Pink-footed geese also occur here in internationally important numbers, particularly in October and November. The Montrose Basin has been designated as an SPA for wintering pink-footed and greylag geese (Stroud *et al* 2001).

Tay & Eden Estuaries

The Tay Estuary is internationally important in winter for pink-footed and greylag geese, while the Eden Estuary supports internationally important numbers of greylag geese. Both sites are designated as an SPA for these species (Stroud *et al* 2001).

Firth of Forth

Pink-footed geese roost in internationally important numbers at Aberlady Bay, with peak numbers occurring in October and November. The Firth of Forth also holds nationally important numbers of whooper swans in winter. The Firth of Forth has been designated an SPA for pink-footed and greylag goose (Stroud *et al* 2001).

Lothian/Berwickshire coast

The Tweed Estuary holds internationally important numbers of moulting mute swans between July and September. Whooper swans occur in nationally important numbers at Tynninghame Estuary in winter.

4. Conclusions

Whooper swan, pink-footed goose, European white-fronted goose, barnacle goose and brent goose have been highlighted as potentially sensitive species to wind farms (Langstone and Pullan 2002). Although data for offshore wind farms is minimal, the precautionary principle should apply and these species are likely to be focal species for environmental assessment.

Of these five species, whooper swan, pink-footed goose, and barnacle goose occur in at coastal sites bordering the SEA 5 Area in internationally important numbers, with Greenland white-fronted geese occurring in nationally important numbers. In addition, mute swan and greylag goose occur in internationally important numbers.

Offshore wind farm developments should not be considered where potential adverse effects on designated sites for nature conservation may occur. Several coastal sites within the SEA 5 Area have been designated as SPAs for swans and geese on passage and in winter, including Caithness Lochs, the Moray Firth, Loch of Strathbeg, Montrose Basin, Tay and Eden Estuaries, and the Firth of Forth.

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APPENDIX A
SPECIES COUNTS 1991 - 2003

Mute Swan

Site	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	Recent 5yr Mean	Previous 5yr Mean
Tweed Estuary	370 ¹	640 ¹	720 ¹	593 ¹	450 ¹	664 ²	544 ²	615 ²	580 ²	575 ²	-	-	596	555
Loch of Harray	564 ¹	261 ¹	275 ¹	211 ¹	219 ¹	249 ²	413 ²	441 ²	495 ²	597 ²	597 ³	577 ³	541	273
Inner Moray Firth	-	291 ⁴	365 ⁴	295 ⁴	354 ⁴	332 ⁴	322 ⁴	400 ⁴	356 ⁴	381 ⁴	489 ⁴	315 ⁴	388	334
Montrose Basin	-	220 ¹	291 ¹	297 ¹	299 ¹	356 ²	315 ²	304 ²	343 ²	327 ²	246 ²	-	378	277
Loch of Strathbeg	333 ⁵	269 ⁵	269 ⁵	83 ⁵	-	167 ⁵	-	149 ⁵	352 ²	179 ⁶	150 ⁵	182 ⁵	202	197

Data Sources

1	WeBS Report 1995/96	5	North East Scotland Bird Report
2	WeBS Report 2000/01	6	Scottish Bird Report
3	Orkney Bird Report	7	Angus Bird Report
4	Highland Bird Report	8	Moray & Nairn Bird Report

Whooper Swan

Site	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	Recent 5yr Mean	Previous 5yr Mean
Loch of Strathbeg	176 ¹	140 ⁵	302 ¹	75 ⁵	243 ⁵	158 ²	310 ²	476 ²	413 ⁵	424 ²	503 ⁵	342 ⁵	432	218
Dornoch Firth	38 ¹	17 ¹	120 ¹	-	31 ¹	13 ²	73 ²	89 ²	84 ²	307 ²	-	-	113	52
Loch of Wester	-	-	187 ¹	49 ¹	-	98 ²	114 ²	123 ²	45 ²	86 ²	-	-	93	118
Forth Estuary	-	-	-	-	-	-	-	79 ²	-	95 ²	-	-	87	-
Loch Eye/ Cromarty Firth	340 ¹	389 ¹	72 ¹	191 ¹	89 ¹	120 ²	52 ²	28 ²	126 ²	39 ²	-	-	73	216
Tynninghame Estuary	-	-	-	18 ¹	44 ¹	65 ²	44 ²	113 ²	76 ²	15 ²	-	-	63	31
Loch Heilen	56 ¹	25 ¹	17 ¹	110 ¹	51 ¹	51 ²	99 ²	38 ²	33 ²	-	-	-	54	52
Inner Moray Firth	97 ¹	155 ¹	19 ¹	40 ¹	47 ¹	-	-	74 ²	-	-	-	-	54	90

Swan & geese review for SEA 5

Pink-footed Goose

Site	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	Recent 5yr Mean	Previous 5yr Mean
Loch of Strathbeg	37,950 ⁵	30,650 ⁵	38,970 ¹	58,150 ⁵	48,500 ¹	41,000 ⁵	33,556 ²	37,078 ²	31,031 ²	42,615 ²	35,272 ⁵	39,900 ⁵	37,179	44,035
Montrose Basin	25,000 ¹	35,000 ¹	41,210 ¹	36,000 ¹	18,500 ¹	17,150 ²	35,000 ²	33,012 ²	18,480 ²	29,922 ²	38,669 ⁷	12,500 ⁷	26,517	29,572
Ythan/Meikle Loch	-	4,360 ¹	23,880 ¹	22,590 ¹	25,000 ¹	17,400 ²	12,200 ²	16,400 ²	15,500 ²	23,500 ²	30,000 ⁵	8,000 ⁵	18,680	20,214
Aberlady Bay	9,995 ¹	7,000 ¹	26,000 ¹	5,750 ¹	11,320 ¹	4,650 ²	6,540 ²	13,260 ²	4,840 ²	16,750 ²	-	-	9,208	12,013
Findhorn Bay	-	-	-	-	-	-	-	-	-	5,500 ²	8,500 ⁸	-	7,000	-
Tay Estuary	5,208 ¹	2,800 ¹	-	1,938 ¹	6,117 ¹	8,897 ²	3,765 ²	5,355 ²	4,630 ²	8,930 ²	-	-	6,315	3,273
Loch Eye/ Cromarty Firth	1,527 ¹	800 ¹	2,797 ¹	9,668 ¹	9,350 ¹	1,570 ²	465 ²	295 ²	12,000 ²	126 ²	-	-	2,891	4,828
Skinflats	2,155 ¹	2,596 ¹	2,051 ¹	2,100 ¹	3,070 ¹	1,560 ²	-	-	-	2,750 ²	-	-	2,155	2,394

Greenland white-fronted Goose

Site	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	Recent 5yr Mean	Previous 5yr Mean
Caithness Lochs	148 ¹	160 ¹	180 ¹	196 ¹	258 ¹	210 ²	310 ²	230 ²	280 ²	232 ²	-	-	252	188
Orkney West Mainland	-	-	-	-	-	126 ²	128 ²	125 ²	201 ²	153 ²	112 ³	106 ³	139	127

Swan & geese review for SEA 5

Greylag Goose

Site	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	Recent 5yr Mean	Previous 5yr Mean
Orkney	4,637 ¹	4,533 ¹	4,774 ¹	6,082 ¹	9,931 ¹	9,338 ²	13,361 ²	18,110 ²	20,475 ²	15,914 ²	23,065 ³	30,126 ³	21,538	8,697
Caithness Lochs	4,216 ¹	6,800 ¹	5,433 ¹	5,563 ¹	12,376 ¹	5,378 ²	7,200 ²	12,731 ²	10,017 ²	8,326 ²	-	-	8,730	6,878
Loch Eye/ Cromarty Firth	4,659 ¹	16,842 ¹	14,842 ¹	12,014 ¹	8,716 ¹	5,320 ²	5,416 ²	9,181 ²	5,674 ²	6,192 ²	-	7,000 ⁴	7,012	9,262
Findhorn Bay	-	-	-	-	3,150 ¹	1,860 ²	2,350 ²	1,760 ²	2,600 ²	620 ²	7,000 ⁸	-	3,238	3,179
Dornoch Firth	927 ¹	1,560 ¹	692 ¹	2,597 ¹	1,937 ¹	1,132 ²	3,211 ²	2,352 ²	3,351 ²	3,339 ²	-	-	2,677	1,543
Tay Estuary	-	-	-	280 ¹	1,358 ¹	1,080 ²	650 ²	4,350 ²	2,221 ²	1,116 ²	-	-	1,883	819
Loch Fleet Complex	940 ¹	1,570 ¹	1,500 ¹	1,300 ¹	960 ¹	1,200 ²	843 ²	2,970 ²	980 ²	1,700 ²	-	-	1,539	1,254
Eden Estuary	816 ¹	293 ¹	2,020 ¹	1,071 ¹	1,520 ¹	1,070 ²	68 ²	-	1,330 ⁶	840 ⁶	-	-	1,207	1,050
Loch of Strathbeg	900 ¹	2,000 ⁵	1,600 ¹	253 ⁵	4,280 ¹	409 ⁵	222 ⁵	637 ⁵	513 ⁵	817 ⁵	1,454 ⁵	525 ⁵	789	1,353

Barnacle Goose

Site	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	Recent 5yr Mean	Previous 5yr Mean
Loch of Strathbeg (Svalbard)	71 ⁵	850 ⁵	41 ¹	350 ⁵	533 ¹	554 ⁵	353 ²	6,200 ²	513 ²	3,700 ²	7,900 ⁵	314 ⁵	3,725	366
South Walls	1,200 ¹	1,050 ¹	890 ¹	1,208 ¹	1,138 ¹	1,170 ²	1,180 ²	1,140 ²	1,000 ⁶	600 ³	900 ³	-	964	1,091

(Greenland)
